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User's Guide

# CHARTrunner

Version 3.5

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## CHAPTER 1

# Welcome

CHARTrunner provides an SPC charting solution for data stored virtually anywhere. Use it to chart and analyze data that is stored in Excel, Access, SQL server, Oracle, text files, and other data sources.

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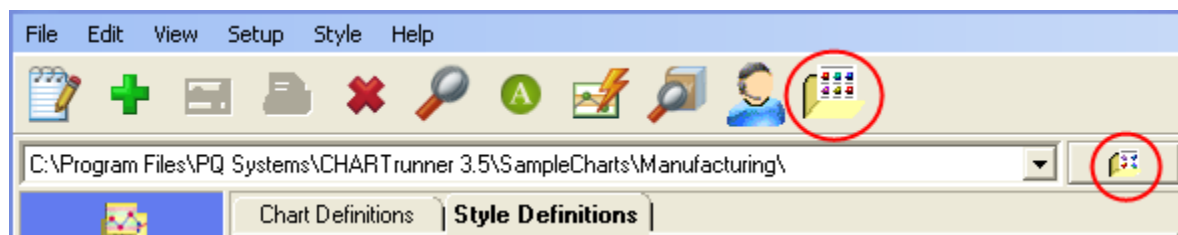
## What's new in CHARTrunner 3.5

Support for concurrent user licensing.

Historically CHARTrunner has been licensed on a per-workstation basis. CHARTrunner 3.5 will support concurrent user (or floating) licensing as well as per-workstation licensing.

Change the working folder from the toolbar.

Feedback from users indicated that it should be more obvious how to change the working folder that contains the current list of chart and dashboard definitions. So we changed the icon and added the ability to change the working folder via the toolbar, as shown below. The tooltip that appears when the mouse hovers over these buttons, or over the field that displays the working folder path, was also improved.




### Live chat with technical support

Get answers to your CHARTrunner questions answered faster and easier by clicking on the new "Live chat with technical support" button. The live chat button has been added to the main toolbar as shown below. The live chat button has also been added to the bottom of the chart definition editor. Your browser will open to allow you to establish a chat session with PQ Systems technical support when the "Live chat" button is clicked.



### Improved access to context sensitive help

In order to make access to context sensitive help even easier, the new green question mark "help button"  has been added to many of the forms used in CHARTrunner. When you click on this help button a help topic appropriate to that area of CHARTrunner will be displayed.

### Improved naming of the first three tabs of the chart definition editor



When creating a new chart definition the user should enter the required information on the first tab (Chart name/type), then the second tab (Data source), and finally the third tab (Data definition). In order to emphasize this three step process, the names of the first three tabs have been changed to:

- Step 1: Chart name/type
- Step 2: Data source
- Step 3: Data definition.

### Improved validation messages in the chart definition editor

The error messages that can appear when attempting to save a new or modified chart definition have been improved to better explain what's wrong with the chart definition.

### New icon for browsing for a folder

The icon that represents the "browse for a folder" operation has been changed to  in an effort to make it more visually distinguishable from the "browse for a file" icon .

### New chart title code


The @CNM title code displays the names of the data source columns that have been "treated as" a Measurement.

# About your CHARTrunner documentation

CHARTrunner documentation includes the following:

- User Guide - The PDF document can be printed to create a hard-copy of the CHARTrunner documentation.

On-line Help - Provides descriptions of the application's commands and windows. It is displayed when

you select a help option from the Help Menu, or press F1, or click on the green question mark button . For more information, see the topic ***Getting help***.

- Quality Advisor - Provides an overview of using SQC tools. It explains SQC terminology and issues. The Quality Advisor is an on-line help file that you can open from the Help Menu.

## About PQ Systems

For more than 20 years, PQ Systems, Inc. has been dedicated to helping customers continuously improve their organizations. We are a full service quality management firm offering a comprehensive network of products and services designed to help all industries improve quality and comply with standards. PQ Systems provides the expertise, training, and software tools necessary to assist organizations through every step of the quality process. Our highly-regarded products have made us a leader in the industry, but our commitment to customer service and support keeps customers coming back.

### Software

SQCpack® EZ combines powerful SPC techniques such as variables, attributes, and Pareto charting with flexibility and ease of use.

GAGEpack® EZ builds a complete database of an unlimited number of measurement devices, instruments, and gages from which users can generate a variety of reports. It supports ISO 9000, QS-9000, ISO/TS 16949-2002, ISO/IEC 17025, and other standards.

CHARTrunner® draws SPC charts and performs statistical analysis using data that resides in other applications such as Microsoft Excel and Access.

DATAjogger™ provides problem-solving and data analysis tools such as run charts, flow charts, and affinity diagrams to assist your team in an improvement project.

DOEpack® is easy-to-use software that guides you through a logical, step-by-step process for planning, designing, implementing, and interpreting effective experimental designs.

Quality Workbench helps organizations keep day-to-day control over their quality systems in order to comply with ISO 9000 and other standards. It features document control, audits, nonconformities, customer care, and internet viewing modules.

### Training & Consulting

Our consultants and trainers have extensive knowledge and experience in the areas of SPC, continuous improvement, ISO 9000, QS-9000, and trainer and leadership development in a wide variety of industries and organizations. In addition to customized in-house training, we offer public seminars.

K-12 Process and Tools Training helps transform mountains of data into real information that will help bring genuine, long lasting improvement to K-12 schools and shows how tools for planning, problem-solving, data gathering, and analysis work within the PDSA cycle.

### Training Tools

SPC Workout is an interactive multimedia training course on CD-ROM. It provides effective step-by-step instruction on how to implement and apply SPC.

Six Sigma Start-Up is an interactive multimedia course on CD-ROM that provides an introductory course on the principles and practices of Six Sigma.

Gage Mentor is an interactive multimedia training course on CD-ROM. It provides effective metrology training for operators, engineers, and quality personnel.

FMEA Investigator is a step-by-step interactive multimedia training course on CD-ROM that provides effective instructions on how to conduct both design and process FMEAs.

Total Quality Transformation® (TQT®) offers step-by-step help in facilitating quality improvement in organizations. Materials include Practical Tools for Continuous Improvement, Practical Tools for Healthcare Quality, Foundations for Leaders, Foundations of Quality, Team Skills, System Alignment Guide, System Improvement Guide, and Strategic Quality Planning Guide. TQT is part of the Transformation of American Industry training project, which has been used in a variety of manufacturing and service organizations since 1984.

## How to contact PQ Systems

PQ Systems invites your questions and comments about our products and services.

Sales Phone: 1-800-777-3020 or 937-885-2255

Sales E-mail: [sales@pqsystems.com](mailto:sales@pqsystems.com)

PQ Systems, Inc.

210 B East Spring Valley Road

Dayton, OH 45458

Call Sales for:

- General information to help you decide to purchase or evaluate the software
- To place an order or check the status of an order

You can send a fax to either Sales or Technical Support at 937-885-2252. To ensure that your fax is delivered quickly to the right department, please send it to Attn: Sales or Attn: Technical Support.

World Wide Web URL

**<http://www.pqsystems.com>** (<http://www.pqsystems.com>)

International offices

U.K.	PQ Systems Europe Ltd. Ryeground House, Ryeground Lane Freshfield, Formby, Merseyside L37 7EQ England Tel. 01704 871465 Fax 01704-875189
Australia	PQ Systems Pty. Ltd. Level 6 Peninsula Centre 435-437 Nepean Highway Frankston, Victoria 3199 Australia

Tel. 03-9770-1960

Fax 03-9770-1995

## Technical support

Phone: 1-800-777-5060 or 937-885-2255

E-mail: [support@pqsystems.com](mailto:support@pqsystems.com)

Call our experienced technical support team. Our experts can answer questions about software problems, data analysis, and applications.

Before you call, please follow these steps to help our technical advisors answer your questions quickly:

1. Have your license/serial number ready. It is listed in the About dialog box. You can access this dialog box by selecting Help > About from the menu.
2. Be at your computer, if possible.
3. Review the topic for which you have a question in the *User Guide and On-line Help*.

## Maintenance support agreement

The product comes with an initial year of maintenance. After that, you must renew your product maintenance in order to ensure your continued access to the following great benefits:

1. Free software updates via download or CDROM - The product continues to evolve with suggestions from customers like you. Renewing your maintenance plan gives you access to 12 months of updates that include new features, improved usability, and compliance with the latest regulations from ISO 9000, JCAHO, FDA, and other regulatory bodies.  
**<http://www.pqsystems.com/support/SoftwareUpdates.php>**  
(<http://www.pqsystems.com/support/SoftwareUpdates.php>)
2. Access to our legendary technical support - Our legendary support has kept customers coming back for more than 20 years. Renewing your maintenance plan will provide you access to our professional support staff. You have access to software and statistical application help via the phone, and in North America the number is toll-free.
3. Free subscription to Quality eLine - Quality eLine is our highly-acclaimed monthly electronic newsletter offering tips and techniques to enhance your software use and make your day-to-day work easier. Quality eLine includes the Professor Cleary's renowned and always-entertaining Quality Quiz. Renewing product maintenance will ensure you don't miss a monthly issue.  
**<http://www.pqsystems.com/eline/>** (<http://www.pqsystems.com/eline/>)
4. Peace of mind - If your team depends on the product for its improvement charting, having a guaranteed direct line of contact to a committed support team offers priceless peace of mind, especially during an audit or survey. Renewing ensures that the privileges of product maintenance continue uninterrupted.

Contact PQ Systems to renew your maintenance support agreement.



# PQ Systems "per workstation" end-user license agreement

This End-User License Agreement ("EULA") is a legal agreement between you (either an individual or a single entity) and PQ Systems, Inc. for the PQ Systems software that accompanies this EULA, which includes computer software and may include associated media, printed materials, "online" or electronic documentation, and Internet-based services ("Software"). An amendment or addendum to this EULA may accompany the software. YOU AGREE TO BE BOUND BY THE TERMS OF THIS EULA BY INSTALLING, COPYING, OR OTHERWISE USING THE SOFTWARE. IF YOU DO NOT AGREE, DO NOT INSTALL, COPY, OR USE THE SOFTWARE; YOU MAY RETURN IT TO YOUR PLACE OF PURCHASE FOR A FULL REFUND, IF APPLICABLE.

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## Evaluation period

This is not free software. Subject to the terms of this agreement, you are permitted to use the Software for evaluation purposes without charge during the evaluation period. If you want to use the Software after the evaluation period then a registered license must be purchased. The evaluation period may vary from one PQ Systems product to another, but in no case does the evaluation period extend beyond 90 days from the first use of the Software.

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Corporate Headquarters: 10468 Miamisburg-Springboro Road, Miamisburg, Ohio 45342, USA, (937) 885-2255, <http://www.pqsystems.com>. International Offices in: Australia 03-9770-1960, The United Kingdom (01704)871465.

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## Request for new features

PQ Systems wants to provide you with software that meets your quality needs. To do this, we need your input. If there is a feature, function, or operation that you would like to see in a future version of the software, please contact please contact Technical Support by e-mail at [support@pqsystems.com](mailto:support@pqsystems.com) or by phone at 1-800-777-5060 or 937-885-2255.

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## CHAPTER 2

# Installing CHARTrunner

## In This Chapter

Hardware and software requirements.....	9
Using the installation README file.....	9
Installing CHARTrunner .....	9
Upgrading from a prior version of CHARTrunner .....	10

## Hardware and software requirements

You need the following to run CHARTrunner:

- Pentium PC with sufficient memory.
  - Generally speaking, the more memory the better your experience will be. If you are running Windows XP, PQ Systems recommends 256 MB at an absolute minimum, and 512 MB (or more) is better.
- At least 200 MB of free disk space.
- Windows 98, 2000, Windows NT, Windows XP, or Windows Vista.

## Using the installation README file

We strive to continuously improve our software and occasionally make changes that affect the look or use of CHARTrunner. We are not always able to include this information in the documentation that you receive with the product. Instead, PQ Systems includes this information in a ReadMe.htm file. To open the ReadMe.htm file, double-click on the ReadMe icon in the CHARTrunner 3.5 area of the Start menu.

## Installing CHARTrunner

To install CHARTrunner:

1. Put the Quality Suite CD in your CD drive and close the drive. The CD should launch automatically. If it does not:
    - a) Open the Start Menu and select Run.
    - b) In the Run form, type the letter of your CD drive, followed by a colon, backslash, and setup. For example, if your Quality Suite CD is in your D drive, you would type D:\setup.
    - c) Click the OK button.
-

2. From the introduction screen, click on >> or press the PageDown key. From the Quality Suite Main Menu, select Install Products.
3. From the Quality Suite Software screen, click on CHARTrunner. Follow on-screen installation instructions to complete the install.

## Upgrading from a prior version of CHARTrunner

You should not install CHARTrunner 3.5 into the same folder where a previous version of CHARTrunner has been installed.

You can safely install multiple versions of CHARTrunner on the same computer. This allows you to try out the new features of CHARTrunner 3.5 without having to uninstall your prior version. However, please understand that your CHARTrunner license does not permit you to install or run a prior version of CHARTrunner on any computer other than the single licensed computer.

## Chart definition files

When you edit a chart definition that was created in a version 1.7 or earlier, CHARTrunner 3.5 saves the ChartName.CRF, MultiChartName.CRM, or WorkspaceName.CRW chart definition file in the new format (which is not compatible with 1.7 or earlier versions). The prior version of the chart definition file is saved with a .BAK file extension, e.g. ChartName.CRF.BAK, in case you need to recover it for use with the prior-version of CHARTrunner.

If a 2.5 or higher chart definition is edited and saved by 3.5, the original definition file will not be saved with a .BAK file extension.

If a Trend line is created in a chart definition using 3.5, and the chart definition is subsequently edited by 2.5, the Trend line will be converted to an "Extra line" with a y-axis value of zero. Thus, you should avoid editing a 3.5 chart definition that contains a Trend line using CHARTrunner 2.5.

## Style definition files

Prior to CHARTrunner 2.0, all style definition files (these are typically located in the Styles folder) had a .CST file extension. Starting in CHARTrunner 2.0 (and higher), the following extensions are used depending on the type of chart the style is used with:

- Control Chart Style.CSC
- Histogram Chart Style.CSH
- Pareto Chart Style.CSP.

When you edit a style definition that was created in a prior version and now has the new 2.0 file extension, CHARTrunner 2.0 does not save a .BAK copy of the prior version style file. The assumption is made that if you have gone to the trouble of renaming the file extension to the 2.0 (and higher) naming scheme, then that style will be used exclusively with CHARTrunner 2.0 (and higher).

## Steps for migrating to CHARTrunner 3.5

Follow these steps to migrate your existing chart and style definitions to CHARTrunner 3.5. If you are not comfortable with using Windows Explorer to copy and rename files, then contact Technical Support at PQ Systems, and they will assist you.

1. Copy your prior-version chart definitions to a new folder that will be used exclusively by CHARTrunner 3.5 users so that, when CHARTrunner 3.5 saves changes in the new 3.5 chart definition file format, you do not break the chart definition for prior versions of CHARTrunner. Omit this step if you do not need to support prior versions of CHARTrunner.
2. If in your prior version of CHARTrunner you have customized any of the style definitions that look like Default\*.CST or have created one or more new style definitions, then copy these from the Styles folder of the prior version of CHARTrunner into the Styles folder of CHARTrunner 3.5 (typically this is C:\Program Files\PQ System\CHARTrunner 3.5\Styles). If you copied any of the Default\*.CST style files, you will need to first rename or delete the 3.5 version of that style. Then rename each of these .CST style files so that they have the appropriate .CSC, .CSH, or .CSP file extension according to the type of style definition.



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## CHAPTER 3

# Getting started

The following topics illustrate key CHARTrunner forms and provides information on menu functions, program settings, and navigating through the software.

## In This Chapter

New CHARTrunner users .....	13
Why CHARTrunner? .....	14
Starting CHARTrunner .....	14
The CHARTrunner definitions list .....	15
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## New CHARTrunner users

New users are encouraged to read **Getting started** (on page 13) and **Tutorial** (on page 25) to gain familiarity with the basic concepts of using CHARTrunner.

We want your first experience with CHARTrunner to be a good one. If you are a new user, or even if you are just evaluating a trial of CHARTrunner, you can contact PQ Systems for a guided tour of CHARTrunner. To arrange a tour contact the nearest office.

Location	Contact Information
United States	Call: 1-800-777-5060 or 937-885-2255 E-mail: support@pqsystems.com
Europe	Call: 01704 871465 E-mail: tech@pqsys.demon.co.uk
Australia	Call: 03-9770-1960 E-mail: support@pqsystems.com.au

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## Why CHARTrunner?

CHARTrunner is designed for organizations that want to perform statistical process control analysis on data already stored in a database or spreadsheet applications. Use it to monitor and improve systems throughout an organization from sales to production to customer service. Working with data from Access, dBASE, Excel, FoxPro, Paradox, and text files or through ODBC links or ADO;OLE DB database drivers, CHARTrunner calculates statistics and produces control charts, Pareto diagrams, capability indices, scatter diagrams, histograms, multi-line charts, dashboards, and more. CHARTrunner helps identify process problems quickly and provides the tools for prioritizing them. It provides on line answers to your SPC questions including chart selection and interpretation.

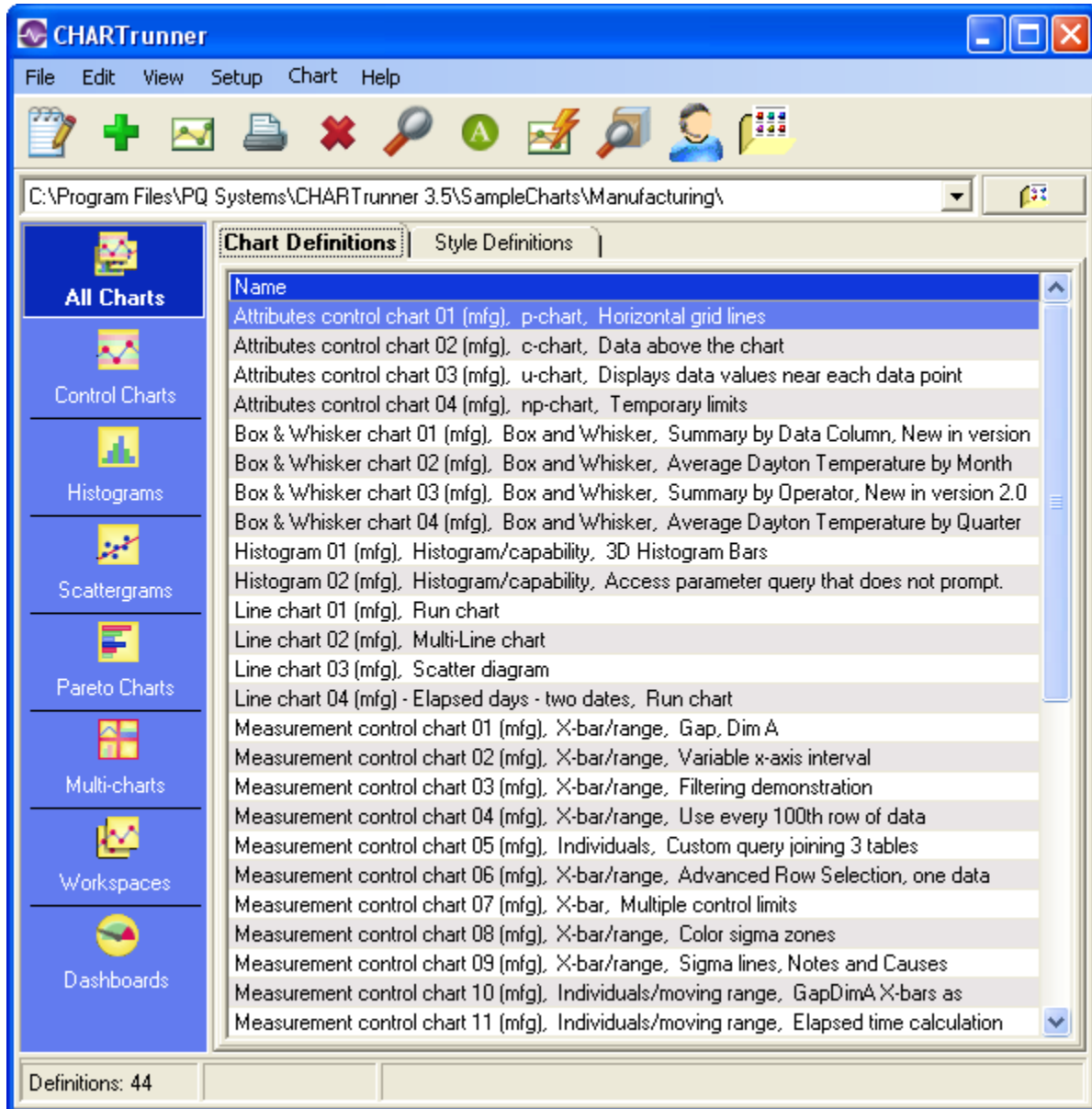
## Starting CHARTrunner

To start CHARTrunner, click on the Start Menu and select CHARTrunner. This action is likely to be found under Start > Programs > CHARTrunner 3.5 > CHARTrunner 3.5.



## The CHARTrunner definitions list

When you start CHARTrunner, the first window that you see is the main window that displays the CHARTrunner definitions list. This form shows the current working folder and all of the CHARTrunner definitions found within the working folder.



Click on a button along the left side of the form to select the type of definition to display in the list. Click on a tab above the list to select either the chart definitions list or the style definitions list.

**Quick Search** - When you press a key on the keyboard, the selection cursor in the definitions list will advance to the new definition name that begins with that key.

## Chart definition form

The chart definition form is used to create and define charts. It consists of a series of tabs, briefly described below. For detailed information on the Chart Definition form and its tabs, please refer to **Charting Data**. The Chart Definition form is displayed when you select the edit, copy, or new chart definition functions.

### Step 1: Chart name/type tab

The Step 1: Chart name/type tab, shown below, allows you to assign a chart name, description, chart type, chart style, and refresh interval for your chart.

The screenshot shows the 'CHARTrunner - Measurement control chart 18 (mfg)' dialog box. The 'Step 1: Chart name/type' tab is active. The 'Chart name' field contains 'Measurement control chart 18 (mfg)'. The 'Chart style' dropdown is set to 'Docs control chart style'. The 'Description' field contains 'Access parameter query that prompts for starting/ending dates and operator'. The 'Refresh interval (blank = none):' field is empty, followed by 'seconds'. Below these fields are two columns of radio buttons for 'Chart categories' and 'Chart types'. The 'Chart categories' column has 'Measurement control charts' selected. The 'Chart types' column has 'X-bar' selected. To the right of these columns is a 'Sample chart image' showing two line charts. At the bottom of the dialog are buttons for 'View data', 'Save as default', a help icon (question mark in a green circle), 'OK', and 'Cancel'.

Field Name	Description
Chart Name	Enter the name for this chart. The name you enter will be used as the file name of the chart definition, so the nine characters ? : " \ < > *   are not allowed, since they cannot be used in a file name. If you change the name of an existing chart definition, you will be asked if you want to retain the chart definition with the old name. You may search for a chart based upon the chart's name. This is a required field.

Chart Style	Select a chart style name from the drop-down menu. The chart style defines many of the visual “look-and-feel” aspects of the chart (such as the chart background color). See <b><i>Using styles to control the look of your chart</i></b> for more information about chart styles.
Description	The description is used to provide additional information about the chart. Because the description can be displayed in the CHARTrunner definitions list, a chart description may help to locate charts more easily. You may search for a chart based upon the chart description. This is an optional field.
Refresh interval (blank - none)	<p>The refresh option will redraw a displayed chart at the specified interval. If data is added frequently, set a refresh interval to keep the chart current. A refresh interval may be set for a chart or multi-chart. Leave this field blank if you do not want the chart to automatically refresh. Set this to the desired number of seconds if you want the chart automatically to refresh while it is displayed. Each time the refresh interval passes, the chart will be re-displayed, reflecting any new data that may have arrived since the last refresh.</p> <p>NOTE: Be careful not to set the refresh interval too short. For example, if you add new data to the underlying database once every 30 minutes, there is really no need to set the refresh interval to 10 seconds. This makes the computer do unnecessary work to re-query the database and re-draw the chart. One use for the refresh interval is to monitor a chart in one location based on data that is being collected in some other location. For example, in showing data that is being collected during a manufacturing process.</p>
Chart categories and Chart type	Specify the category and type of chart that you want. When you select a chart type, the Sample chart image shows you a representation of what the chart will look like. For descriptions of available chart types, please refer to Data and chart types. For information on chart-specific settings, please refer to <b><i>Customizing a chart definition</i></b> (on page 113).

When you have finished with the Step 1: Chart name/type tab, the next step is to tell CHARTrunner how to connect to the database or data file for the chart by clicking the Step 2: Data source tab.

## Step 2: Data source tab

Use the Step 2: Data source tab to select the type of database, spreadsheet, or text file and specify the source file path and name. For ODBC and ADO;OLE DB sources, this form also prompts for user name, password, and a connection string.

The screenshot shows the CHARTrunner - Measurement control chart 01 (mfg) dialog box, specifically the Step 2: Data source tab. The dialog has a blue title bar and a tabbed interface with tabs for Step 1: Chart name/type, Step 2: Data source (selected), Step 3: Data definition, Limits/specs, Control chart, Titles, and Misc. The main area contains a 'Type:' dropdown menu set to 'Microsoft Access' with a green question mark icon to its right. Below this is a 'Database or file name:' text box containing the path '[:AppPath:]\\SampleData\\SampleAccess2K.mdb' and a folder icon to its right. A checkbox labeled 'Keep current column mappings and allow for non-existing file.' is checked. At the bottom, there are buttons for 'View data', 'Save as default', a user icon, a green question mark icon, 'OK', and 'Cancel'.

CHARTrunner - Measurement control chart 01 (mfg)

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Limits/specs | Control chart | Titles | Misc.

Type:  
Microsoft Access

Database or file name:  
[:AppPath:]\\SampleData\\SampleAccess2K.mdb

☒ Keep current column mappings and allow for non-existing file.

View data | Save as default | [User Icon] | [Green Question Mark Icon] | OK | Cancel

## Step 3: Data definition tab

Settings in the Step 3: Data definition tab tell CHARTrunner where to find and how to handle data within the source file. This tab deals with questions like: Is the data stored in a table or a query in the database? Or, do you want to create a custom query? Which columns of data should be included on the chart? Which can be ignored? Which are identifiers? Data filters and advanced row selection are set on this tab as well.

The screenshot shows the 'CHARTrunner - Measurement control chart 01 (mfg)' dialog box, specifically the 'Step 3: Data definition' tab. The dialog has several tabs: 'Step 1: Chart name/type', 'Step 2: Data source', 'Step 3: Data definition' (selected), 'Limits/specs', 'Control chart', 'Titles', and 'Misc.'. The 'Source for data records' section has four radio buttons: 'Table' (selected), 'Query or view', 'Stored procedure', and 'Custom query'. To the right of these is a 'Table' label and a 'Keep columns' checkbox (checked). Below these are two dropdown menus: 'GapDimA' and 'Subgroup'. There are three buttons: 'Filtering' (disabled), 'SQL settings', and 'Advanced >>' (disabled). Below these is a 'Result records to include:' label and a dropdown menu set to 'All'. The 'How to treat the columns:' section contains a table with four columns: 'Column name', 'Data type', 'Treat as', and 'Label'. The table has five rows of data. Below the table are three buttons: 'Refresh Columns', 'Validate Chart Data', and 'Clear all'. At the bottom of the dialog are five buttons: 'View data', 'Save as default', a help icon (a person with a question mark), 'OK', and 'Cancel'.

Source for data records:

- ☒ Table
- ☐ Query or view
- ☐ Stored procedure
- ☐ Custom query

Table ☒ Keep columns

GapDimA

Column to use for Order By:

Subgroup

☐ Filtering  ☐ Advanced >>

Result records to include: All

How to treat the columns:

Column name	Data type	Treat as	Label
Date	Text	Identifier	Date
Shift	Text	Identifier	Shift
Gap1	Numeric	Measurement	Gap1
Gap2	Numeric	Measurement	Gap2
Gap3	Numeric	Measurement	Gap3
Gap4	Numeric	Measurement	Gap4

## Titles tab

The Titles tab is used to enter titles that will be displayed on the chart.

**CHARTrunner - Measurement control chart 01 (mfg)**

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Limits/specs | Control chart | **Titles** | Misc.

Titles at top of chart:

Line	Left title	Center title	Right title
1		CHARTrunner Lets You Add Annotations To Your Charts	
2		~	
3		Annotations allow you to put text on the chart where you...	
4		You can position an annotation at a fixed location on the	

Titles at bottom of chart:

Line	Left title	Center title	Right title
1		@DT	
2	@image(crlogo.wmf)	www.chartrunner.com 800-777-3020	@image(pqlogo.wmf)
3			
4			



Left title (vertical text on left side of chart):

Right title (vertical text on right side of chart):

☒ Chart type as a title
 ☐ Title grid lines

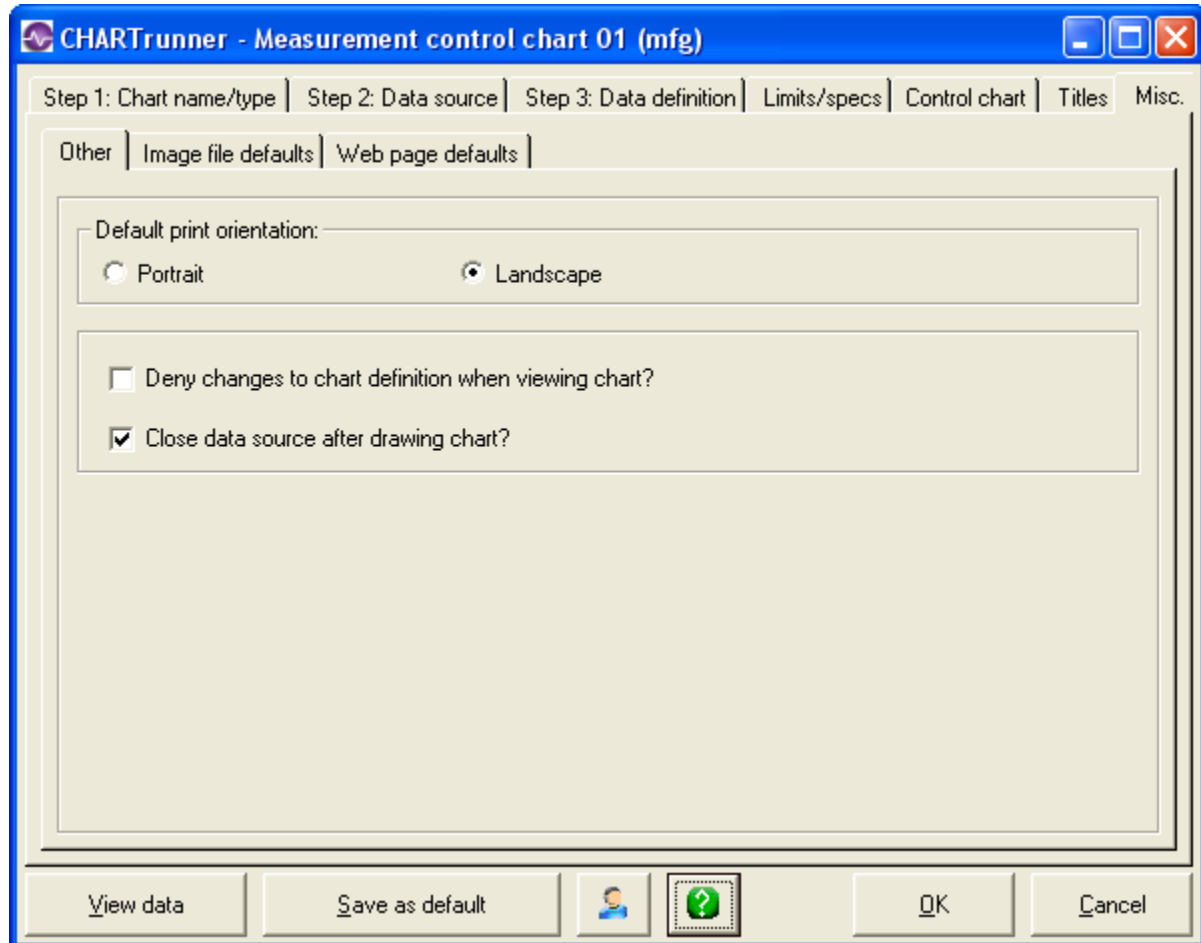
☒ Control limits as a title

☐ Multiple control limit titles

View data | Save as default |   | OK | Cancel

## Misc. tab

The Misc. tab is used to set the printer orientation, default parameters for chart image files, and default parameters for creating a chart's Web page.



## All other tabs

All other tabs on the chart definition form are chart specific and will be discussed in **Customizing a chart definition** (on page 113).

## Multi-chart and chart workspace forms

The Multi-chart function lets you view several charts on a single page or screen. You can mix and match charts from different source chart definitions.

A Chart workspace is a collection of two or more regular charts designed to be viewed or printed together. However, each chart will appear in its own window or be printed on its own page.

The forms for setting up Multi-charts and Chart workspaces are virtually the same. Use these forms to add, delete, or modify charts that will be displayed in a Multi-chart or Chart workspace.

**Chart workspace**

Name: Sample workspace 01 (mfg)

Description: Four attributes control charts

Charts

#	Name	Chart type	Description	Chart definition
1	Attributes control chart 01 (mfg)	p-chart	Horizontal grid lines	C:\Program Files\
2	Attributes control chart 02 (mfg)	c-chart	Data above the chart	C:\Program Files\
3	Attributes control chart 03 (mfg)	u-chart	Displays data values n	C:\Program Files\
4	Attributes control chart 04 (mfg)	np-chart	Temporary limits	C:\Program Files\

Add charts  
 Display chart  
 Modify chart  
 Remove chart

You may resize this window as needed. CHARTrunner will remember the window size.



## Chart style form

This Control chart styles form is displayed when you select New or Edit chart style. Depending on the chart type, you can use the properties of a style definition to set colors, data markers, line styles, and fonts.

**Control chart styles**

Style name: Default control chart style

Description:

Backgrounds	Color	Pattern
Page background	Yellow	
Chart background	White	
Zone 1	Light Green	
Zone 2	Yellow	
Zone 3	Pink	
Zone 4	White	
Cell background	White	

Lines	Color	Width	Style
Page outline	Black		
Chart outline	Black		
Data 1	Blue		
Data 2	Green		
Data 3	Red		
Data 4	Grey		
Data 5	Black		
Data 6	Cyan		
Data 7	Purple		


Default ? OK Cancel

## Saving chart, workspace, and style definitions

CHARTrunner automatically saves your settings when you create or modify a definition and click the OK button to close the editor.

## Getting help

CHARTrunner offers several help options:

- On-line Help - On-line help is a quick way to find answers to your questions about CHARTrunner while working in the program. To access help for a specific form within the program, press the F1 key or click the green question mark button . For general help, open the Help menu and select Contents.
- Tool tips - If you hold the mouse pointer over an icon, a pop-up help message will appear. Move the mouse away from the icon to clear the message.
- Quality Advisor - The on-line SQC Quality Advisor provides answers to commonly asked questions about SPC. To open the SQC Quality Advisor, open the Help menu and select Quality Advisor.
- README file - This file contains updated information on CHARTrunner.

Technical Support - Our technical support team will be happy to answer your questions. For free technical support, call 1-800-777-5060 or submit your questions to [support@pqsystems.com](mailto:support@pqsystems.com) (<http://www.support@pqsystems.com>). Our fax number is 1-937-885-2252. Customers of our England office can call 01704 871465 or fax to 01704 875189. Customers of our Australian office can call 03-9770-1960 or fax to 03-9770-1995.

## Exiting CHARTrunner

To exit CHARTrunner press the Alt+F4 keys or open the File menu and select Exit.

## CHAPTER 4

# Tutorial

This brief walk-through introduces you to a few of the key features of CHARTrunner. It is designed to get you started with a minimal amount of setup. To get the most from this tutorial, complete the topics in order.

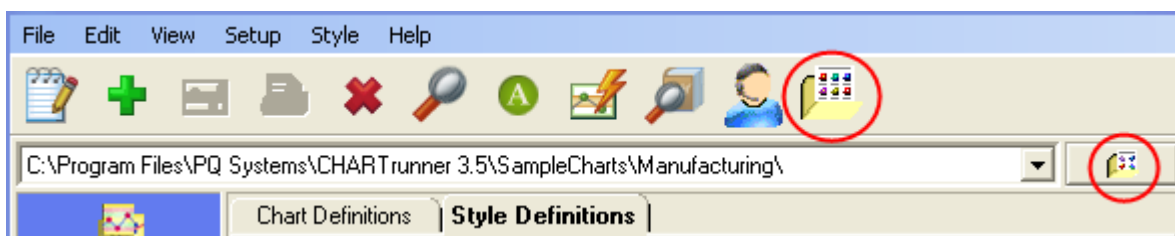
## In This Chapter

Lesson 1 - Set the working folder .....	25
Lesson 2 - Define a chart definition .....	28
Lesson 3 - display and customize the chart.....	34
Lesson 4 - using the CHARTrunner-XL Excel add-in .....	41
To learn more about CHARTrunner and CHARTrunner-XL .....	45

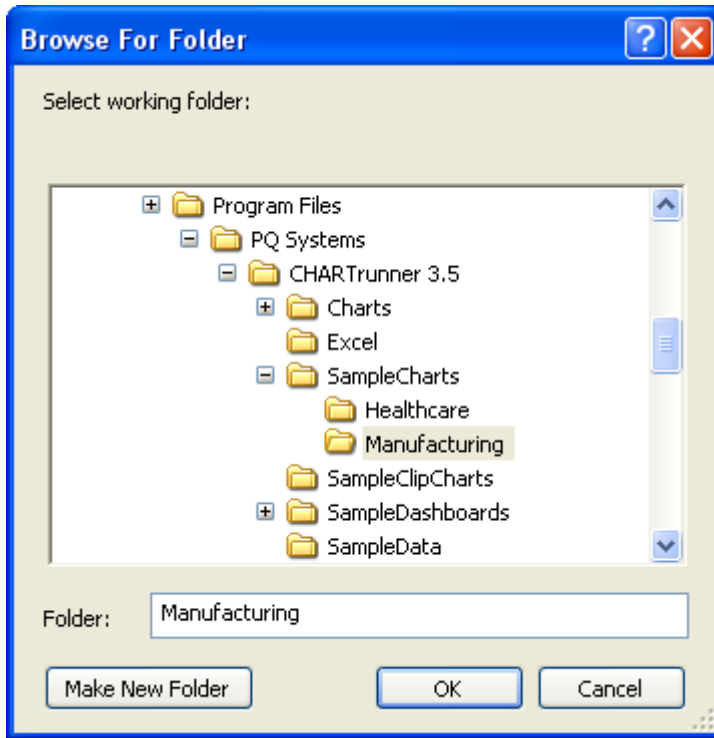
## Lesson 1 - Set the working folder

CHARTrunner can store your chart and dashboard definitions in one or more folders on your local or network disk. The folder that CHARTrunner uses to display the list of available definitions is called the working folder. For the walk-through, we will use the ...\\SampleCharts\\Manufacturing folder that was installed with CHARTrunner.

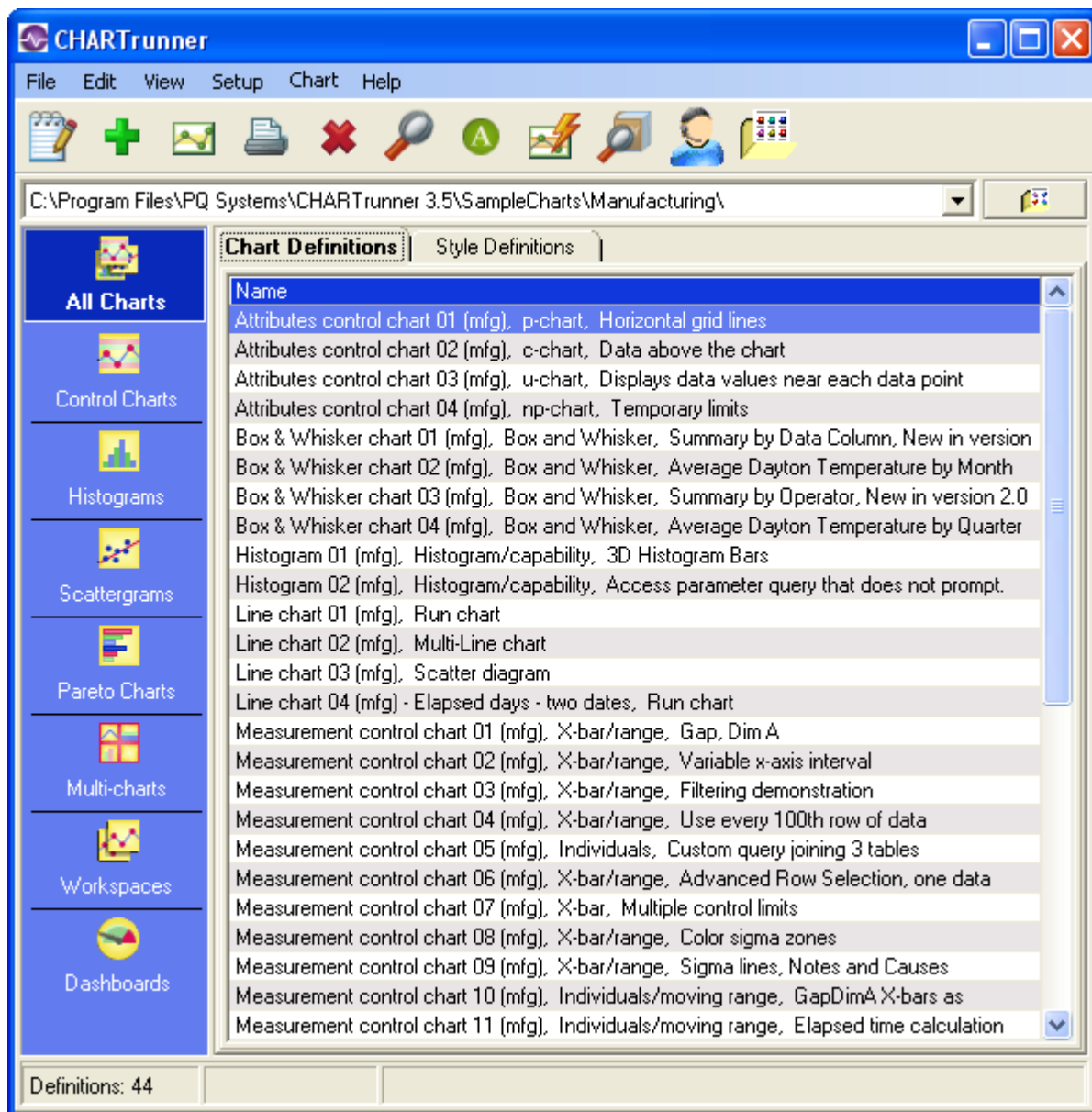
Click on either of the buttons shown highlighted below to open the Browse for Folder dialog. Or, open the File menu and select Set folder containing charts. Or, press the Ctrl-W hotkey. Or, select from a list of recently used folders by clicking on the field that displays the current working folder.



1. In the Browse for Folder window, select the “C:\Program Files\PQ Systems\CHARTrunner 3.5\SampleCharts\Manufacturing” folder, as shown below, and click on the OK button.

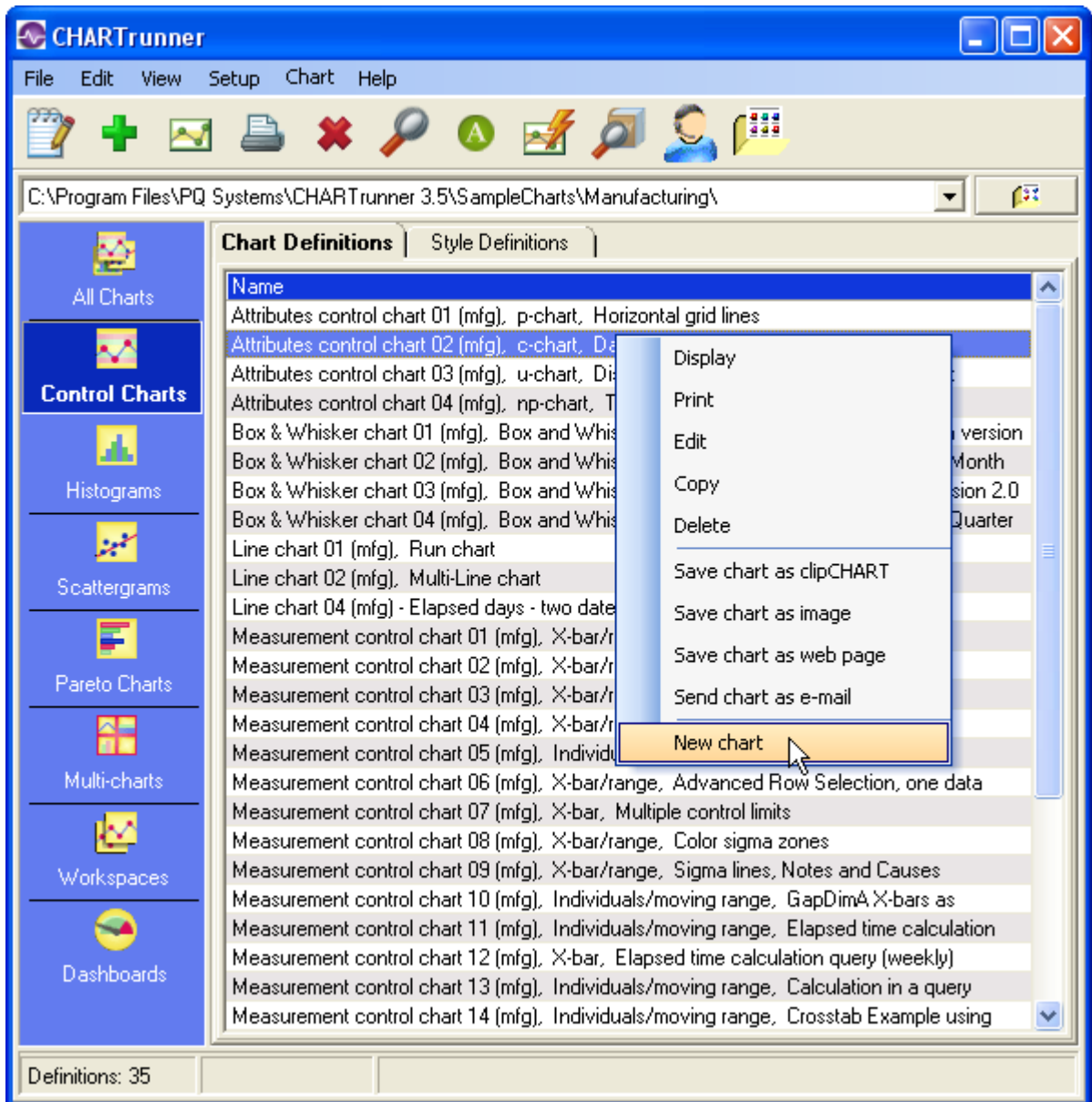


2. CHARTrunner displays the definitions found in the working folder as shown below.



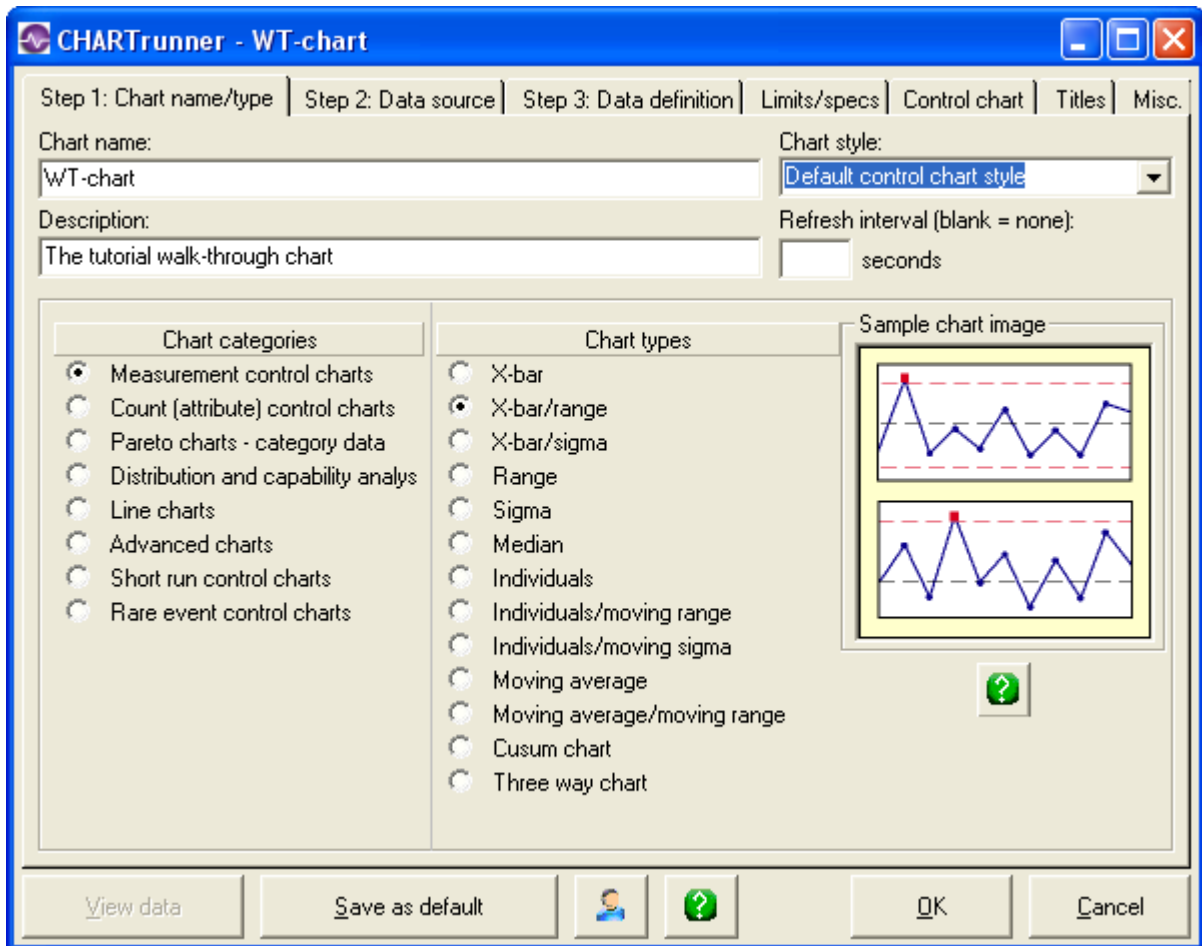
## Lesson 2 - Define a chart definition

1. Right click on a chart definition in the list and select New chart from the pop-up menu. Or, click on the New chart icon (the one that looks like a green plus sign) on the toolbar.




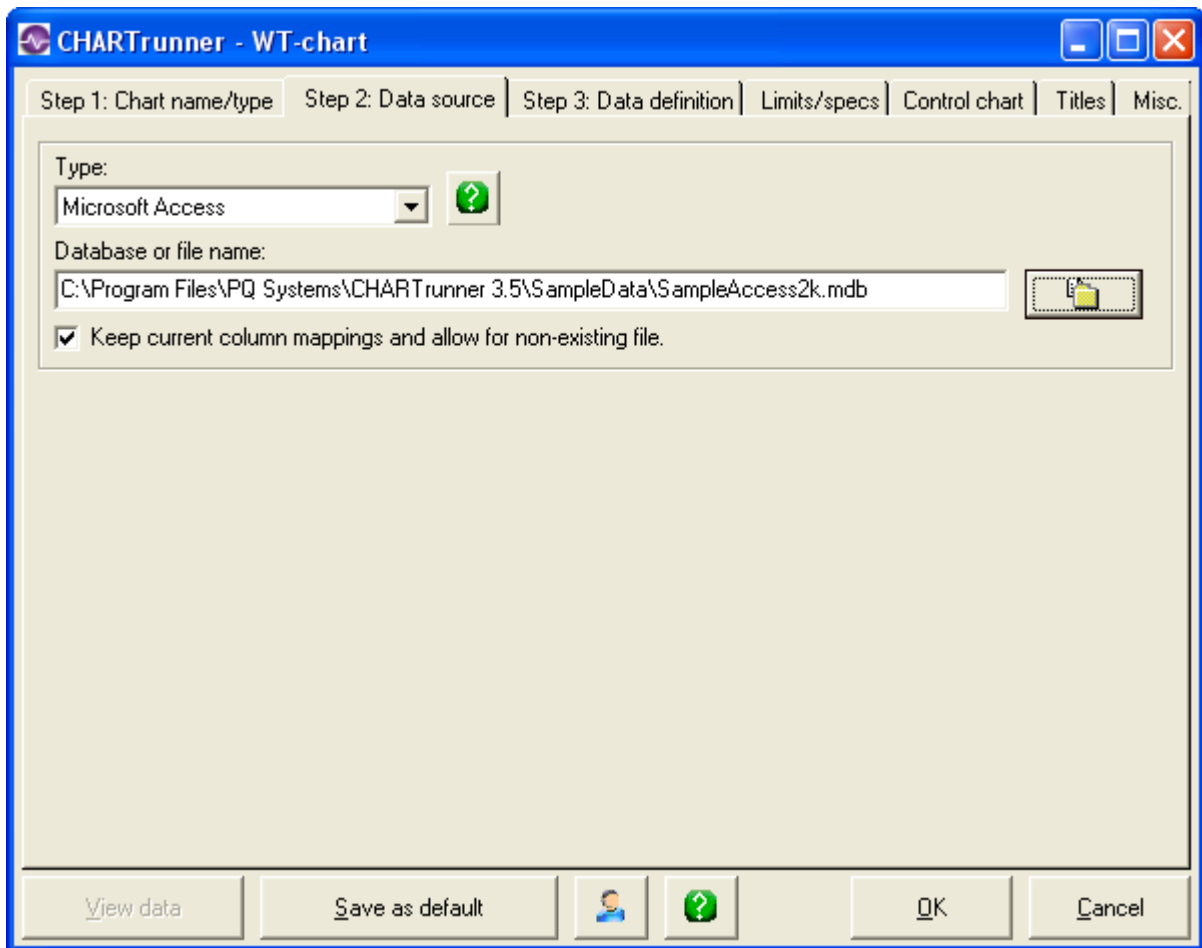
2. The chart definition form will open, and the Step 1: Chart name/type tab will be displayed. In the Chart name field enter WT-chart as shown below.
3. By default CHARTrunner selects an X-bar/range as the thyp of chart to be displayed, and that is the chart type we will use for this walk-through. But you could select a different type of chart at this point in creating a new chart.

4. Notice that the Chart style drop-down menu automatically contains Default Control Chart Style. The named chart style definition that you specify determines many of the visual properties of the chart, such as the colors and fonts used by the chart. You can create your own style definitions, but for now we will use the Default Control Chart Style.



5. Click on the Step 2: Data Source tab where you will tell CHARTrunner what data source to use for your chart.
6. From the Type drop-down menu, select Microsoft Access.

7. Click on the Browse for file button  to select the Microsoft Access database file to use. Select the "C:\Program Files\PQ Systems\CHARTrunner3.5\SampleData\SampleAccess2k.mdb" file. If CHARTrunner was installed into a different target folder you must adjust the file location accordingly.



8. Click on the Step 3: Data definition tab where you will specify the data to be used for the chart.
9. Select Table as the Source for data records.
10. From the Table drop-down menu, select the DailyProduction table.



11. From the Column to use for Order By drop-down menu, select MfgDate. For a control chart, it is a good idea to always specify the order for the chart's data. Some data source providers can vary the order of the data from one run to another if no order has been specified, which can result in a different looking control chart each time the chart is rendered.

**CHARTrunner - WT-chart**

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Limits/specs | Control chart | Titles | Misc.

Source for data records:

- ☒ Table
- ☐ Query or view
- ☐ Stored procedure
- ☐ Custom query

Table ☒ Keep columns

DailyProduction

Column to use for Order By: MfgDate

☐ Filtering ☐ SQL settings ☐ Advanced >>

Result records to include: All

How to treat the columns:

Column name	Data type	Treat as	Label
MfgDate	Date / Time	Unique identifier	MfgDate
Operator	Text	Identifier	Operator
Length_1	Numeric	Measurement	Length_1
Length_2	Numeric	Measurement	Length_2
Length_3	Numeric	Measurement	Length_3
Length_Cause	Text	Cause	Length_Cause
NoteField	Text	Note	NoteField

Refresh Columns Validate Chart Data Clear all

View data Save as default OK Cancel

12. After you select a Table, Query or view, Stored procedure, or Custom query, the How to treat the columns grid will list the data columns that are available to you. You must tell CHARTrunner in the Treat as column how to handle the data in each column.

To specify the Treat as for a column:

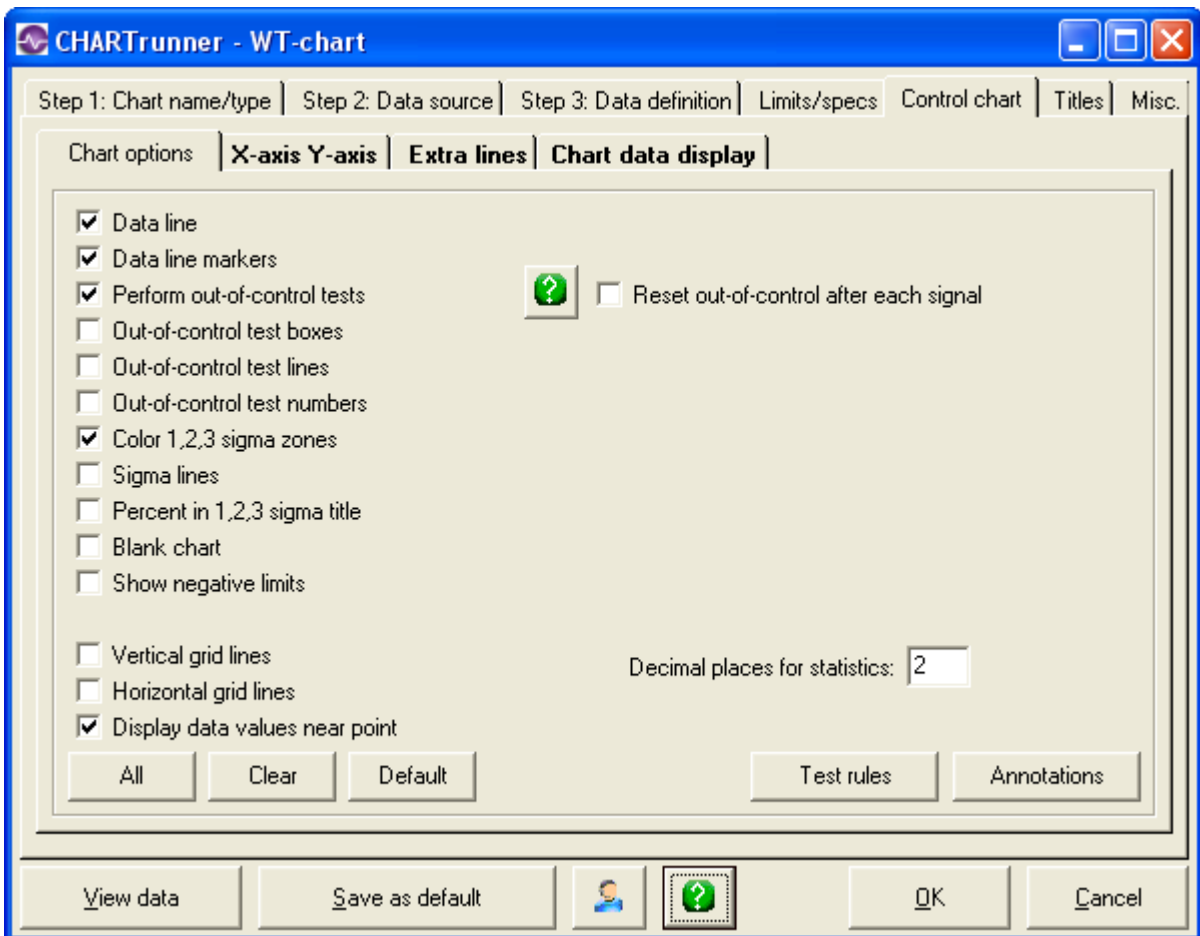
- Click on the Treat as field.
- Click on the down arrow to open the drop-down list. Select Treat as options from that list as shown below.

Column	Treat As
Key	Ignore
MfgDate	Unique Identifier
Operator	Identifier
Length_1	Measurement
Length_2	Measurement

Length_3	Measurement
Length_cause	Cause
Width_1	Ignore
Width_cause	Ignore
NoreField	Note

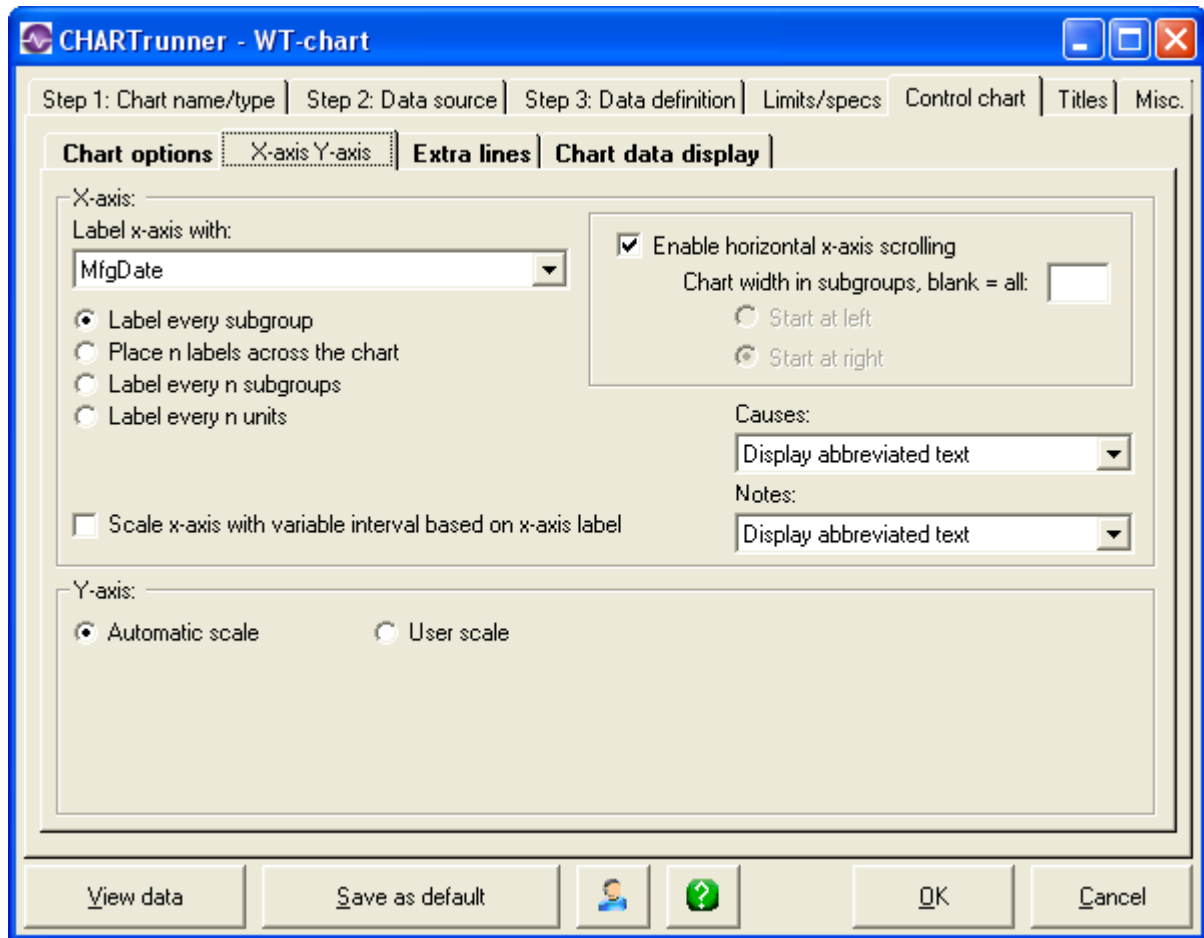
**CAUTION!** If you return to the Step 3: Data definition tab another time, columns that were not mapped will not be listed. To list these columns, click on the Refresh button.

13. Click on the Limits/specs tab.
14. Select Use temporary limits computed from data in the chart.
15. Click on the Control chart tab. There are four sub-tabs where you specify the options you desire for this chart.
16. Select the options as shown on the next illustration.



17. Click on the X-axis Y-axis tab within the Control chart tab.

18. Set the options as shown in the next illustration.



19. Click on the Titles tab.

20. Enter the titles as shown on the graphic below by double-clicking on a title cell and entering the desired text. You can use your own name in the "Prepared by" title.

**CHARTrunner - WT-chart**

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Limits/specs | Control chart | **Titles** | Misc.

Titles at top of chart:

Line	Left title	Center title	Right title
1		Tutorial	
2	@DATE		Prepared by Bob
3			
4			
5			

Titles at bottom of chart:

Line	Left title	Center title	Right title
1			
2			
3			
4			
5			

Left title (vertical text on left side of chart):

Right title (vertical text on right side of chart):

☒ Chart type as a title      ☐ Title grid lines

☒ Control limits as a title

☐ Multiple control limit titles

View data    Save as default    ?    OK    Cancel

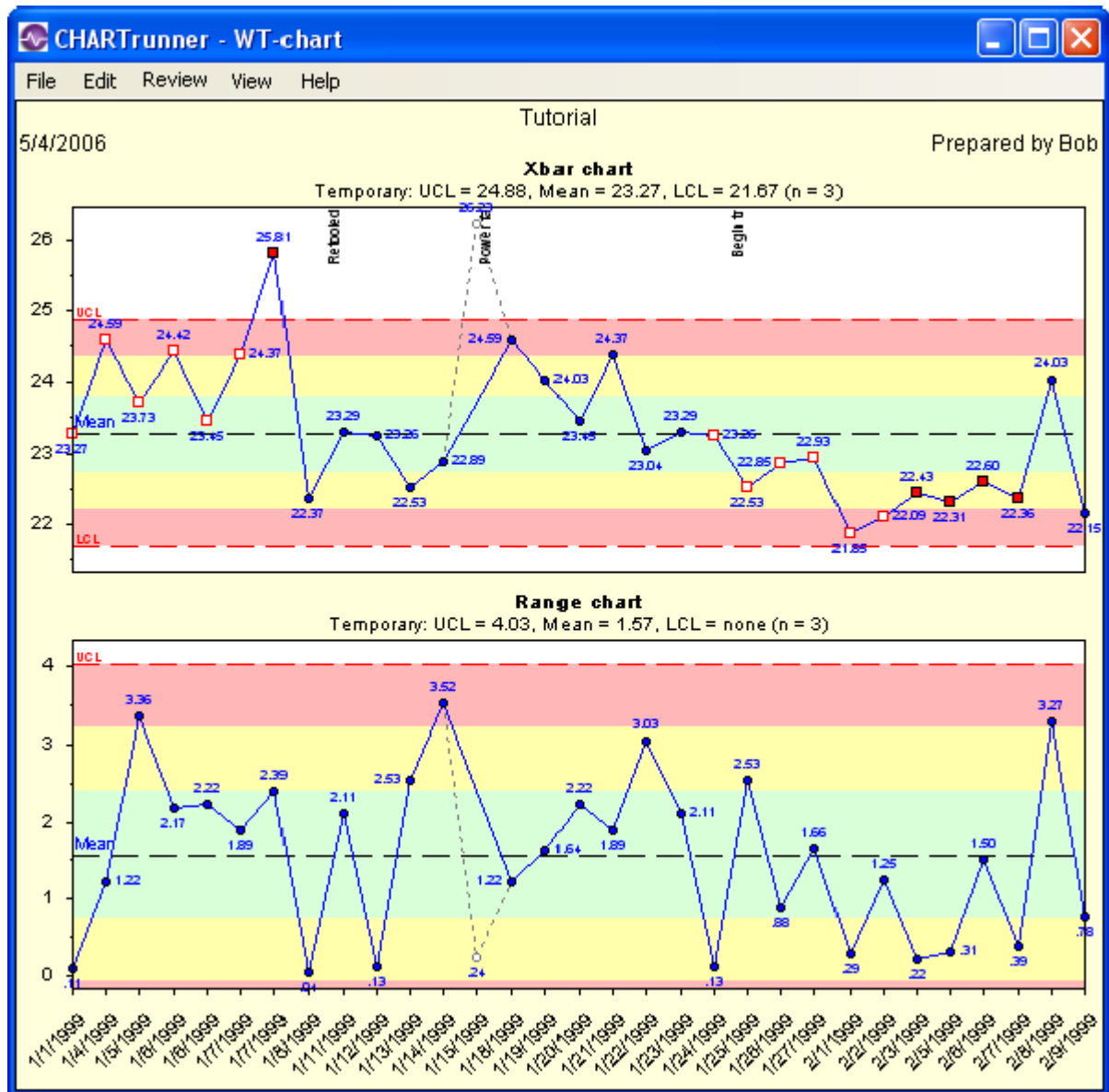
21. Click on the OK button to save the chart definition.

## Lesson 3 - display and customize the chart

To display the new chart:

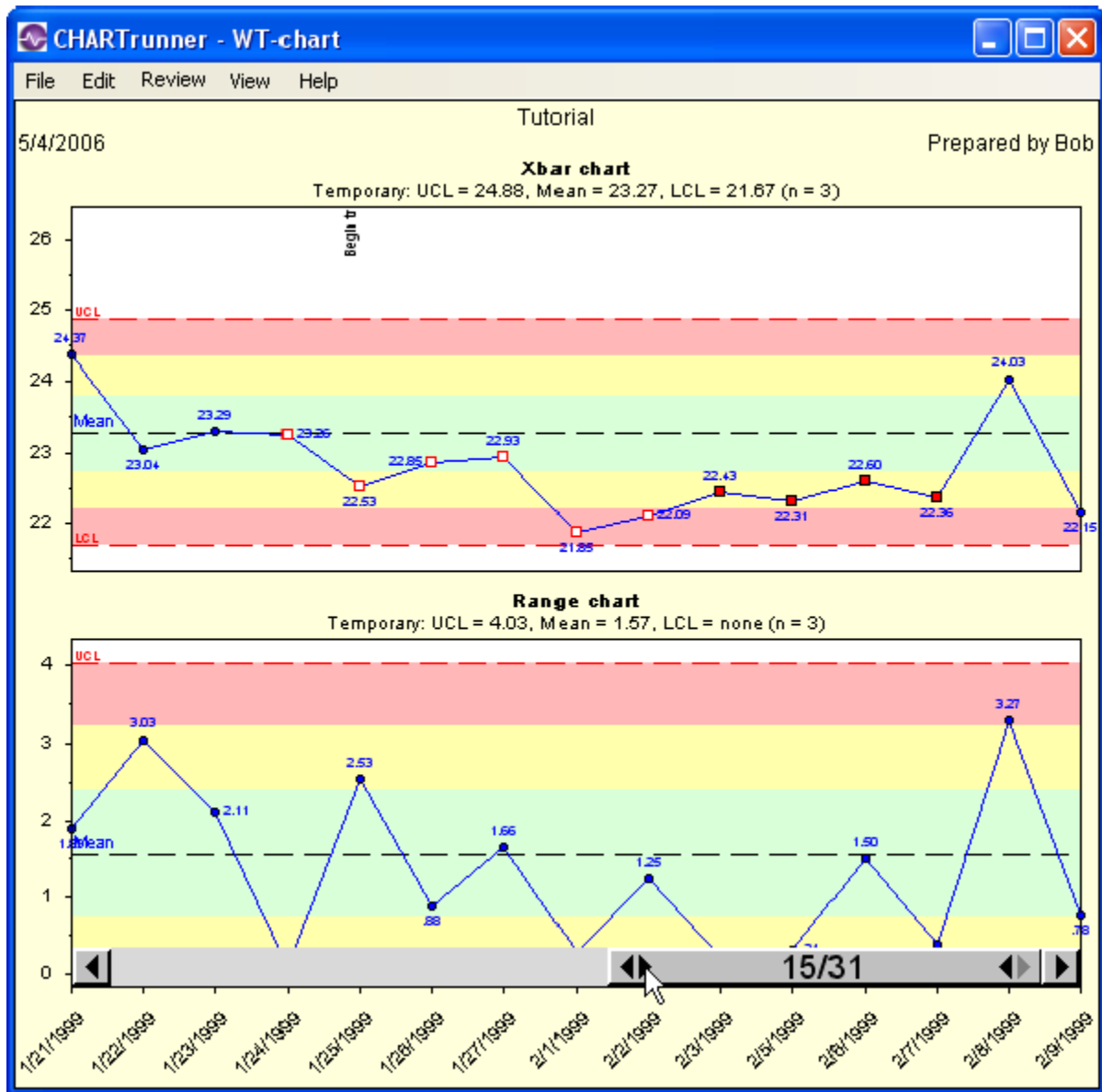
1. In the CHARTrunner definitions list, right-click on the chart named WT-chart.

2. Select Display from the pop-up menu. The chart will be displayed in a window similar to that shown below.



## To scroll through the data

Move the cursor to the bottom of the chart and pause. The horizontal scroll bar will appear above the x-axis as illustrated below. If not, verify that Enable horizontal x-axis scrolling is selected on the X-axis Y-axis sub-tab of the Control chart tab.



Click on the scroll bar arrows to scroll the chart right or left across the chart's data. In the example shown above the scroll bar has been used to reduce the number of subgroups being displayed on the chart from 31 subgroups to 15 subgroups.

## To close the chart display

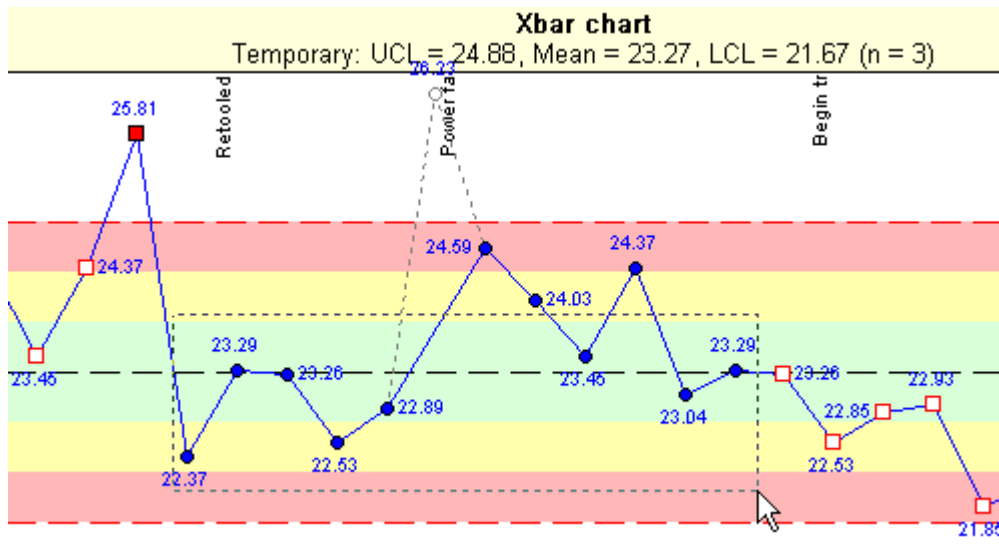
Click on the X in the upper right corner of the chart window or select File > Close on the menu or press Alt+F4.

## Editing the chart definition or style

Right-click on the control chart and select Edit chart definition or Edit chart style. Make the desired changes and click on the OK button. Note that when you close the chart display window, you will be asked if you want to save any changes that were made to the definition while the chart was displayed.

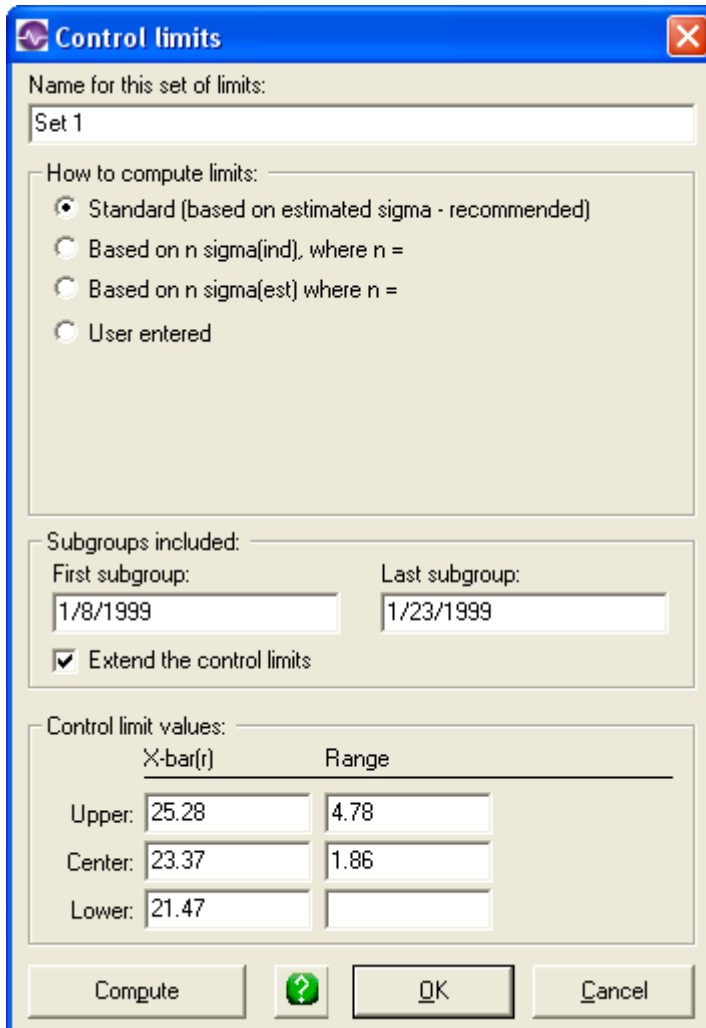
## Create a set of control limits on the chart

1. Click on or near a data point and, holding the mouse button down, drag the mouse pointer to select about 10 data points as illustrated below. The dotted selection rectangle shows you which data points are currently selected. The mouse pointer must stay within the boundaries of the chart.



Release the mouse button when the desired data points have been selected and the selected data points will be highlighted.

2. Right-click on the selected area. From the pop-up menu, select Compute limits. The Control limits form will open, as illustrated below.



The image shows a 'Control limits' dialog box with a blue title bar and a close button. It contains several sections for configuring control limits.

**Name for this set of limits:**  
Set 1

**How to compute limits:**

- ☒ Standard (based on estimated sigma - recommended)
- ☐ Based on n sigma(ind), where n =
- ☐ Based on n sigma(est) where n =
- ☐ User entered

**Subgroups included:**

First subgroup: 1/8/1999      Last subgroup: 1/23/1999

☒ Extend the control limits

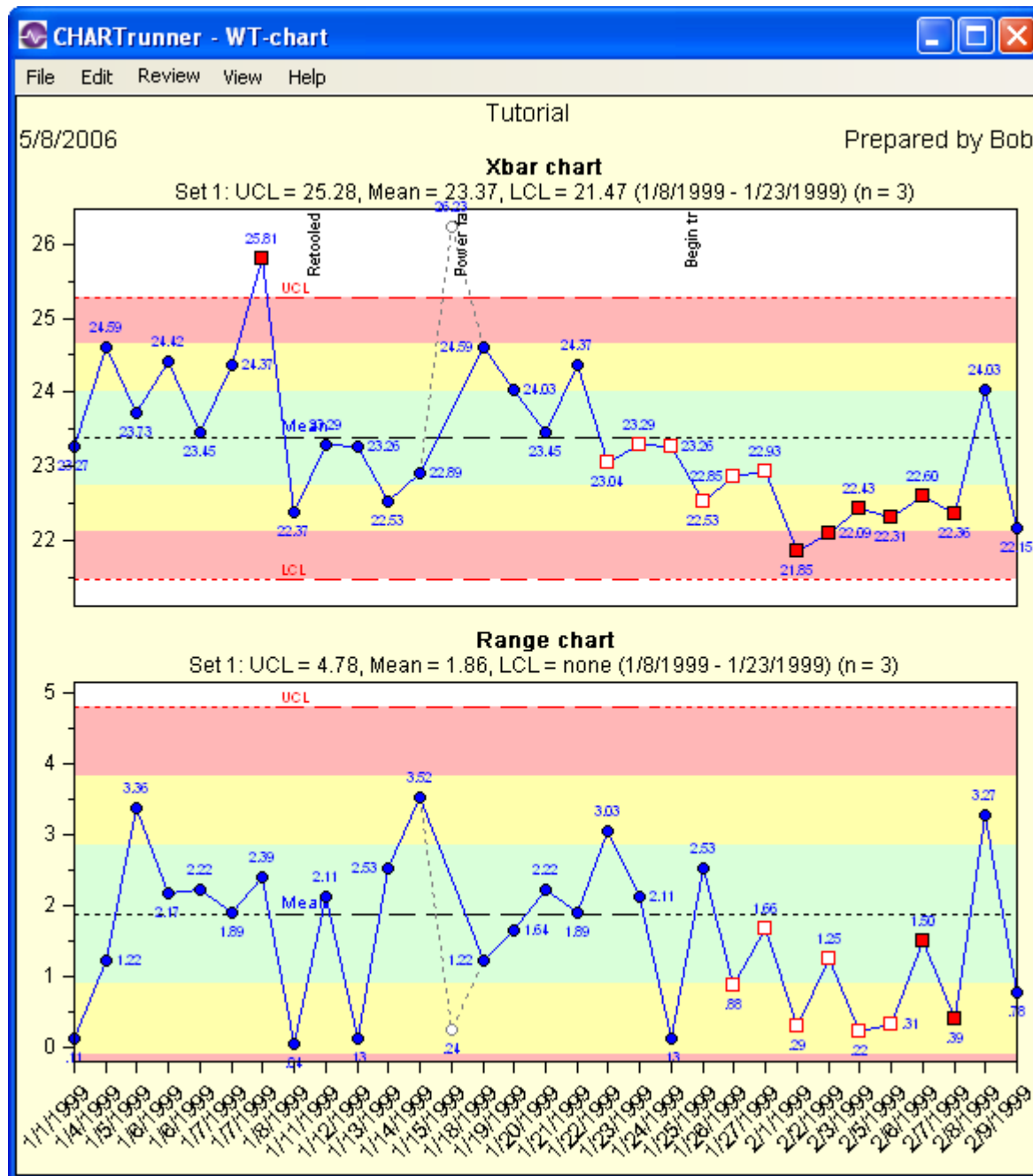
**Control limit values:**

	X-bar(r)	Range
Upper:	25.28	4.78
Center:	23.37	1.86
Lower:	21.47	

Buttons at the bottom: Compute, ? (help), OK, Cancel



Each set of limits has a name; the default for this set is "Set 1." You can assign a different name if you like. The Standard method for computing limits is recommended. Click on the OK button to save this set of limits. The chart now shows the "Set 1" limits that you created, as illustrated below.



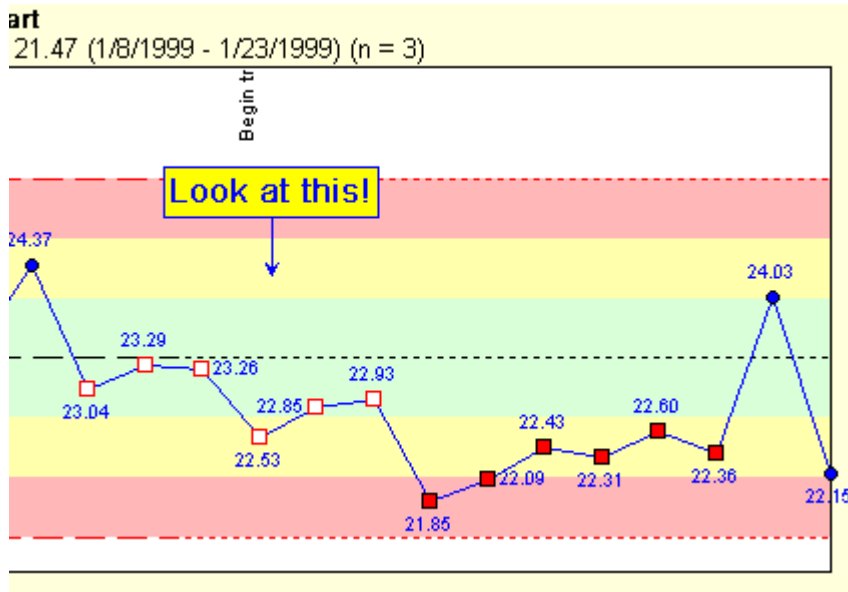
## To add an annotation to the chart

1. Right-click on the chart display window at the place where you want the annotation to appear and select Add annotation from the pop-up menu. The chart annotation form will open, as illustrated below.

2. Type "Look at this!" in the Annotation text field.
3. Set the options for Line, Text, Box, and Annotation Position as desired for the annotation. There are many options to choose from, so experiment to become familiar with how each option affects the annotation. As you change an option on the Annotation Editor, the annotation displayed on the chart updates to reflect the change. You may need to reposition the annotation form by left-clicking and dragging the title bar of the Annotation Editor, so that you can see how the parameter changes affect the annotation.

The Connect X to the data option attaches the annotation to the x-axis position of the data point so that as the data point moves across the chart so does the annotation. In order to use this feature, one of the data source columns must be "treated as" the Unique Identifier on the Step 3: Data definition tab.

- Click the OK button to save your changes. The new annotation will be displayed on the chart, as illustrated below.



## Lesson 4 - using the CHARTrunner-XL Excel add-in

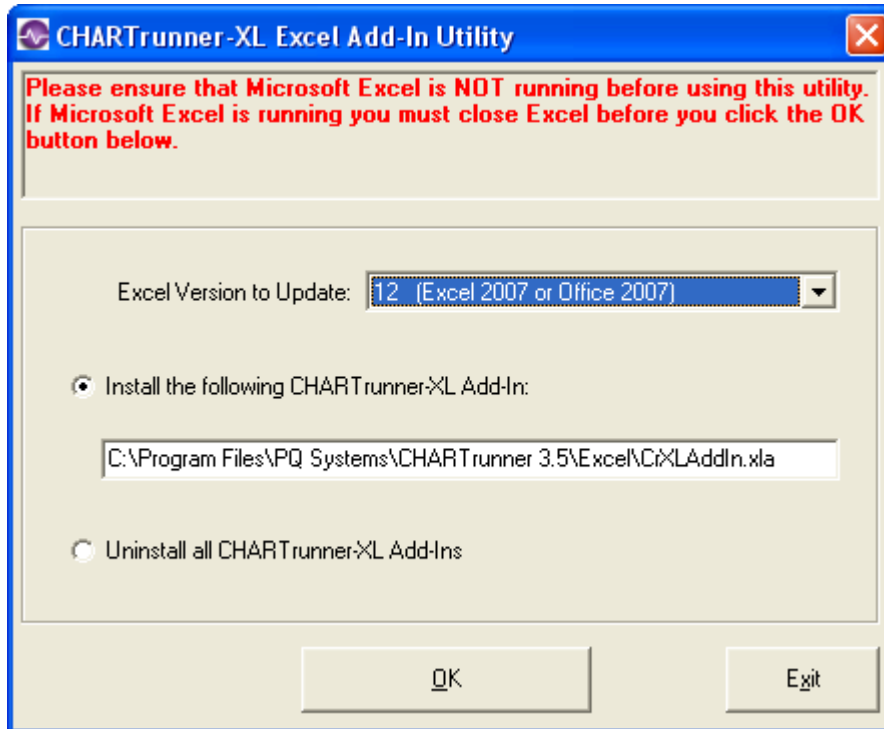
CHARTrunner-XL is an Add-In for Microsoft Excel 2000 (or higher) that allows you to use CHARTrunner within Excel to define, display, and manage CHARTrunner charts using the data in the Excel workbook. When you use the CHARTrunner-XL Add-In, your chart definitions are stored in the Excel workbook along with the Excel data, so that you do not need to leave Excel to display CHARTrunner charts. In addition, the CHARTrunner-XL Add-In allows you to chart data that is arranged "horizontally" (subgroups that are stored in columns rather than rows), a feature that is not supported in the stand-alone version of CHARTrunner.

### Activate the Excel Add-In

The CHARTrunner-XL Add-In is installed when you install CHARTrunner. However, in order to use the Add-In within Excel, you must activate the Add-In as described below. There are two ways to activate the CHARTrunner-XL Add-In:

- Activating via the CHARTrunner Excel Add-In Utility.

- Both CHARTrunner and Microsoft Excel must be installed and not currently running. Open the Start Menu and select CHARTrunner 3.5 | CHARTrunner Excel Add-In Utility. The utility will open, as illustrated below.



- If you have multiple versions of Excel, select the Excel version you want to update.
- Select the Install the following CHARTrunner-XL Add-In option (as shown above) and click the OK button.
- You should not need to run this utility again unless you want to change the activation status of the Add-In.

2. Activating through the Excel Add-In option:

- Start Excel.
- Open the Tools Menu and select Add-Ins. If this option is grayed out, click on the New file icon and try again.

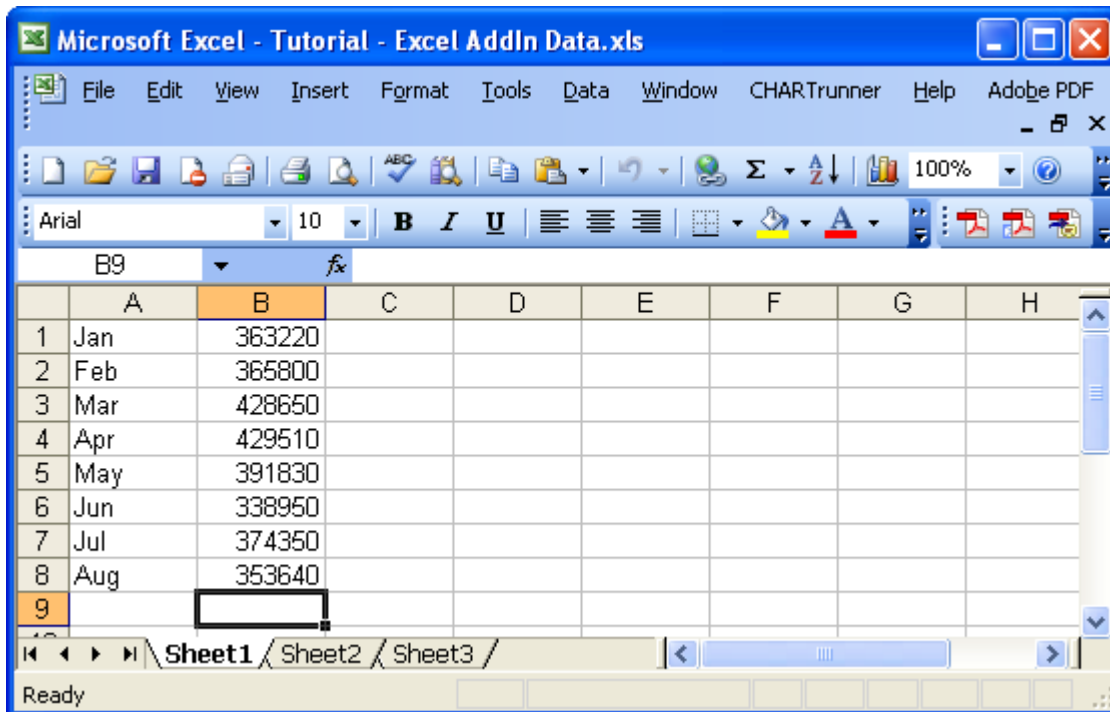
In the Add-Ins available column, select CHARTrunner Excel Add-In. If this is not listed, click on the Browse button. The Add-In file will be in the CHARTrunner directory. The default location is "C:\Program Files\PQ Systems\CHARTrunner 3.5\Excel." Select CrXLAddIn.xla and click the OK button to close the Browse form.

- Click the OK button to close the Add-In form.

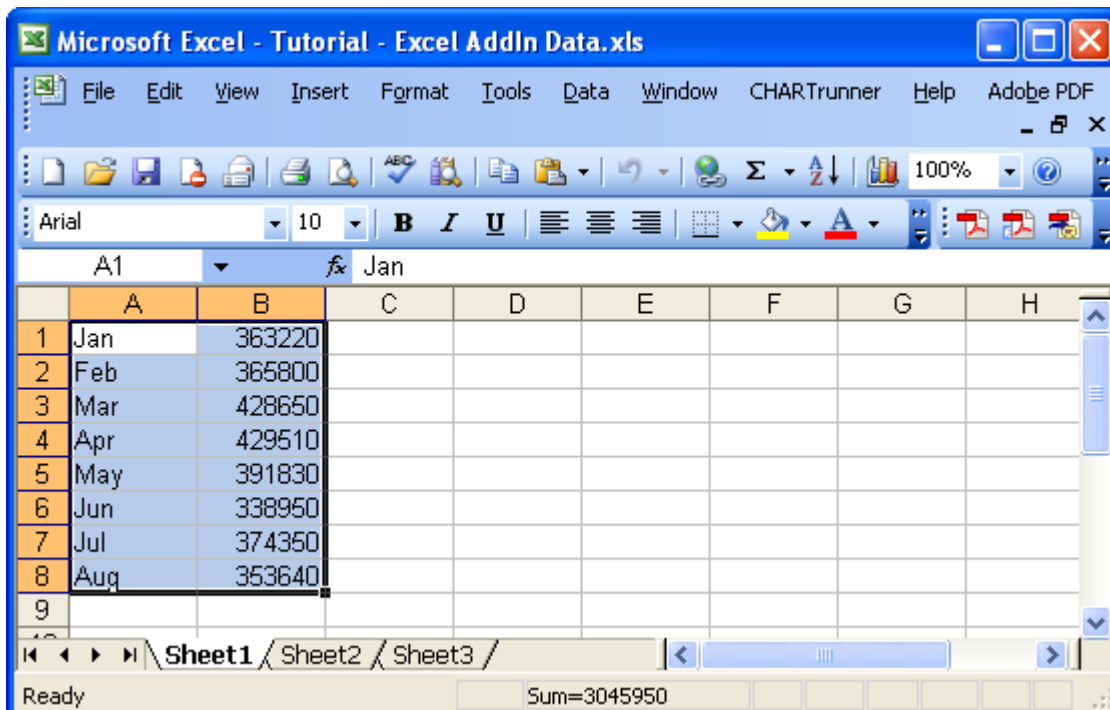
## Creating a chart in Excel

- Open a new Excel worksheet.

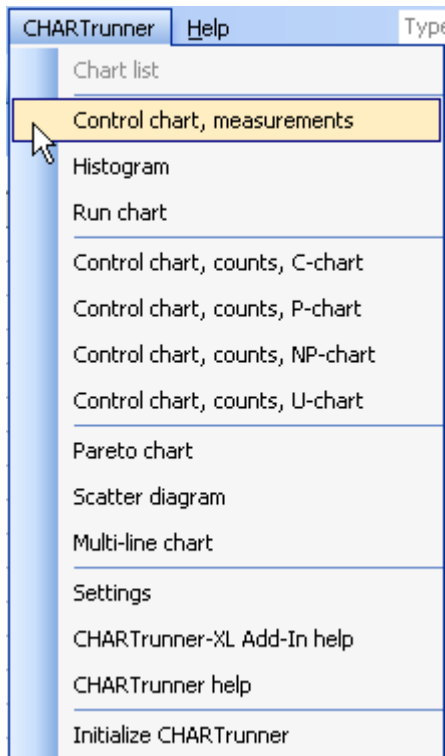
2. Enter 5 to 10 rows of numbers, as shown below.



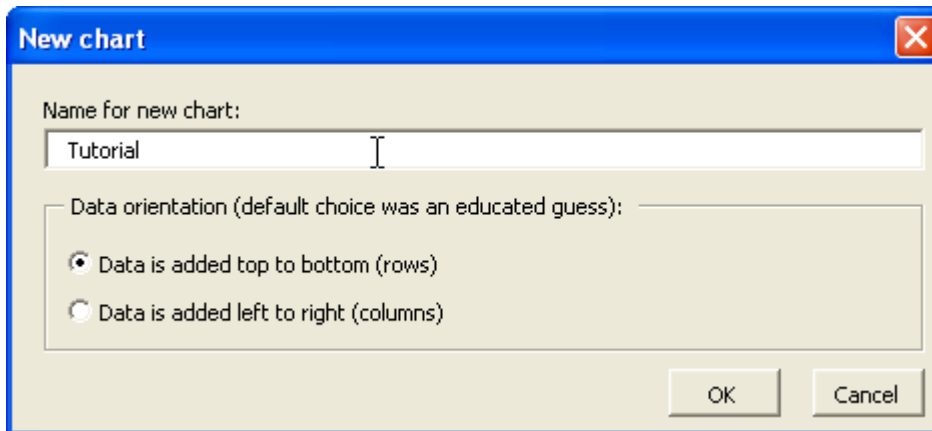
3. Highlight the data that you entered by clicking on the first cell and dragging to the last cell that contains data.



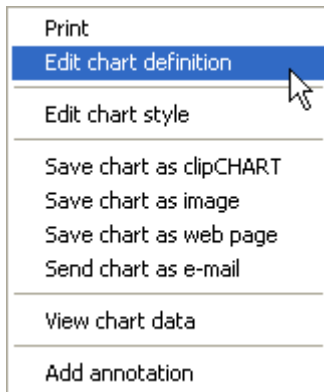
4. With this data highlighted, open the CHARTrunner menu and select Control chart, measurements.



5. Enter Tutorial as the chart name. Set the data orientation to Data is added top to bottom (rows). Click the OK button.



6. A simple control chart will open in a new window. To edit the chart, right-click on the chart and select Edit chart definition from the pop-up menu.



7. Click on the Control chart tab, then click on the X-axis Y- axis sub-tab. In the Label x-axis with field, select Field1 from the drop-down menu. Then click the OK button.
8. Close the chart window.

## To learn more about CHARTrunner and CHARTrunner-XL

The CHARTrunner video tour is available on the software CD. To run the video, double-click on CHARTrunner.avi.exe file in the Video folder.

A video illustrating CHARTrunner-XL features is available on the software CD. To run the video, double-click on CHARTrunner-XL.avi.exe file in the Video folder.

These videos, along with other CHARTrunner tutorials, can be viewed online at <http://www.pqsystems.com/ProductInfo.php> (<http://www.pqsystems.com/ProductInfo.php>).





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## CHAPTER 5

# Data and chart types

CHARTrunner provides tools for analyzing variables, attributes, Pareto, and other types of data. The following topics examine key data types and analytical tools, so that you can select the best one for your data. Note, however, that the topics do not describe all possible applications of CHARTrunner's charts.

## In This Chapter

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## Variables data

### What is variables data?

Variables data is data that is collected through measurements, such as length, time, diameter, strength, weight, temperature, density, thickness, or height. Variables data offers the advantage of choice in the degree of accuracy required. For example, you can measure an item to the nearest centimeter, millimeter, or micron.

### What Charts Are Used for Analyzing Variables Data?

CHARTrunner offers control charts, histograms, multi-line charts, scatter diagrams, and run charts for analyzing variables data. Use variables control charts to determine if a process is predictable or to see how changes affect the process. Use histograms to analyze the distribution of data from a stable process. Use histograms with capability analysis to determine the capability and/or performance of the system. Use run charts for a quick look at a system's direction or when you do not have enough data for conventional control chart analysis.

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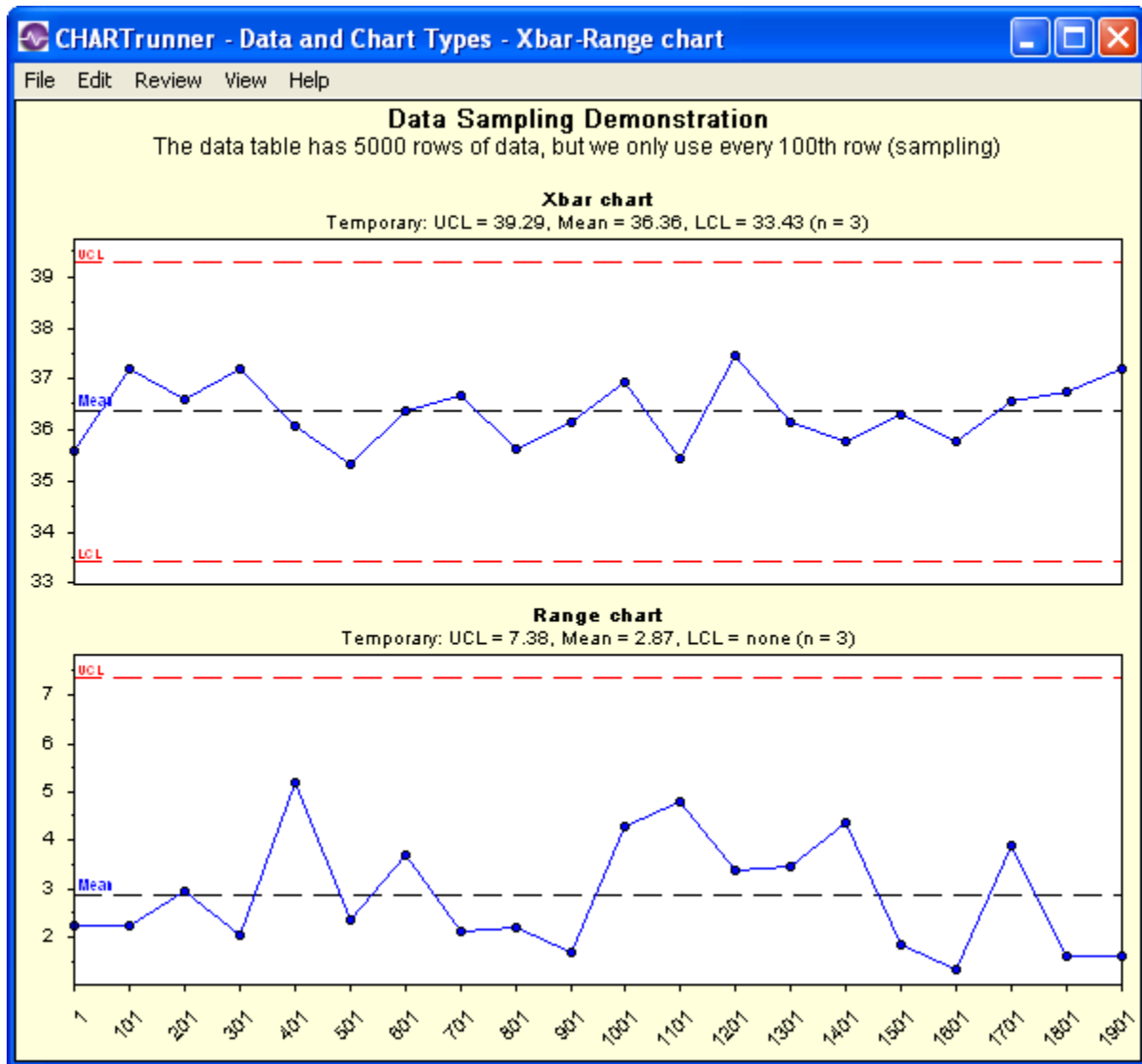
## Measurement control charts

Variables data is usually analyzed in pairs of charts that present data in terms of location or central tendency and spread. Location, usually the top chart, shows data in relation to the process average. It is presented in X-bar or individuals charts. Spread, usually reflected in the bottom chart, looks at piece-by-piece variation. Range (R), sigma (S), or moving range charts are used to illustrate process spread. Because the median chart shows each observation, it illustrates both process spread and location. Another aspect of these variables control charts is that the subgroup size is typically constant.

## X-bar and range

X-bar and range (R) charts create a picture of a process over time. This chart pair is used with data that has a subgroup size of two or more. The X-bar chart, on top, illustrates variation between subgroups. Each data point on the X-bar chart shows the average of each subgroup of data.

The range chart, on the bottom, illustrates variation within a subgroup. Data points on the range chart show the range for each subgroup.



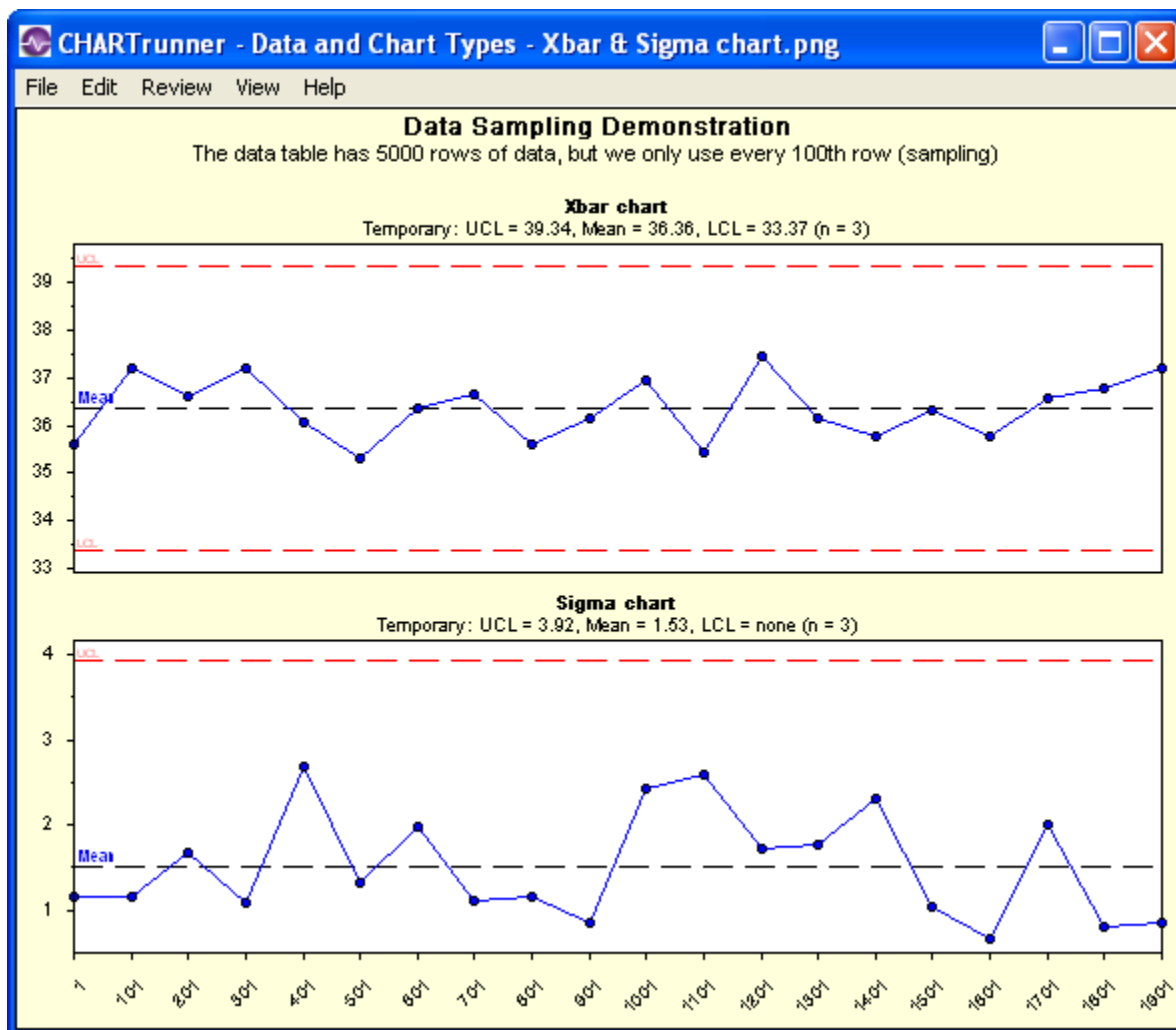
When do you use X-bar and R charts?

Use X-bar and R charts:

- When you want to see if your process is stable and predictable
- When you want to see how planned change affects the process
- When the time order of the subgroups is preserved
- When you have collected data in subgroups larger than one.

## X-bar and sigma

The X-bar and sigma (S) chart is a variation of the X-bar and range (R) chart. Again, the X-bar chart (top) shows the average or mean of each subgroup of data. Instead of range, however, the lower chart shows the standard deviation of each subgroup. This chart combination is generally used when the subgroup size is large, for example, eleven or more observations per subgroup.



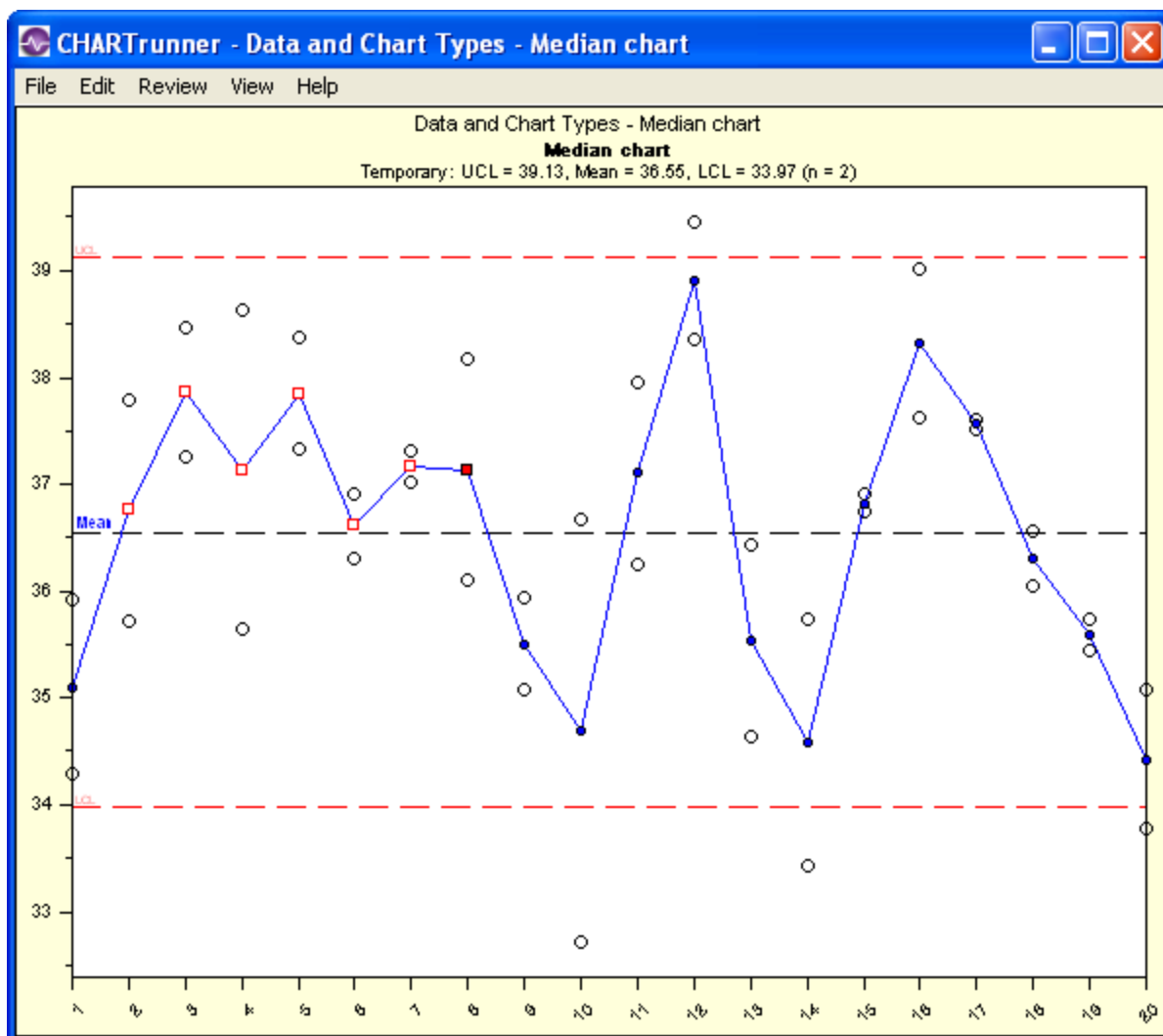
When do you Use X-bar and S charts?

Use X-bar and S charts:

- When you want to see if your process is stable and predictable
- When you want to see how planned change affects the process
- When the time order of the subgroups is preserved
- When you have collected data with a subgroup size of eleven or more.

## Median

A median chart is a special purpose variation of the X-bar chart. It uses the median or middle value of a subgroup to show the system's central location. It shows all the individual observations of each subgroup.



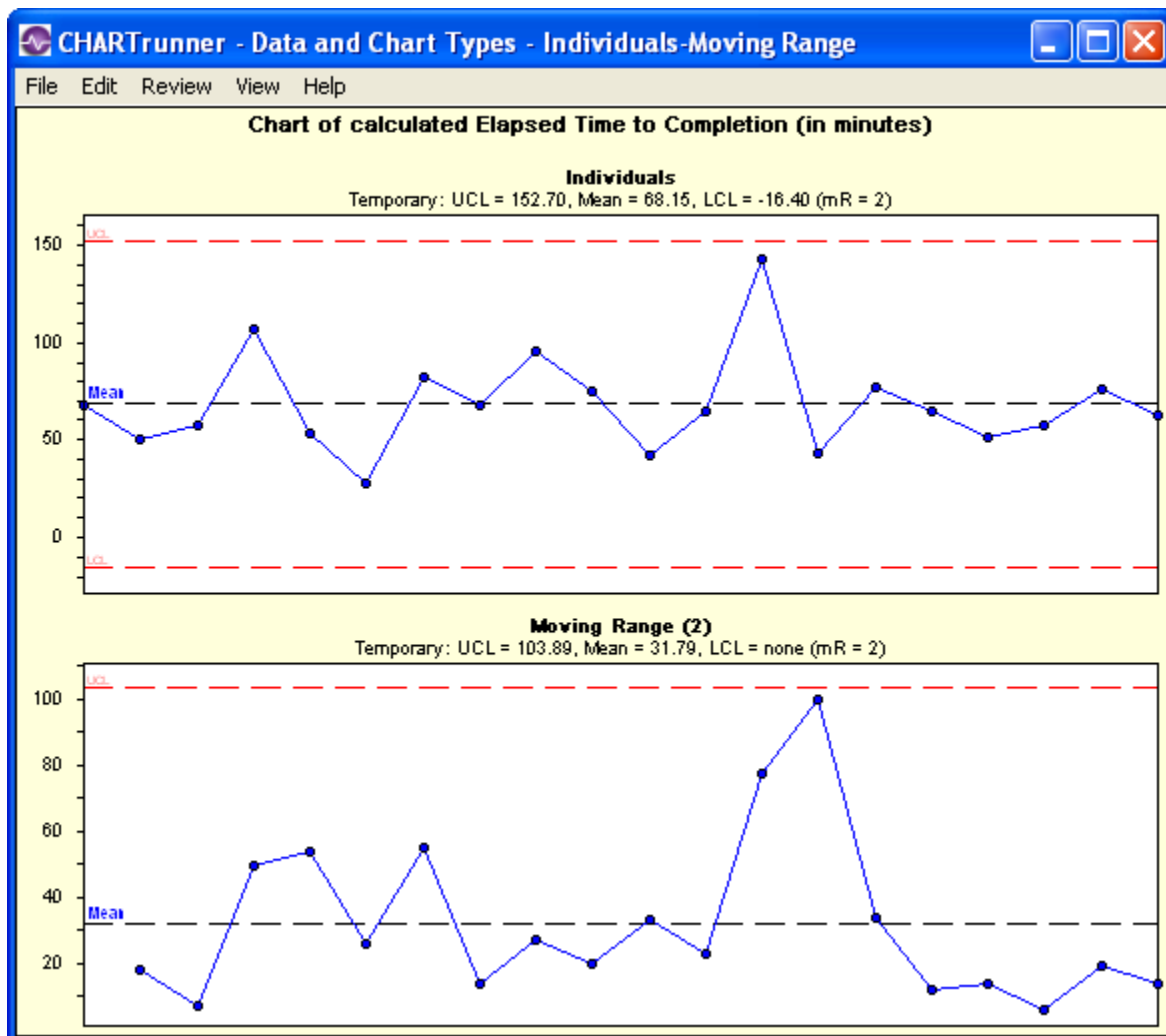
When do you use median charts?

Use median charts:

- When you want to see if a process is stable and predictable
- When you want to see how planned change affects the process
- When the time order of the subgroups is preserved
- When you want to see all the individual data points on the chart
- When you have collected data in subgroups larger than one.

## Individuals and moving range

Individuals (X) and moving range (MR) chart combination is a variation of the X-bar and R chart. It is used with subgroups containing one observation. The X chart, on top, shows individual data values. The MR chart, on the bottom, creates ranges by finding the difference between consecutive data values. It uses absolute values, thus avoiding negative moving range values.



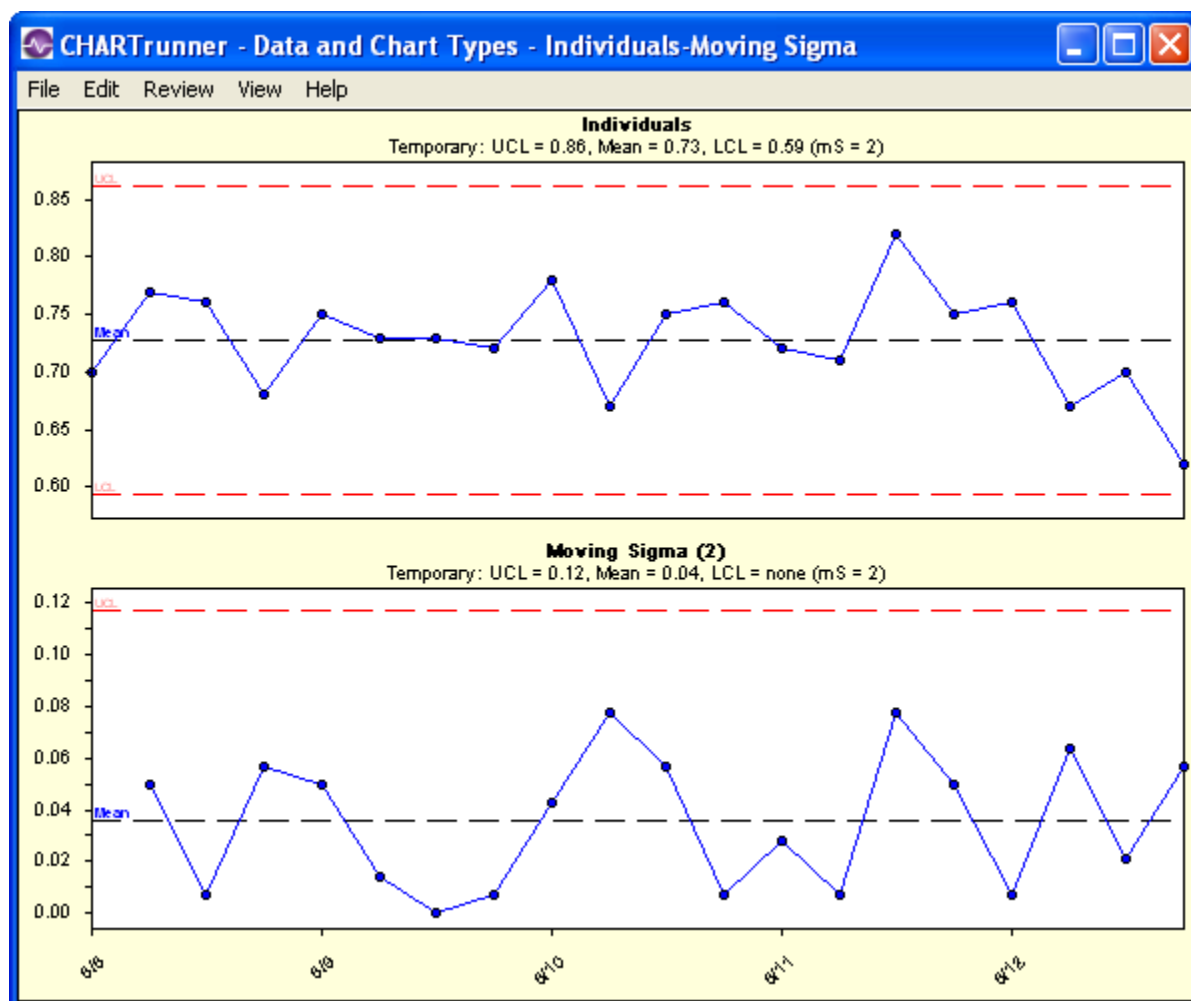
When do you use individuals and moving range charts?

Use individuals and moving range charts:

- When you want to see if your process is stable and predictable
- When you want to see how planned change affects the process
- When the time order of the subgroups is preserved
- When you have collected data in subgroups of one.

## Individuals and moving sigma

Individuals (X) and moving sigma (MS) chart combination is a variation of the X-bar and sigma chart. It is used with subgroups containing one observation. The individuals chart, on top, shows individual data points. The MS chart, on the bottom, creates sigma by calculating the standard deviation between consecutive data values.



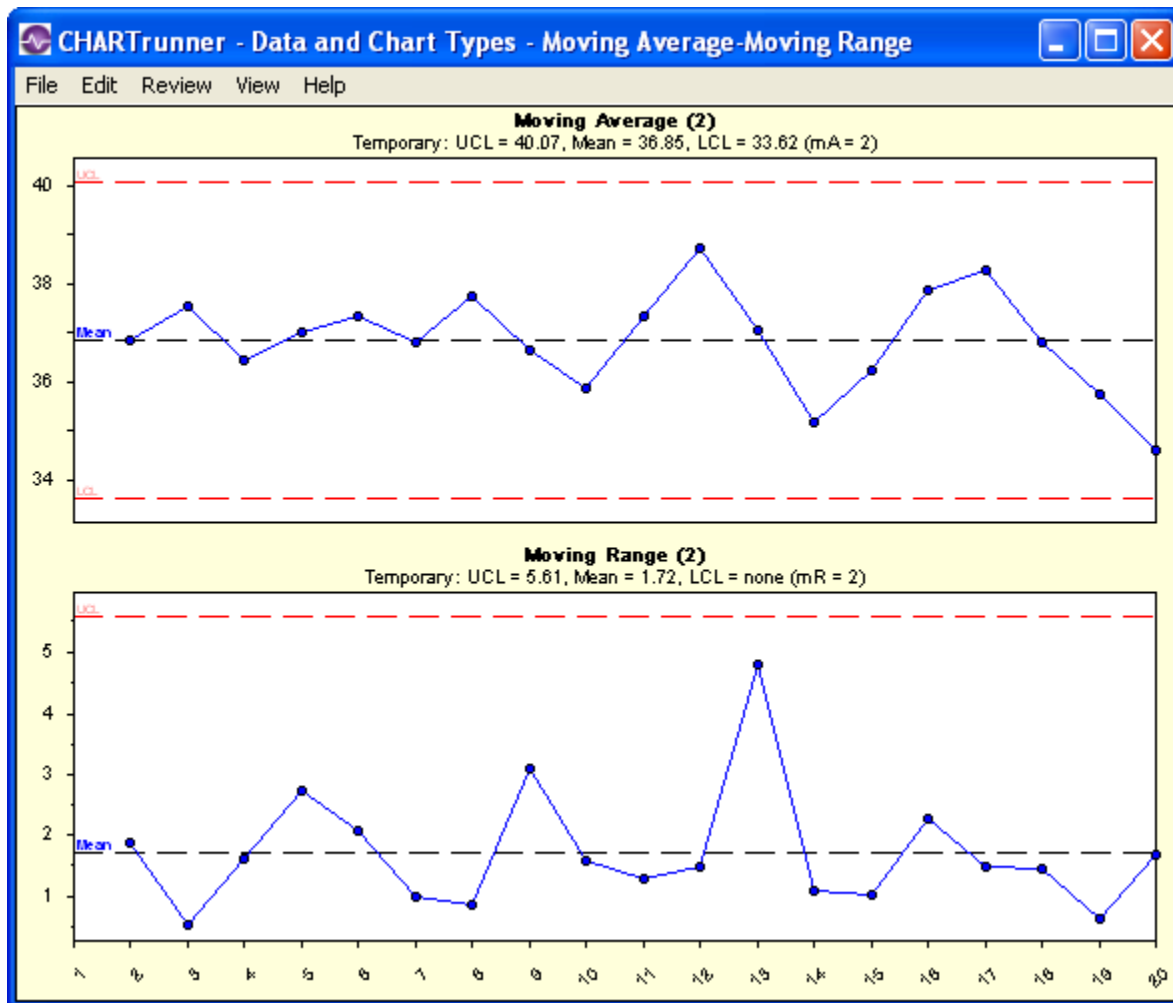
When do you use individuals and moving sigma charts?

Use individuals and moving sigma charts:

- When you want to see if your process is stable and predictable
- When you want to see how planned change affects the process
- When the time order of the subgroups is preserved
- When you have collected data in subgroups of one.

## Moving average and moving range

Moving average is a smoothing technique for time series data that averages out the short-term fluctuations in the system and concentrates on long-term trends. Moving averages work much the same as moving ranges work on the individual and moving range chart. These charts are used with subgroups containing one observation, but, instead of plotting the individual values, you plot an average of two or more observations. This hides minor (yet frequent) variation between individual readings and shows how the system is running over time.





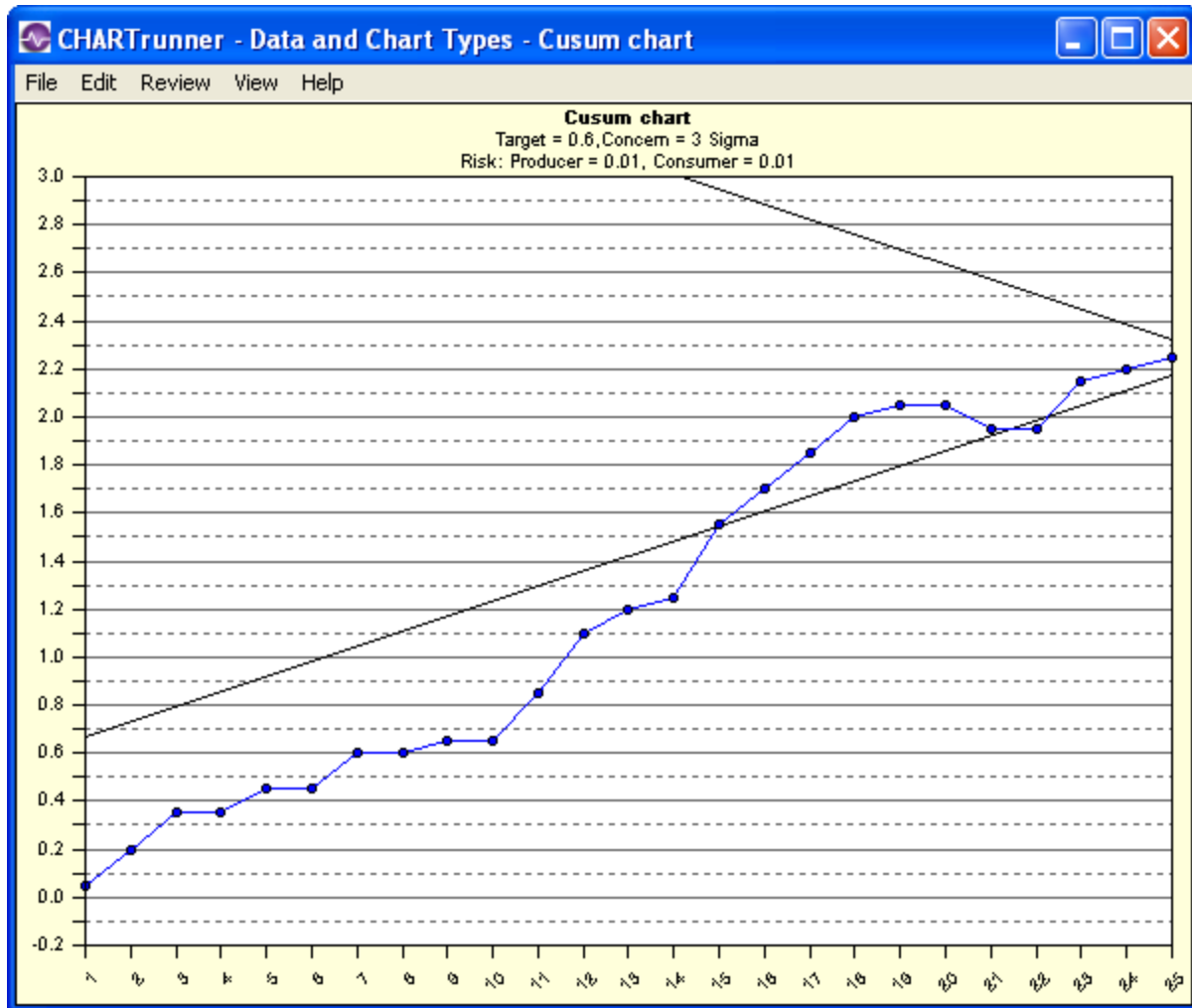
When do you use moving average and moving range charts?

Use moving average and moving range charts:

- When you want to see if your process is stable and predictable
- When you want to see how planned change affects the process
- When the time order of the subgroups is preserved
- When you have collected data in subgroups of one
- When the process changes slowly relative to how often samples are collected
- When the individual data values are subject to considerable variation.

## Cusum

Cusum is an advanced analysis that uses current and historical data to detect small shifts in the process average. Cusum stands for cumulative sum of deviations from the target and treats past and present data equally. Studying cumulative sums rather than subgroup averages emphasizes ongoing changes in the process mean.



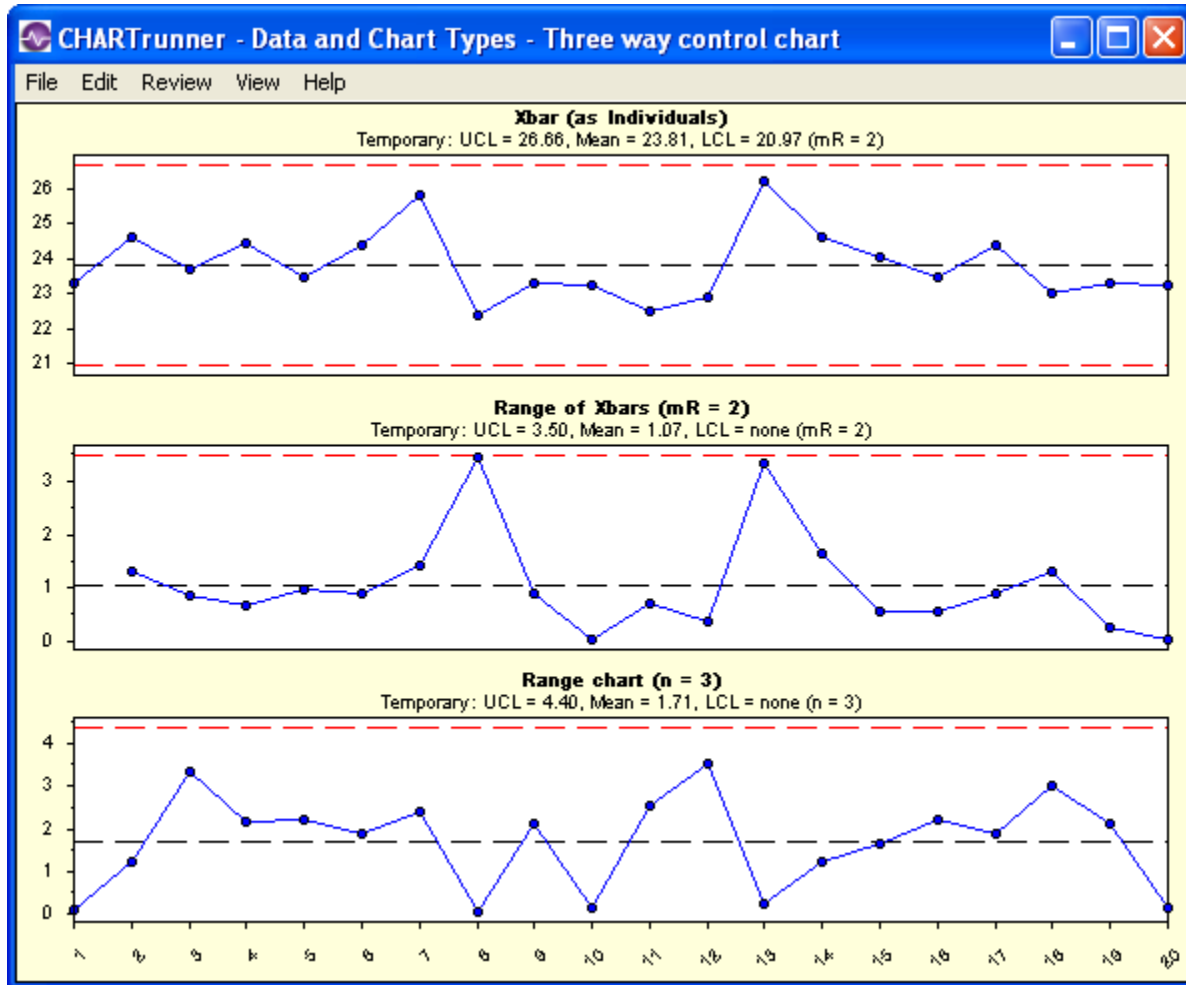
When do you use a cusum chart?

Use a cusum chart:

- When you want to see if your process is stable and predictable
- When even a slight variation can result in waste and product deficiency
- When you want to see how a planned change affects the process
- When the time order is preserved.

## Three-way control

The three-way control chart estimates the process standard deviation using a moving range of subgroup averages. As shown below, a three-way control chart consists of a chart of subgroup means ( $\bar{X}$ ), a moving range chart of the subgroup means (Range of  $\bar{X}$ ), and a chart of subgroup ranges (Range chart).



When do you use three-way control charts?

Use three-way control charts:

- When you want to see if your process is stable and predictable
- When you want to see how planned change affects the process
- When the time order of the subgroups is preserved
- When you have collected data in subgroups larger than one
- When each data subgroup you collect is almost identical to the previous subgroup. This is known as auto-correlated data.

# Attributes data

## What is Attributes Data?

Attributes data is data that can be classified and counted. There are two types of attributes data: nonconformities and nonconforming.

Nonconformities data refers to defects or occurrences that should not be present but are. It also refers to any characteristics that should be present but are not. Dents, scratches, bubbles, and missing buttons are examples of nonconformities.

Nonconforming data is a count of defective units. It is often described as go/no go, pass/fail, or yes/no, since there are only two possible outcomes to any given check. It also refers to a count of defectives or rejects. For example, a light bulb either works or it does not. You can track either the number failing or the number passing.

## What charts are used to analyze Attributes Data?

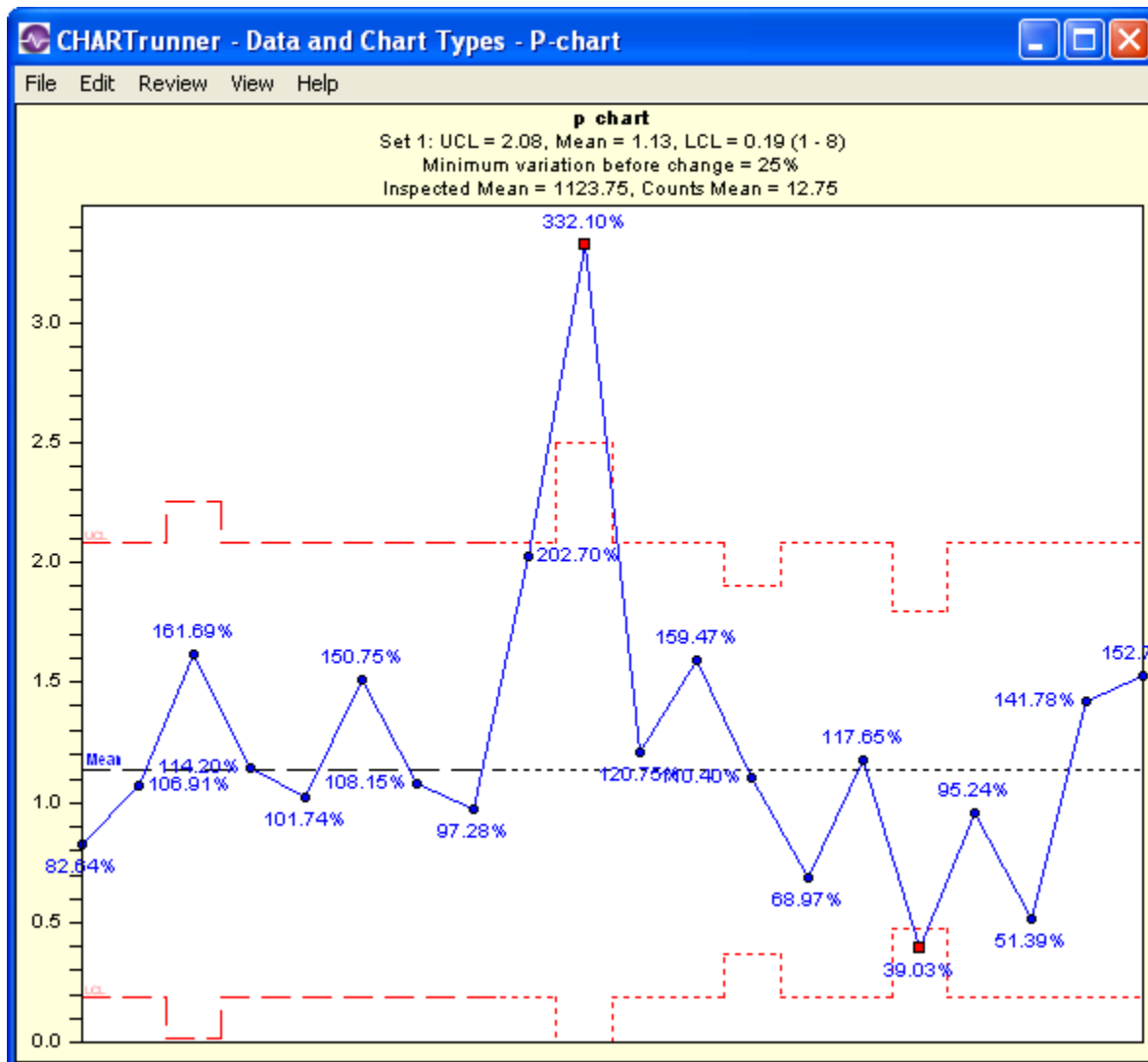
CHARTrunner offers two control charts for each type of attributes data. For nonconforming units, these are p-charts and np-charts. For nonconformities, these are u-charts and c-charts.

# Count (attributes) control charts

## p-chart

A p-chart shows how a process changes over time. However, instead of using the actual count of nonconforming units, p-charts use a proportion of the nonconforming items, since the subgroup size may vary. Subgroup sizes that vary more than 25 percent from the average subgroup size may require special handling of the control limits.

CHARTrunner can perform special calculations to adjust the control limits accordingly and then plot the proportions.



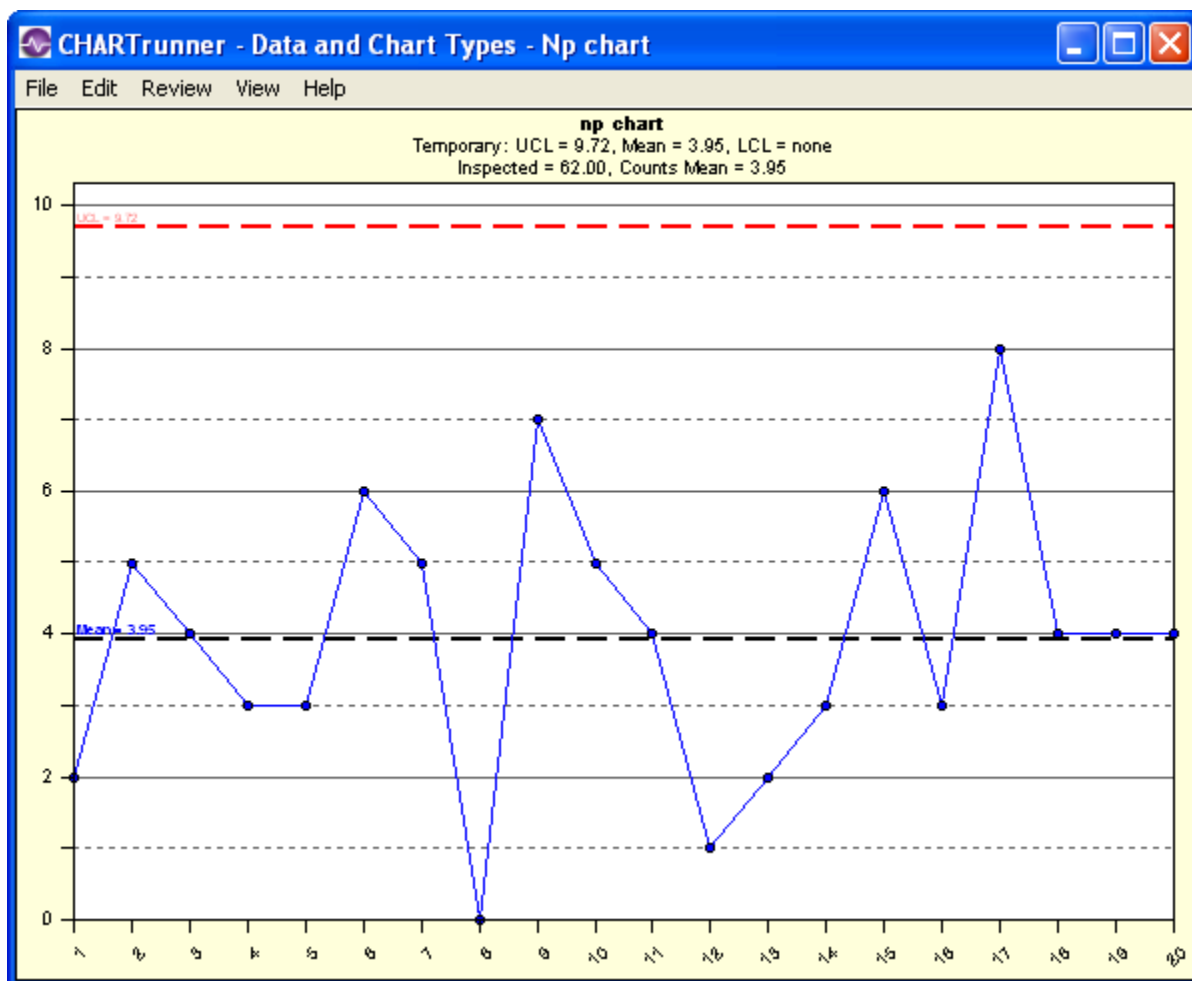
When do you use p-charts?

Use p-charts:

- When you want to see if your process is stable and predictable
- When you want to see how a planned change affects the process
- When you are counting nonconforming units
- When the time order of the subgroups is preserved
- When the subgroup size can vary.

## np-chart

An np-chart is an attributes control chart used with data collected in subgroups that are the same size. Np-charts show how the process, measured by the number of nonconforming items it produces, changes over time. The process attributes (or characteristic) is always described in a yes/no, pass/fail, or go/no go form. For example, the number of incomplete accident reports in a constant daily sample of five would be analyzed on an np-chart. Np-charts are used to determine if the process is stable and predictable, as well as to monitor the effects of process improvement theories.



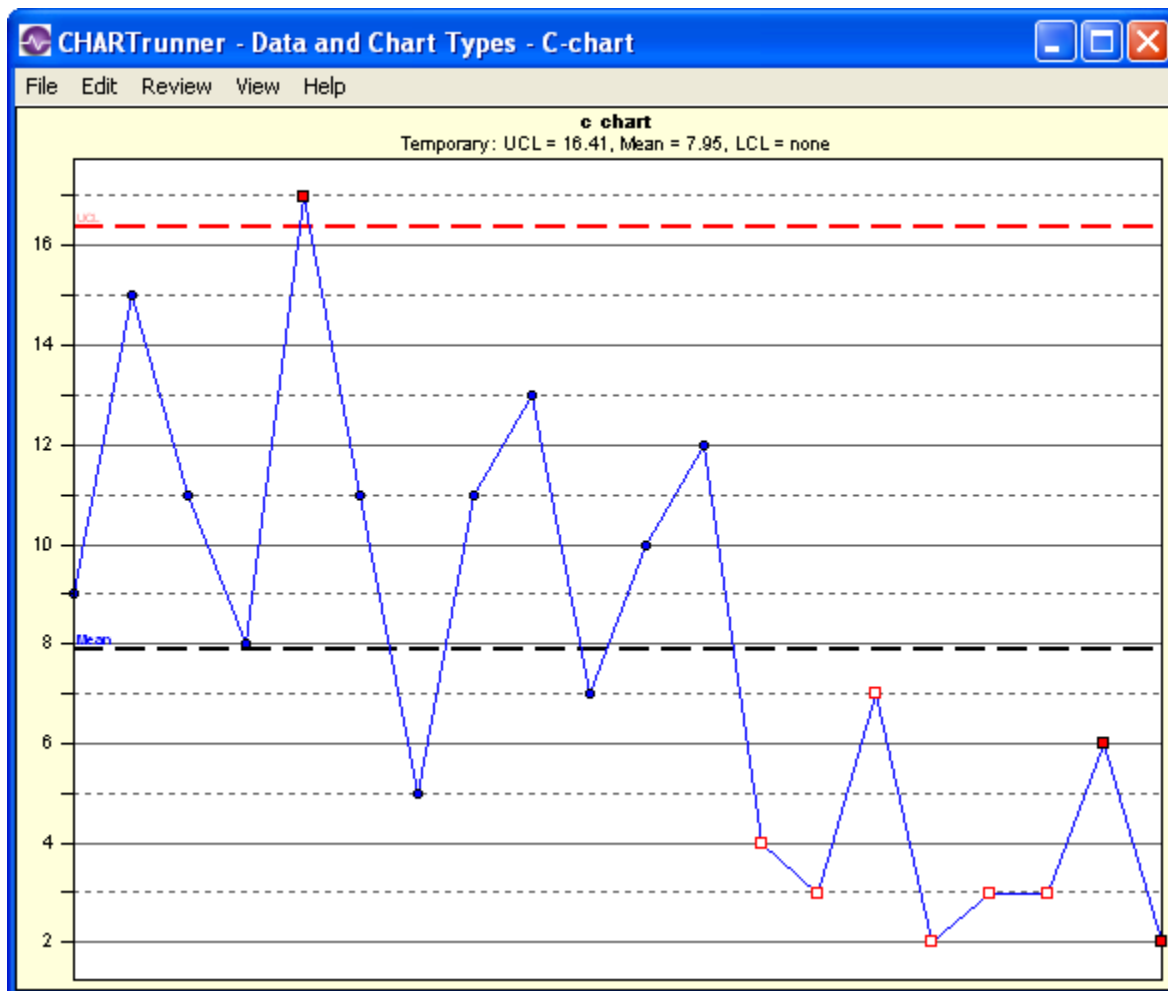
When do you use np-charts?

Use np-charts:

- When you want to see if your process is stable and predictable
- When you want to see how a planned change affects the process
- When you are counting nonconforming units
- When the time order of the subgroups is preserved
- When the subgroup size is constant.

## c-chart

C-charts show process changes over time by looking at the number of nonconformities the process produces. For c-charts, the subgroup size must be constant. C-charts show the actual number of nonconformities per subgroup.



When do you use c-charts?

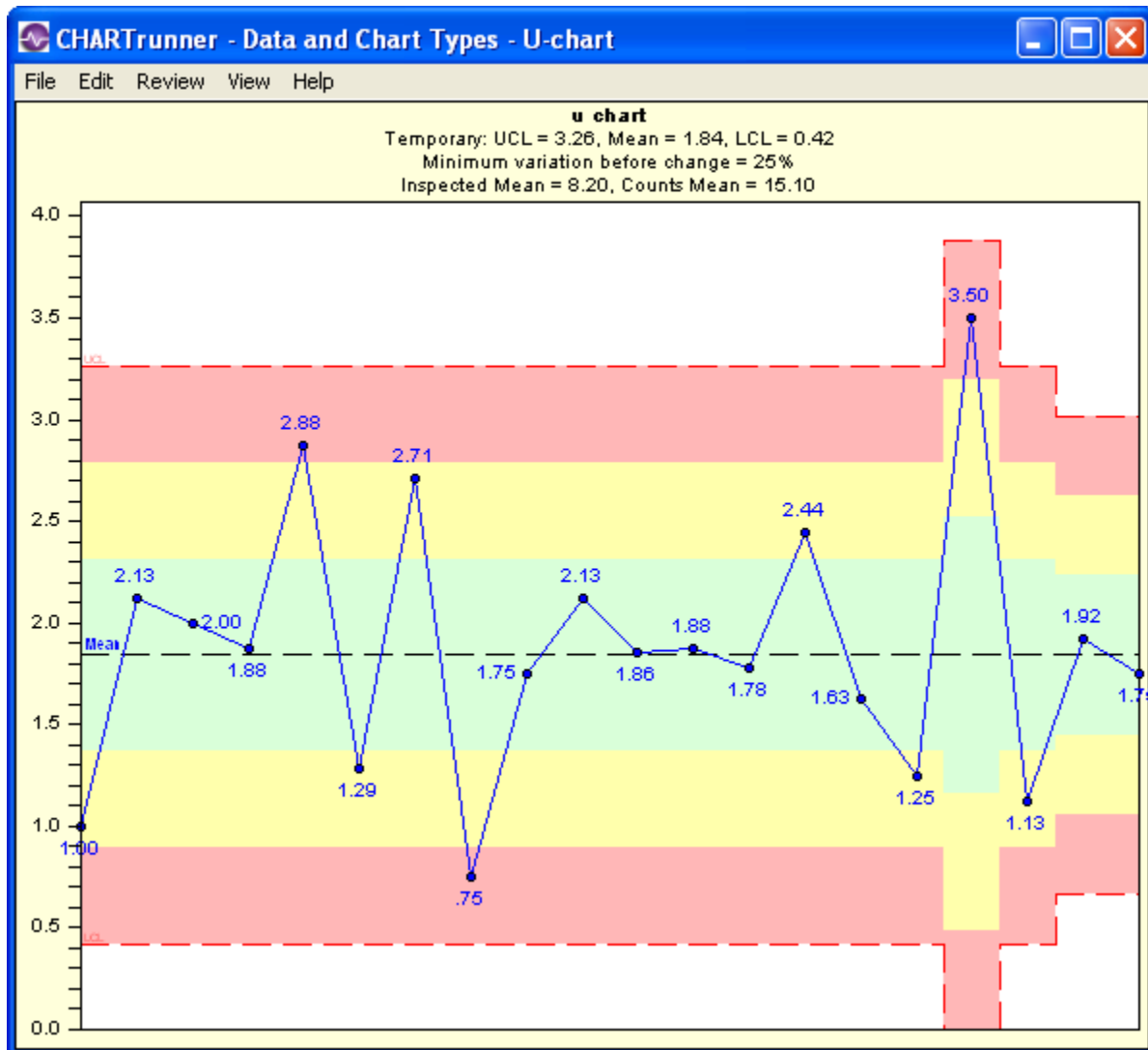
Use c-charts:

- When you want to see if your process is stable and predictable
- When you want to see how a planned change affects the process
- When the data is a count of nonconformities
- When the time order of the subgroups is preserved
- When the subgroup size is constant.



## u-chart

U-charts show process changes over time by looking at the number of nonconformities the process produces. The subgroup size can vary; therefore, u-charts show the number of nonconformities in proportion to the subgroup size. Subgroups that vary more than 25 percent from the average subgroup size may require special handling of the control limits. CHARTrunner can perform special calculations to adjust the control limits accordingly and then plot the proportions for you.



When do you use u-charts?

Use u-charts:

- When you want to see if a process is stable and predictable
- When you want to see how a planned change affects the process
- When the data is a count of nonconformities
- When the time order of the subgroups is preserved
- When the subgroup size can vary.

# Pareto data

## What is Pareto Data?

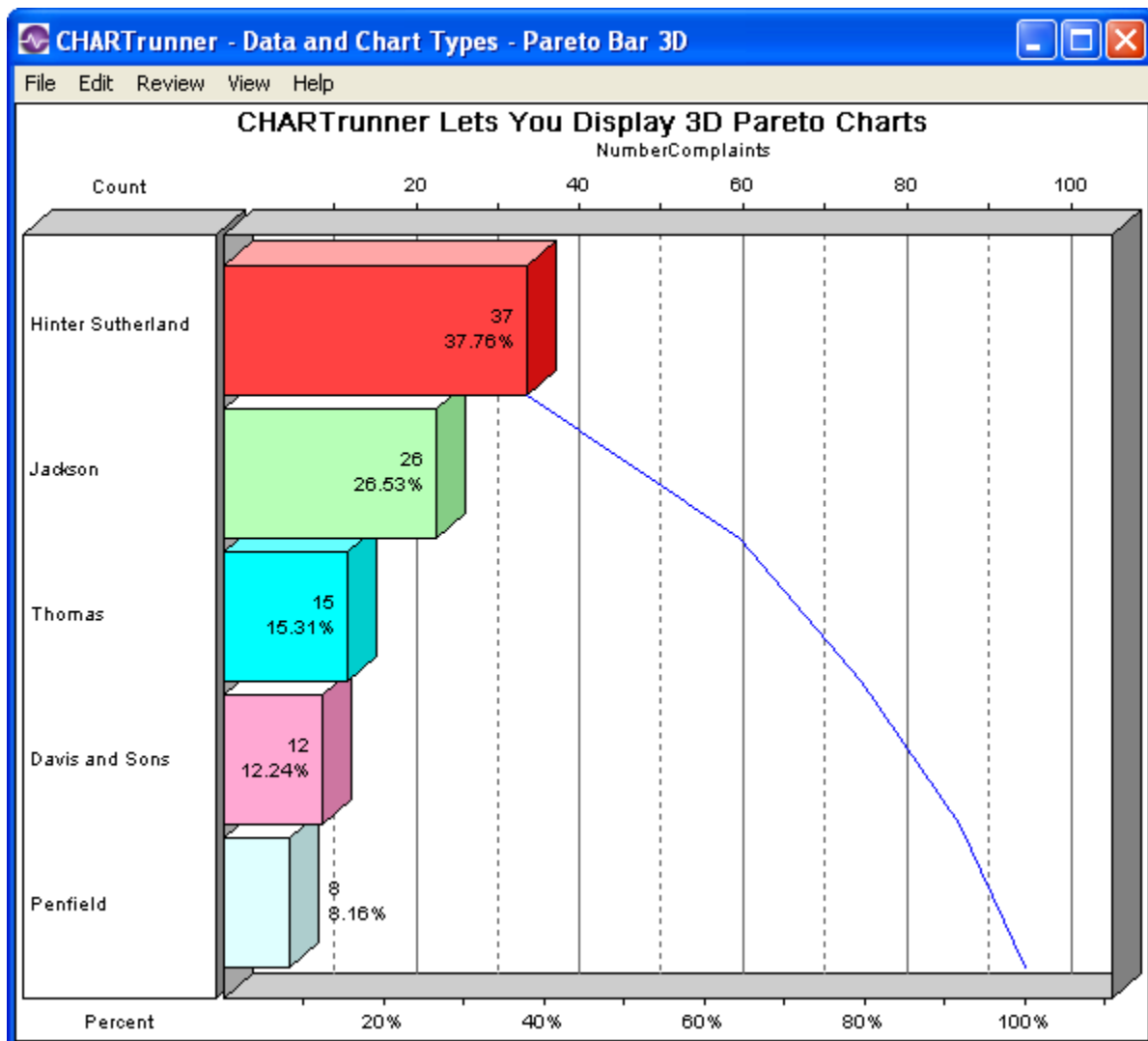
Pareto data counts items in various categories. It is used to rank the categories in decreasing order of occurrence. Based on the twentieth-century principle developed by Italian economist Vilfredo Pareto, it is the law of the significant few versus the trivial many. The significant few cause 80 percent of the problem(s), while the trivial many make up about 20 percent of problem(s).

## What Charts Are Used to Analyze Pareto Data?

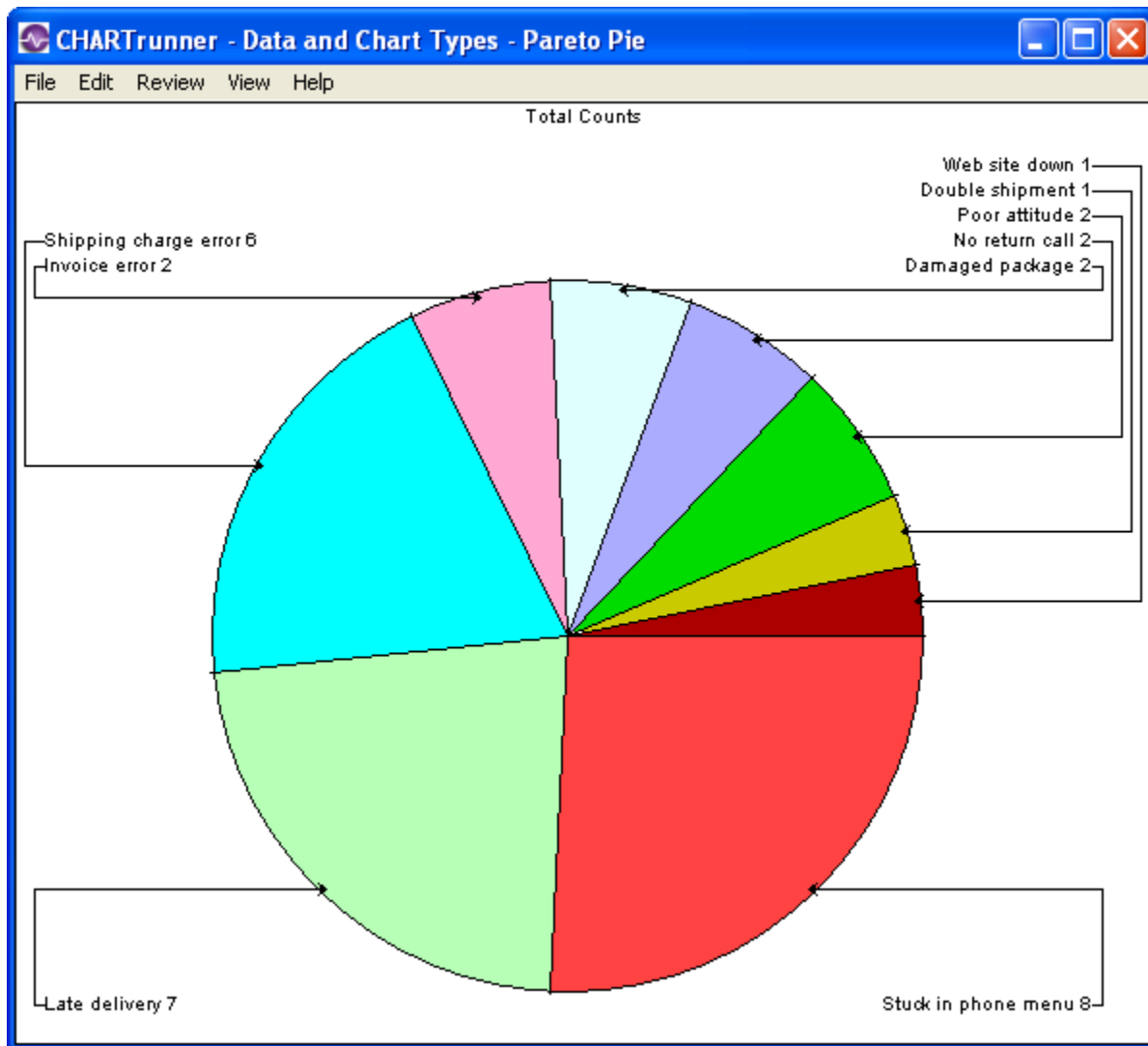
Pareto diagrams are used to analyze Pareto data. Usually a Pareto diagram is a simple bar chart. However, CHARTrunner also allows you to display count data in a pie chart.

# Pareto charts - category data

## Pareto - bar/column



## Pareto - pie



## When do you use pareto charts?

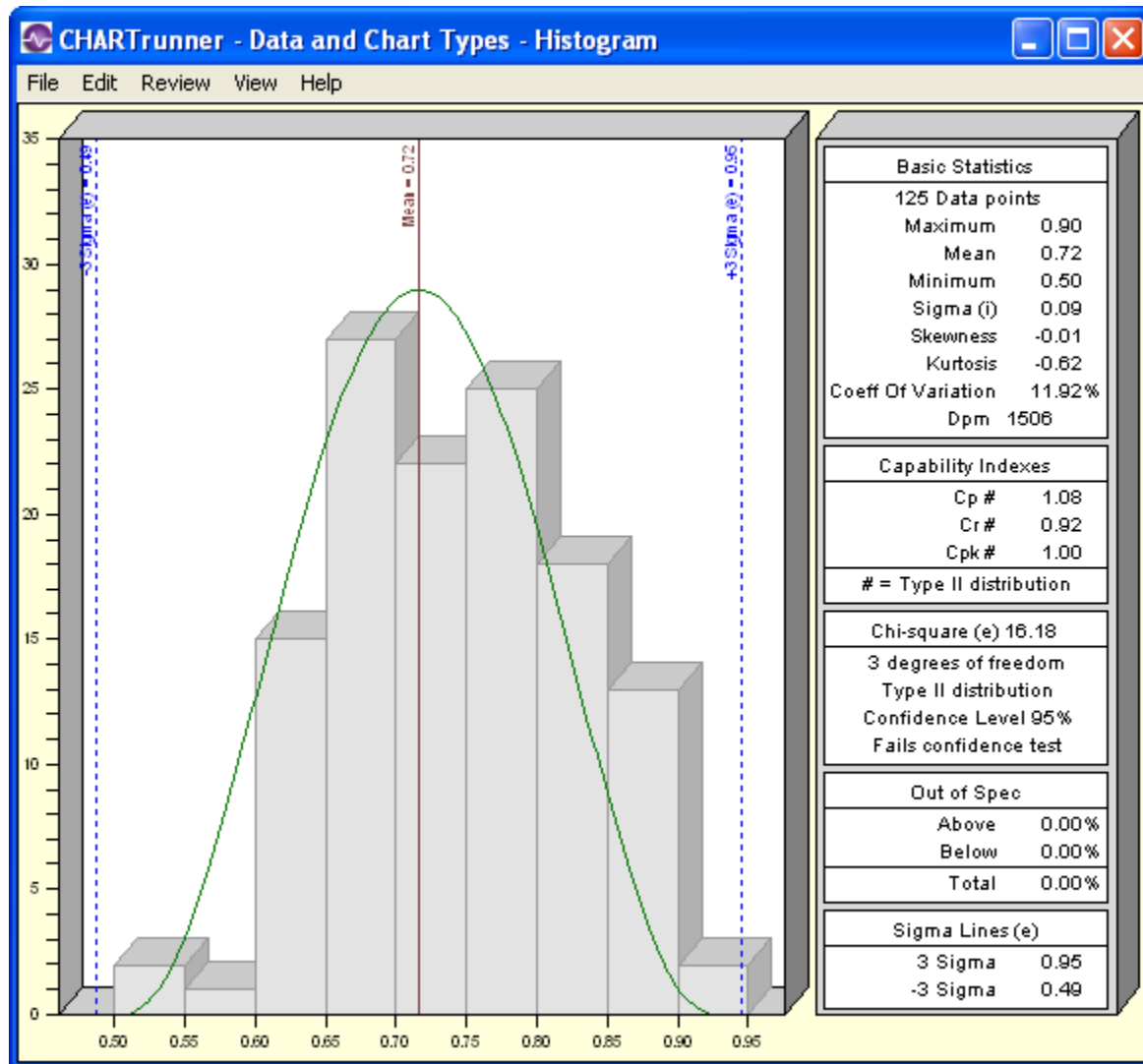
Use Pareto Charts:

- When your data can be arranged into categories
- When the rank of each category is important.

# Distribution and capability analysis

## Histogram

Histograms are bar charts that show how raw data is distributed. They show basic information such as central location (mean), width of spread (range or standard deviation), and shape. CHARTrunner allows you to select descriptive statistics, such as *skewness* and *kurtosis*, for histograms.



When do you use a histogram?

Use a histogram:

- When you want to visualize the central location, shape, and spread of data
- When the process is stable, and you want to predict future behavior.

## Capability analysis

Capability analysis is a set of statistical calculations performed on a set of data in order to determine the capability of the system. The capability of the system refers to the ability of the system to perform with respect to its specification limits. A system is said to be capable if it is producing 100 percent within specification limits.

CHARTrunner offers the following capability indices. Please refer to the Quality Advisor for a detailed description of each index and what you can learn from it. You can also refer to Appendix A for the formulas. CHARTrunner capability indices include:

Cp	Cpm	Pp
Cpk	Cpu	Ppk
Cr	Cpl	Pr

When do you use capability analysis?

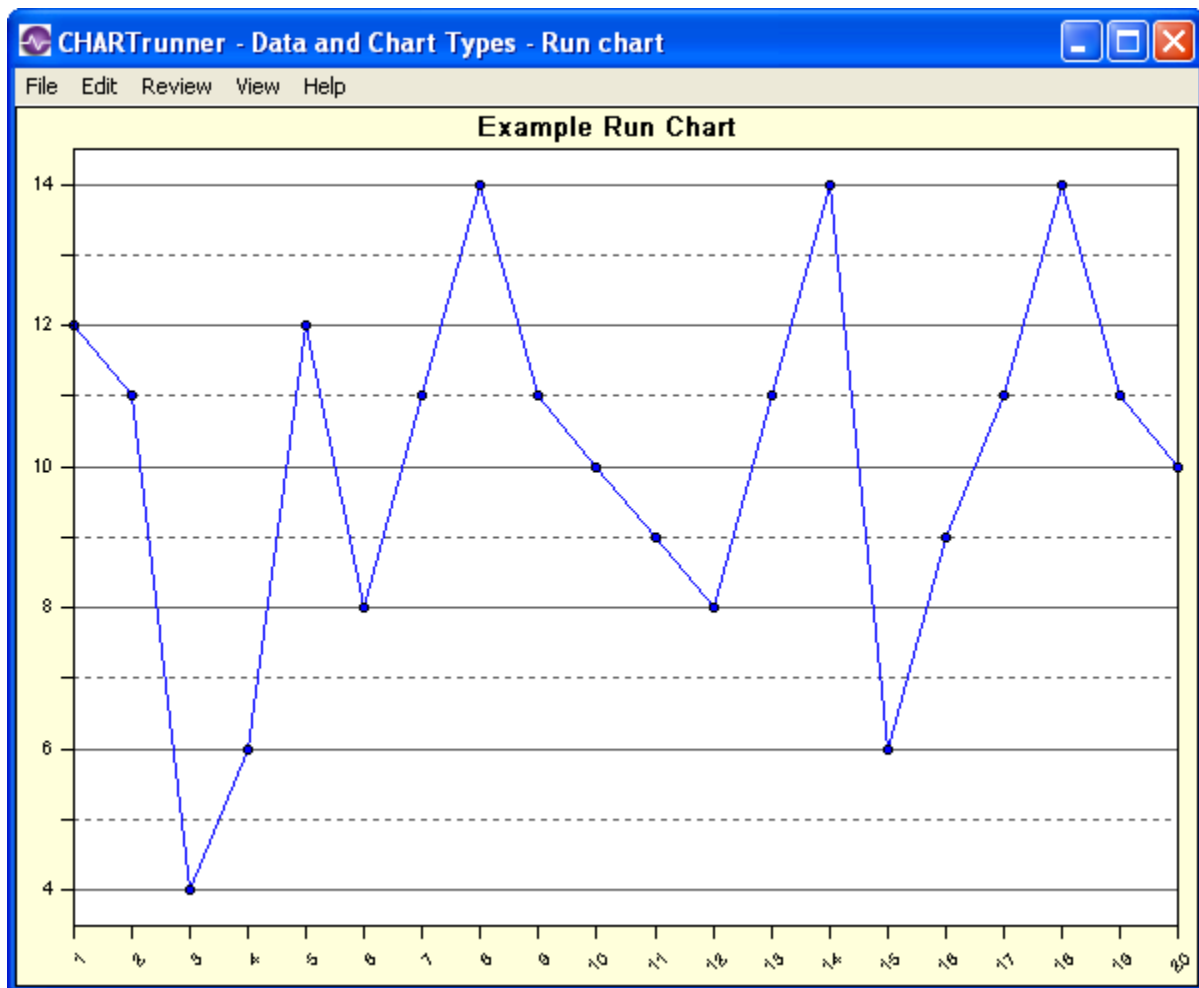
Use capability analysis:

- When the system is stable
- When the individual values of the variables data are normally distributed
  - If the system does not follow the normal distribution, you may want to choose “assume the distribution is non-normal” when creating a histogram in CHARTrunner.
- When you want to know how the system performs in relation to the specification limits.

# Line charts

## Run chart

Run charts are line graphs of individual data points plotted over time. They are used to look for patterns or trends in the data.



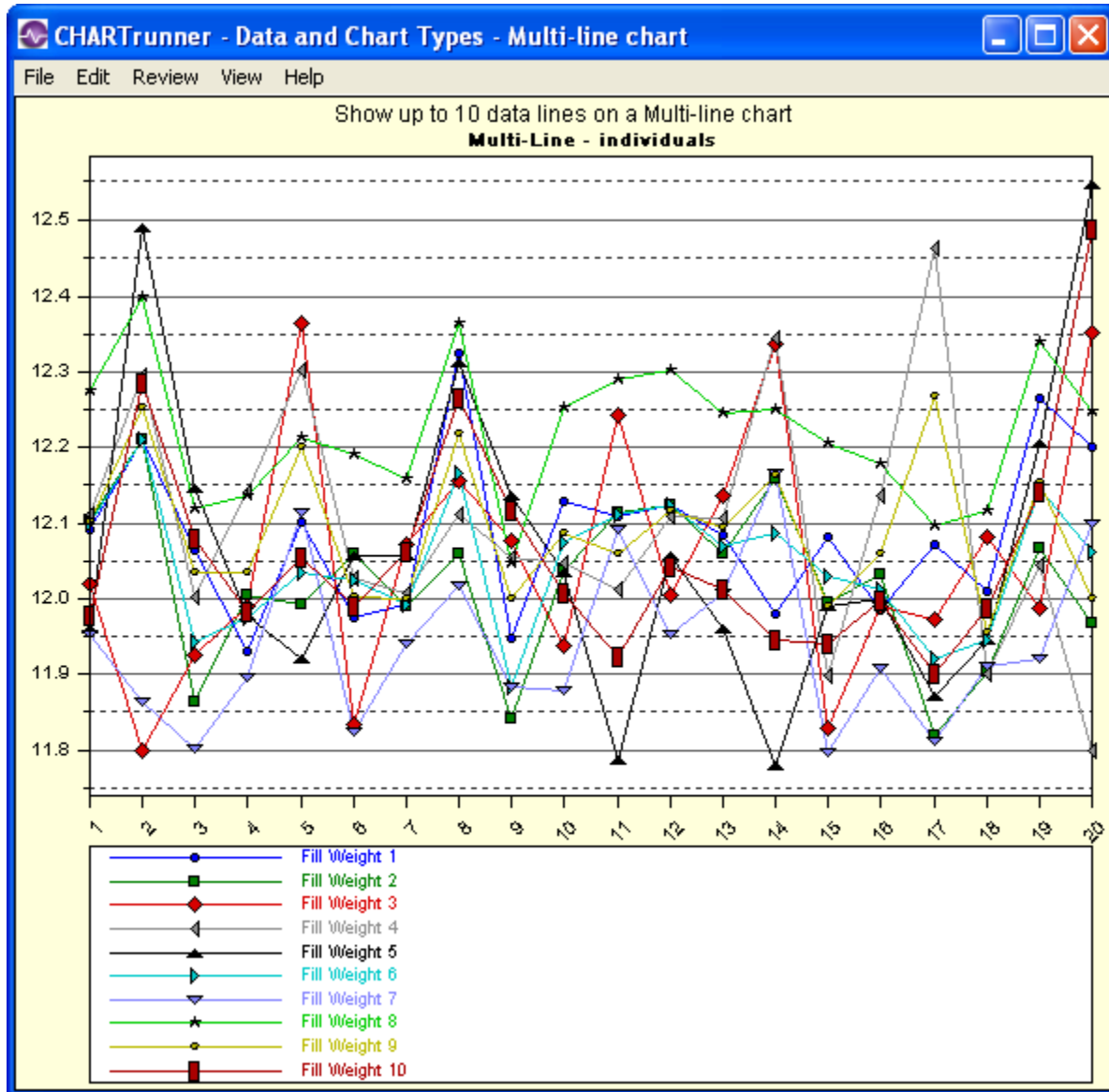
When do you use run charts?

Use run charts:

- When data is collected over time
- When the time order has been preserved
- When you want a quick test of process performance
- When you do not have enough data for conventional control chart analysis.

## Multi-line charts

A multi-line chart is used to look for trends across different characteristics or related data sets. You can display up to 10 data lines.



When do you use multi-line charts?

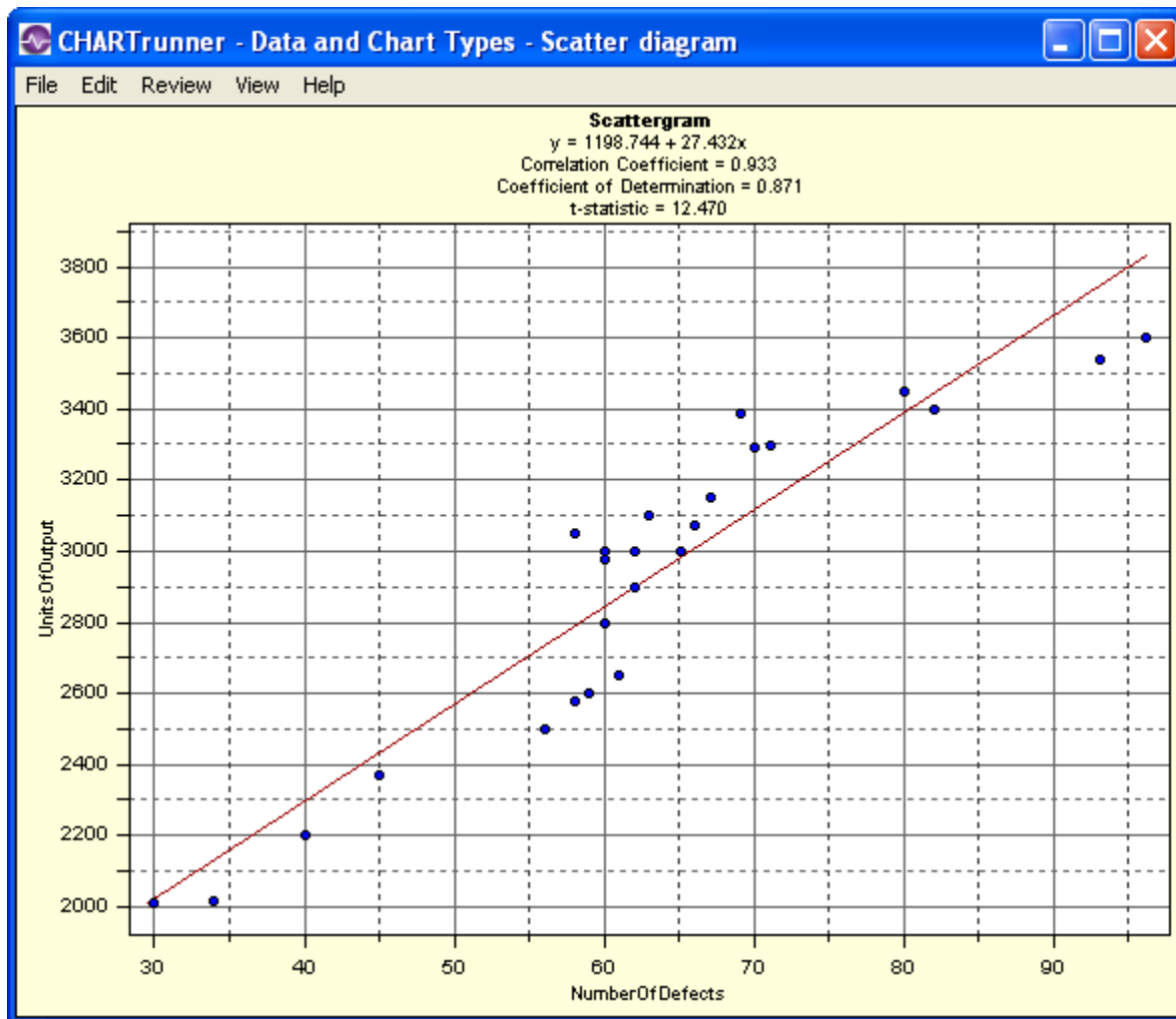
Use multi-line charts when you want to compare data from different factors on the same chart.



## Scatter diagrams

They are graphs that show the plotted values of the factors with each point on the graph representing a pair of measures. One factor is plotted on the horizontal axis and the other on the vertical. The purpose of the scatter diagram is to identify whether the factors are related as indicated by the pattern formed by the plotted values. If a relationship does exist, the factors are correlated.

If they are positively related, the values will fall on a line trending upward and have a correlation coefficient ( $r$ ) = 1.0. If the factors are negatively related, the values will tend to fall on a line trending downward and have a correlation coefficient = -1.0. A correlation coefficient = 0 implies that there is no linear relationship.



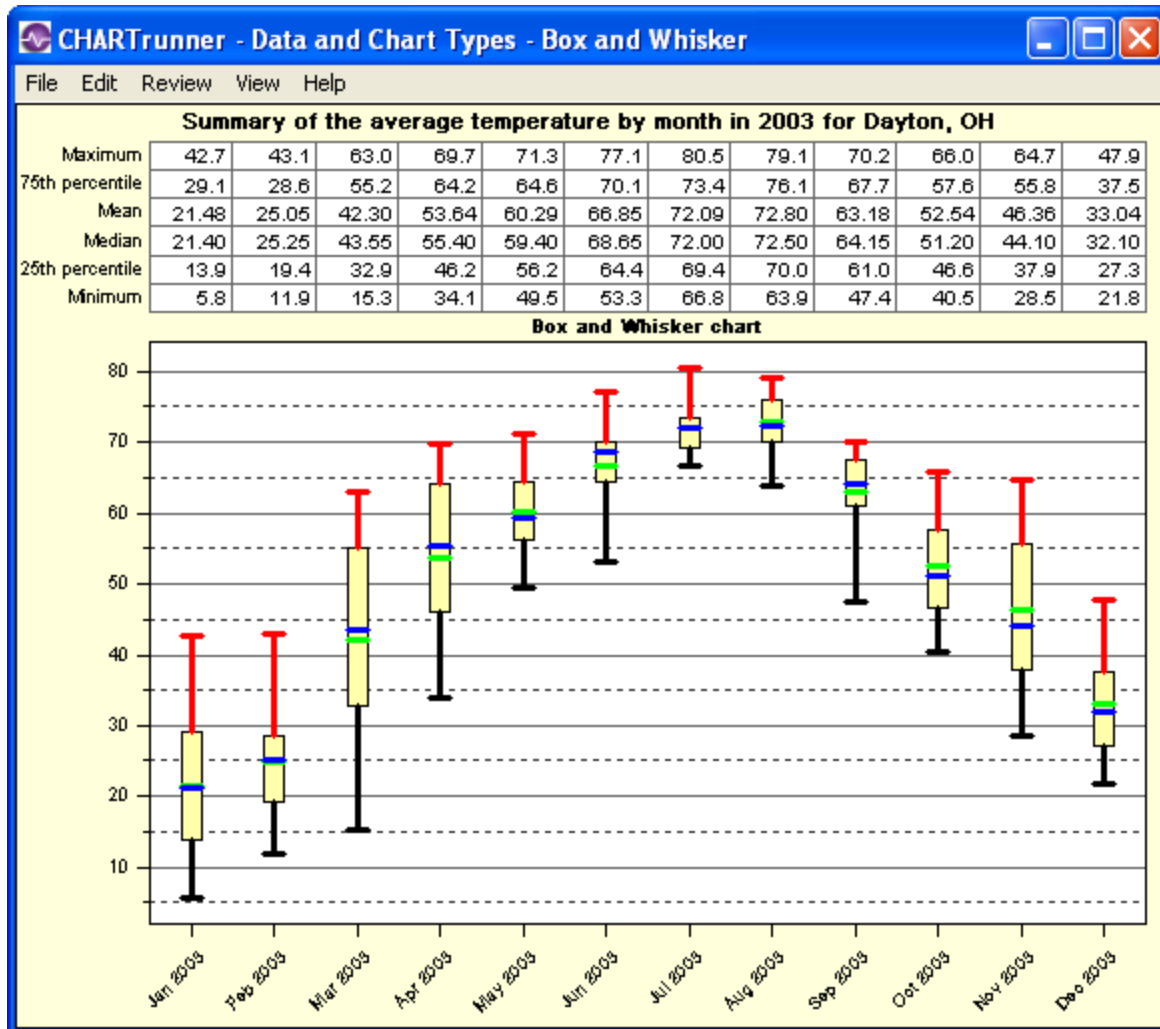
When do you use scatter diagrams?

Use scatter diagrams when you suspect the performance of one factor is related to the performance of another factor.

# Advanced charts

## Box and whisker

A box and whisker chart summarizes several different measurements in a single graphical display.



When do you use box and whisker charts?

Use box and whisker charts:

- When you want to visually compare different sets of related data
- When you want to visually compare both the range and the central location of multiple related data sets.

## Short-run SPC

In some applications, control charts are not practical. One example of this is manufacturing operations where small lots of many different products are produced. Since each product has different specifications, monitoring this with traditional control charts can be cumbersome.

In *Short-run SPC*, special control charts allow you to chart differences from a target value. Sometimes the absolute difference from target is plotted. In other cases a *normalized* difference from target is plotted. The idea is that a zero difference from target is good and any deviation away from zero is bad.

A common example used to demonstrate short-run SPC is a machine set up to cut bar stock into different lengths. The operator may cut 6-inch bars for an hour and then switch to 12-inch bars for a few hours. Rather than keep one control chart for 6-inch bars and a different chart for 12-inch bars, short-run SPC allows the operator to monitor 6-inch, 12-inch, and any other size bars all on a single chart. You might think of the chart as monitoring “How well are we cutting bars?” rather than “How well are we cutting 6-inch bars?”

For short-run SPC, CHARTrunner uses techniques described in *Short Run SPC*, Donald J. Wheeler, PhD, SPC Press. 1991.

## Short-run chart types

Here is a complete list of the short-run chart types. Notice that your options differ based on subgroup size of one vs. subgroup size larger than one.

Subgroup size is 1	Subgroup size greater than 1
Difference from target, moving range	Difference from target (X-bar), range
Zed, W	Zed bar, W
Zed*, W*	Zed bar*, W*
Mean ranges	Mean ranges

The *mean ranges* chart is unique to short-run SPC. It will help you decide which type of chart you need for your specific data set. Consider these two scenarios:

### 1. Scenario 1

- You are making products that have similar target values and similar variation around the mean. In our example, the 6-inch bars and 9-inch bars might qualify as *similar*.

### 2. Scenario 2

- You are making products where both the target values and the variations are very different. For example, the first product might have a target of 675 and vary from 650 up to 700. The second product might have a target of 1.1 and vary between .98 and 1.3.

The important question is *how different are your products in terms of the mean and the variation?* If your products are *similar*, you will use the *difference* chart. (*There is an interesting sentence!*) If your products are not *similar*, you will use the *zed* charts.

If you display a mean ranges chart and all the points (products) fall within the control limits, use a *difference from target* chart.

If you display a mean ranges chart and points are outside the control limits, select one of the *zed* charts.

## Difference chart vs. zed chart

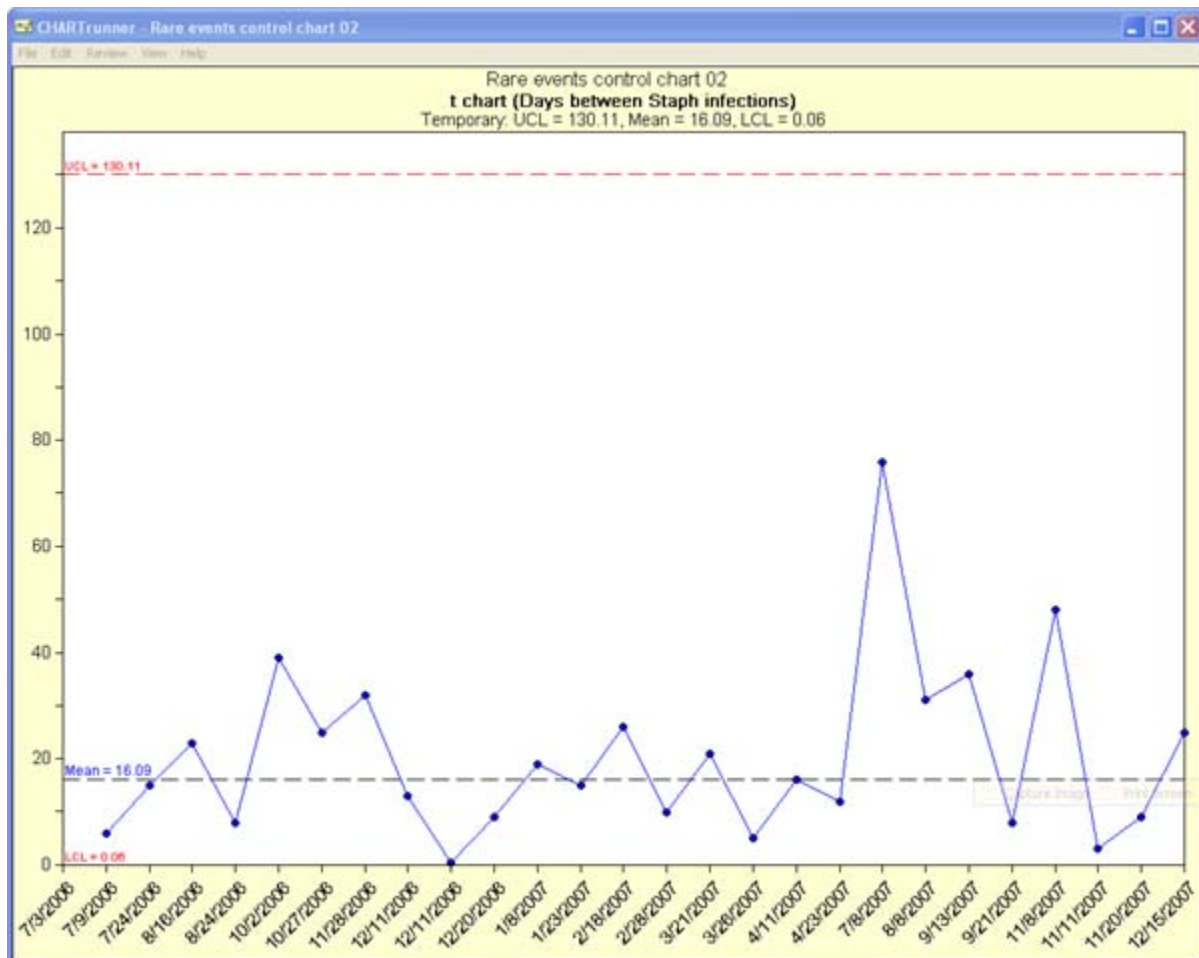
A *difference* chart is plotting the difference from target in absolute units. A *zed* chart takes the difference from target, *normalizes* this difference in units of *sigma*, and plots this *normalized* value as the difference.

PQ Systems' *Practical Tools for Continuous Improvement* provides more details about the types of data and tools for analysis. It also provides detailed information on tools for planning, problem-solving, and interpreting control charts. Contact the PQ Sales Group for more information.

# Rare event control charts

## t-chart

The t-chart creates a picture of a process over time. The units being plotted are time values. Each point on the chart represents an amount of time which has passed since a prior occurrence of some rare event. The time units might be hours, days, weeks, months, etc. For example, a chart might plot the number of days between infection outbreaks at a hospital. Alternatively, it could plot the same information as the number of weeks between infection outbreaks. A traditional plot of this data will contain many points at zero and an occasional point at one. The benefit of the t-chart is visualizing this data in traditional control chart form. The formulas for t-chart control limits are different to account for this type of data.

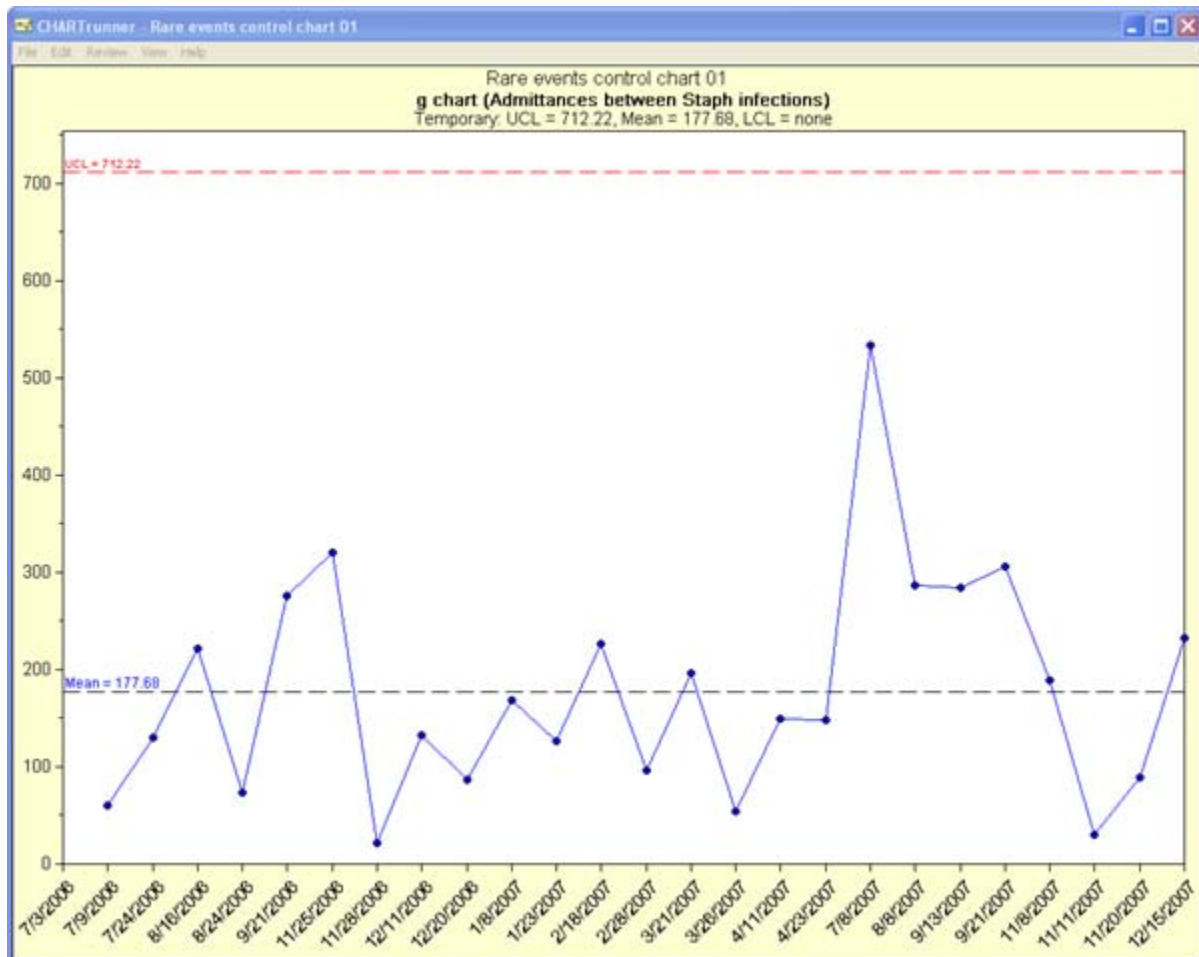


When do you use a t-chart?

- When you want to see if the process is stable and predictable
- When you want to see how a planned change affects the process
- When you are tracking the passage of time between relatively rare events

## g-chart

The g-chart creates a picture of a process over time. Each point represents some number of units that have been “produced” between occurrences of some relatively rare event. For example, in a production setting, where parts are produced daily, you may have occasionally power outages. A g-chart might be used to look at the number of units (products) produced between power outages. The units produced can be almost anything. For example, you might look at the number of invoices printed, the number of customers served, or the number of patients seen – between the occurrences of some event. A traditional plot of data like this is not conducive to control chart interpretation. The benefit of the g-chart is visualizing this data in traditional control chart form. The formulas for g-chart control limits are different to account for this type of data.



When do you use a g-chart?

- When you want to see if the process is stable and predictable
- When you want to see how a planned change affects the process
- When you are tracking the number of units produced between rare events

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## CHAPTER 6

# Basic chart definition

## In This Chapter

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## Database concepts

Since CHARTrunner uses data stored in databases, it might be helpful to review some basic database terms and concepts.

Databases are used to store a wide variety of information. Most databases manage this information in one or more tables. A table usually has a name and contains one or more fields (sometimes called columns) of information. Database tables contain rows that are also called records. Tables can be quite large and often contain thousands of rows of information.

Some information does not fit neatly into a single table. For example, in most order entry systems, a single order may contain several distinct items. In this case, it does not make sense to put the customer information for the order in the same table as all the items in the order (as it would be duplicated). Instead, the information is stored in two tables that are linked by a common column such as Order Number. In this way, a single row in the Order table is related to or linked to multiple rows in the Order Detail table.

People who use the information in database tables often want to work with a subset of the rows within a table, for example, all orders that come from Kentucky. Instead of looking through thousands of records from each state, users can do a query to see a table that contains only the Kentucky records.


Queries are like questions that we ask the database; the answer looks like an ordinary table, but it is really a subset of the rows in the table. Most databases allow you to remember and reuse queries. In this case, refer to the name of the query as if it were a regular table. Queries that are saved in the database are sometimes called views or stored procedures.

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## Basic chart definition concepts

Charts are created with the Chart definition form. This form consists of a series of tabs. The first three tabs, *Step 1: Chart name/type*, *Step 2: Data source*, and *Step 3: Data definition* are used to specify the chart type and to select the data for the chart. These three tabs are used for every type of chart definition. The remaining tabs are used for titles, control and specification limits, and chart-specific options such as x-axis and y-axis labels.

Basic steps to create a new chart definition:

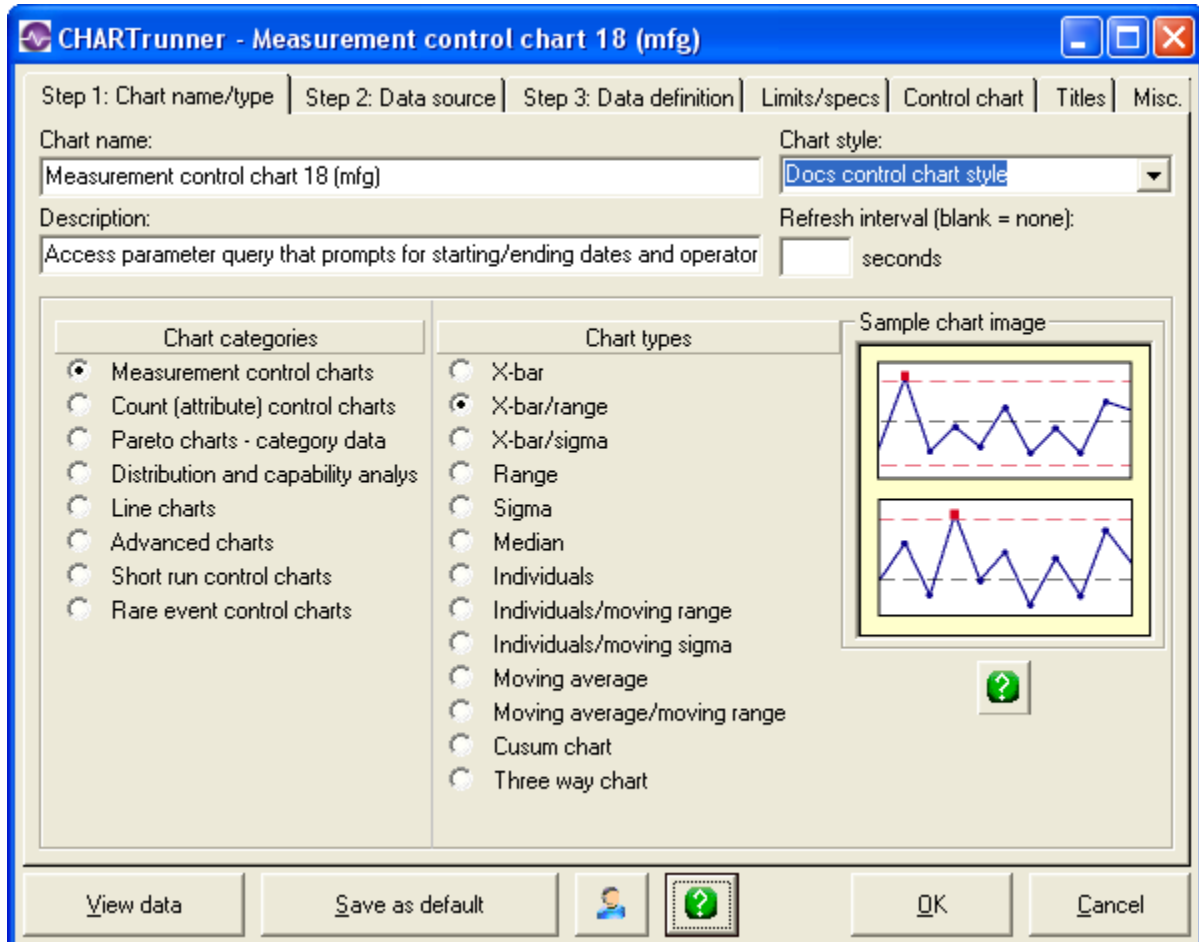
Right-click on a chart in the CHARTrunner definitions list and select New chart from the pop-up menu. The chart definition form will open. Or click on the New definition icon on the toolbar, . Or open the File menu and select New definition.

1. On the Step 1: Chart name/type tab, define the chart name and type. (See **Step 1: Chart name/type tab** (on page 16).)
2. On the Step 2: Data source tab, define how to connect to your database or data file. (See **Step 2: Data source tab** (on page 80).)
3. On the Step 3: Data definition tab, define what data to use and how to treat the data columns. (See **Step 3: Data Definition tab** (on page 87).)
4. Using the other tabs, you can customize your chart by choosing specific settings for the type of chart you have selected.



## Step 1: Chart name/type tab

The Step 1: Chart name/type tab, shown below, allows you to assign a chart name, description, chart type, chart style, and refresh interval for your chart.



Field Name	Description
Chart Name	Enter the name for this chart. The name you enter will be used as the file name of the chart definition, so the nine characters ? : " \ < > *   are not allowed, since they cannot be used in a file name. If you change the name of an existing chart definition, you will be asked if you want to retain the chart definition with the old name. You may search for a chart based upon the chart's name. This is a required field.
Chart Style	Select a chart style name from the drop-down menu. The chart style defines many of the visual "look-and-feel" aspects of the chart (such as the chart background color). See <b>Using styles to control the look of your chart</b> for more information about chart styles.
Description	The description is used to provide additional information about the chart. Because the description can be displayed in the CHARTrunner definitions list, a chart description may help to locate charts more easily. You may search for a chart based upon the chart description. This is an optional field.

Refresh interval (blank - none)	<p>The refresh option will redraw a displayed chart at the specified interval. If data is added frequently, set a refresh interval to keep the chart current. A refresh interval may be set for a chart or multi-chart. Leave this field blank if you do not want the chart to automatically refresh. Set this to the desired number of seconds if you want the chart automatically to refresh while it is displayed. Each time the refresh interval passes, the chart will be re-displayed, reflecting any new data that may have arrived since the last refresh.</p> <p>NOTE: Be careful not to set the refresh interval too short. For example, if you add new data to the underlying database once every 30 minutes, there is really no need to set the refresh interval to 10 seconds. This makes the computer do unnecessary work to re-query the database and re-draw the chart. One use for the refresh interval is to monitor a chart in one location based on data that is being collected in some other location. For example, in showing data that is being collected during a manufacturing process.</p>
Chart categories and Chart type	<p>Specify the category and type of chart that you want. When you select a chart type, the Sample chart image shows you a representation of what the chart will look like. For descriptions of available chart types, please refer to Data and chart types. For information on chart-specific settings, please refer to <b>Customizing a chart definition</b> (on page 113).</p>

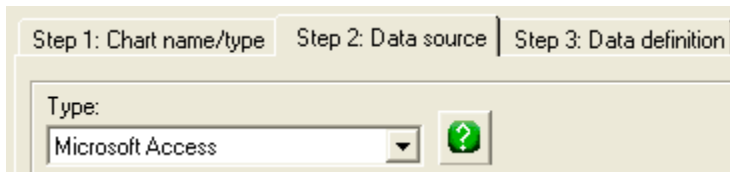
When you have finished with the Step 1: Chart name/type tab, the next step is to tell CHARTrunner how to connect to the database or data file for the chart by clicking the Step 2: Data source tab.

## Step 2: Data source tab

The information on the Step 2: Data source tab tells CHARTrunner how to connect to your database or data file in order to fetch the data to be charted.

When you are finished specifying the properties of the *Step 2: Data source* tab, you can proceed to the Step 3: Data definition tab to select data to be used for the chart. See the topic **Step 3: Data definition tab** for more information.

The first choice you must make on the Step 2: Data source tab is to choose the Type of data source or access method you want to use.



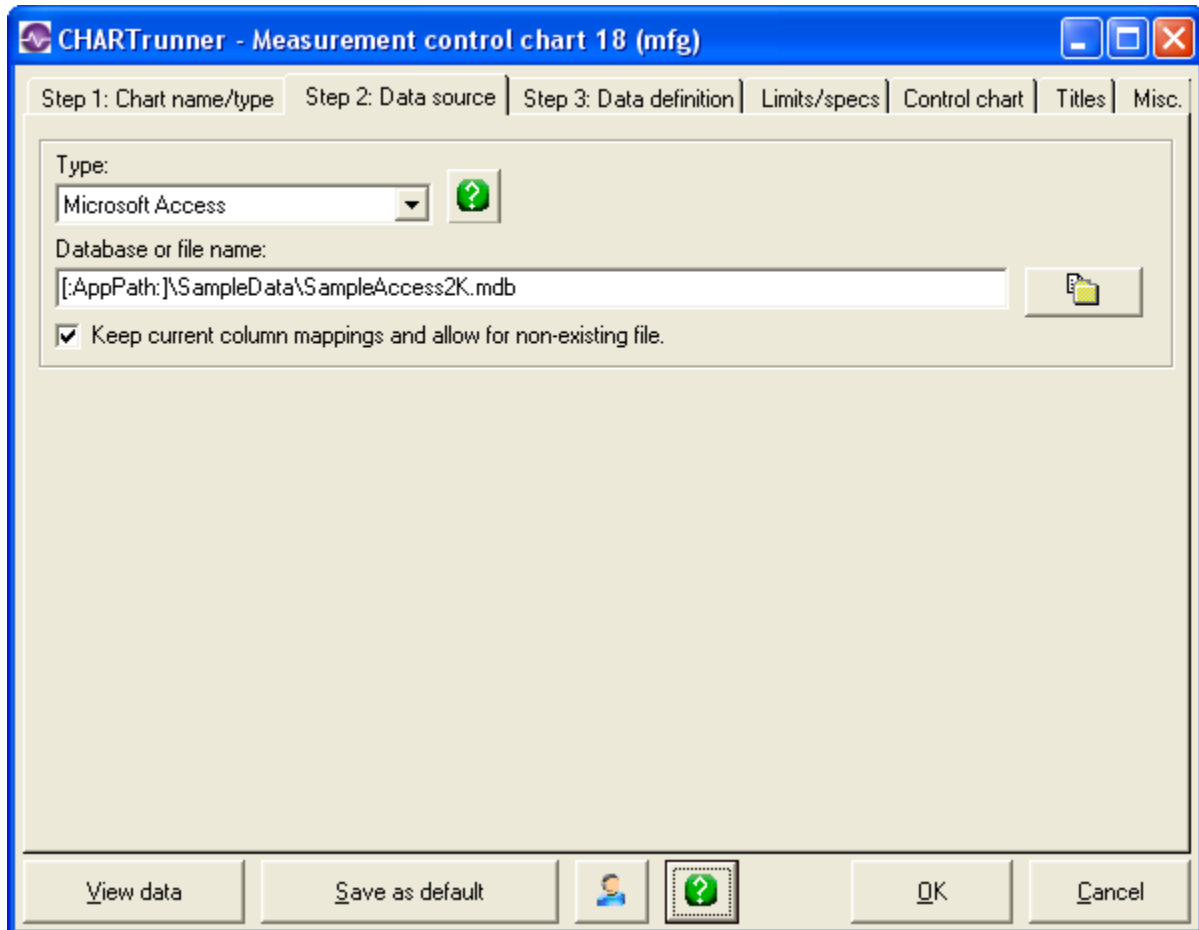
The fields on the Step 2: Data source tab rearrange themselves depending on the Type of data source you specify. There are three basic data access methods to choose from. Later in this topic, a sample Step 2: Data source tab is shown for each of these three methods.



1. Your data source is Microsoft Access (with no password), Microsoft Excel, a text file, Paradox, dBase or Lotus 123. These data sources fetch data directly from a data or database file on the computer's disk. The underlying data retrieval technology used by this method is Microsoft Data Access Objects (DAO).

2. ADO;OLE DB provider – Your data source has an ADO or OLE DB provider. That's a fancy way of saying that someone has written data access software that conforms to the OLE DB specification for your particular data source. The major client-server databases, such as SQL Server and Oracle have an ADO;OLE DB data provider. The underlying data retrieval technology used by this method is Microsoft ActiveX Data Objects (ADO). Given the choice between using an ODBC driver or an ADO;OLE DB provider, typically the best results are obtained by using the ADO;OLE DB provider. Please refer to Appendix D, **Data Sources**, for more information on using ADO;OLE DB to fetch data from specific data sources.
3. ODBC; Open database connectivity - Your data source has an ODBC driver. That's a fancy way of saying that someone has written data access software that conforms to the ODBC specification for your particular data source. The major client-server databases like SQL Server and Oracle have an ODBC driver. FoxPro data is also accessible via an ODBC driver. The underlying data retrieval technology used by this method is Microsoft Open Database Connectivity (ODBC). Given the choice between using an ODBC driver or an ADO;OLE DB provider, typically the best results are obtained by using the ADO;OLE DB provider. Please refer to Appendix D, **Data Sources**, for more information on using ODBC to fetch data from specific data sources.
  - Type - Select the type of data source or access method from the drop-down menu. Your choices are:
    - Microsoft Access – If the Access database requires a database or workgroup password, please refer to Appendix D, **Data Sources**, for more information.
    - Microsoft Excel
    - Text file
    - Paradox
    - dBase
    - Lotus 123 (wk1)
    - Lotus 123 (wk3)
    - Lotus 123 (wk4)
    - ODBC; Open database connectivity
    - ADO; XML record set – Select this to have CHARTrunner fetch XML chart data from a Web site. See Appendix D, **Data sources**, for more information on using this method.

## If You Select Microsoft Access, Microsoft Excel, text file, Dbase, or Lotus 123 as the type of data source

The Step 2: Data source tab shown below is used for a file-based data source, such as Microsoft Access or Excel, where you tell CHARTrunner the location of the data file on the computer's disk.



- Database or file name – This field is used when your data source comes from a disk file or folder. The field is not visible when the data Type is ADO or ODBC. You may use [:AppPath:] as part of the file or folder specification; this gets expanded to be the full path to the folder where CHARTrunner is installed. Your entry in this field depends on the type of data source as explained below.
  - For Access, Excel and Lotus 123: – Enter the directory and data file name in the Database or file name field. Click the  button to open the file selection dialog.
  - For dBase, Paradox, and text files – Enter only the folder (or directory) where the data files are located. You will select the specific data file on the Step 3: Data definition tab. Click the  button to open the folder selection dialog.
- Keep current column mapping and allow for non-existing file – This field allows you to change the data source without losing the How to treat the columns settings that are defined on the Step 3: Data definition tab. This feature is useful if you need to switch between identical databases and retain the same column Treat As definitions.

Why allow for a non-existent data file? You might need this:

- a) If you are creating a chart definition for a data file that is not available to you. For example, you may want to set up a chart for someone else who *will* be able to access the specified data file.
- b) If you are a CHARTrunner-e user and want to set up a chart definition for a data file not available to your computer; use this feature to enter the path of a file or folder that is available to the CHARTrunner-e server.

You must specify an appropriate “Connection string” for the ODBC driver you want to use.

## If you select ODBC as the type of data source

When you select ODBC; Open database Connectivity as the Type, the Step 2: Data source tab looks like the example shown above. You can provide the following ODBC connection information:

Field	Description
ODBC Driver	You can select the ODBC “Data Source Name” you want to use from this drop-down list. This list contains the ODBC “Data Source Names” (DSN) that have been defined on your computer. The Windows Control Panel is used to set up ODBC data sources on your computer. When you select a DSN name from the drop-down list, a default connection string of the form “DSN=SelectedOdbcName;” will be entered for you. Selecting from the ODBC Driver drop-down list is optional because you can always manually enter the required connection string.

View all table objects on the Data Definition tab	When CHARTrunner builds the list of available tables and views on the <i>Step 3: Data definition</i> tab, it limits the list to show only the most commonly used database objects. With some data sources (such as Oracle and SQL Server), select this option to expand the list to include all available database objects, not just the most commonly used ones.
Keep current column mapping and allow for non-existing file	<p>This field allows you to change the data source without losing the <i>How to treat the columns</i> settings that are defined on the <i>Step 3: Data definition</i> tab. This feature is useful if you need to switch between identical databases and retain the same column <i>Treat As</i> definitions.</p> <p>Why keep the current column mapping? You might need this:</p> <ul style="list-style-type: none"> <li>• If you are creating a chart definition for a data source that is not available to you. For example, you may want to set up a chart for someone else who <i>will</i> be able to access the specified data source.</li> <li>• If you are a CHARTrunner-e user and want to set up a chart definition for a data source that is not available to your computer. Use this feature to enter the connection string that is appropriate for the CHARTrunner-e server.</li> </ul>
User	Enter a valid user login name for the data source. The name you enter here will be substituted into the Connection string wherever {{USER}} appears in the string (as shown in the figure above). Alternatively, you may enter the user login name directly into the Connection string (e.g., Uid=MyUserName), in which case you would not enter the user name here.
Password	Enter the password for the data source. The password you enter here will be substituted into the Connection string wherever {{PASSWORD}} appears in the string (as shown in the figure above). Alternatively, you may enter the password directly into the Connection string (e.g. Pwd=MySecretPassword), in which case you would not enter the password here. It is recommended that you use the Password field so that the password is not stored in plain text in the chart definition file.
Connection string	If you selected the driver name from the ODBC Driver drop-down list, a default connection string was created for you. Edit the connection string as appropriate for your ODBC data source.
Prompt for user/password each session	Select this if you want CHARTrunner to prompt for the user login name and password each time the chart initially opens the data source.

For more information on using specific ODBC data sources, see Appendix D, **Data sources**.

## If you select ADO as the type of data source

You must specify an appropriate Connection string for the ADO provider that you want to use.

**CHARTrunner - Sample 01**

Step 1: Chart name/type | **Step 2: Data source** | Step 3: Data definition | Limits/specs | Control chart | Titles | Misc.

Type: ADO; OLE DB provider ADO; OLE DB Provider: OLE DB Provider for SQL Server - Standard security

☐ View all table objects on the Data Definition tab

☒ Keep current column mappings and allow for non-existing file.

ADO provider information:

User: CHARTrunner

Password: xxxxxxxxxxxx

Connection string:  
 Provider=sqloledb; Network Library=DBMSSOCN; Data Source=KNIGHT1; Initial Catalog=CrSampleData; User Id={{USER}}; Password={{PASSWORD}};

☐ Prompt for user/password each session

View data | Save as default | | OK | Cancel

When you select ADO;OLE DB provider as the Type, the Step 2: Data source tab looks like the example shown above. You can provide the following ADO connection information:

Field	Description
ADO;OLE DB Provider	You can select a connection string template for the ADO provider you want to use by selecting from the drop-down list. A default template for that provider's connection string will be placed in the connection string field. But you will still need to edit the connection string to provide information that is specific to your situation. Selecting from the ADO;OLE DB Provider drop-down list is optional because you can always manually enter the required connection string.
View all table objects on the Data Definition tab	When CHARTrunner builds the list of available tables and views on the <i>Step 3: Data definition</i> tab, it limits the list to show only the most commonly used database objects. With some data sources (such as Oracle and SQL Server), select this option to expand the list to include all available database objects, not just the most commonly used ones.
Keep current column mapping and allow for non-	This field allows you to change the data source without losing the <i>How to treat the columns</i> settings that are defined on the <i>Step 3: Data definition</i> tab. This feature is useful if you need to switch between identical databases and retain the same column

existing file	<p><i>Treat As definitions.</i></p> <p>Why keep the current column mapping? You might need this:</p> <ul style="list-style-type: none"><li>• If you are creating a chart definition for a data source that is not available to you. For example, you may want to set up a chart for someone else who will be able to access the specified data source.</li><li>• If you are a CHARTrunner-e user and want to set up a chart definition for a data source that is not available to your computer, use this feature to enter the connection string that is appropriate for the CHARTrunner-e server.</li></ul>
User	Enter a valid user login name for the data source. The name you enter here will be substituted into the Connection string wherever {{USER}} appears in the string (as shown in the figure above). Alternatively, you may enter the user login name directly into the Connection string (e.g., Uid=MyUserName), in which case you would not enter the user name here.
Password	Enter the password for the data source. The password you enter here will be substituted into the Connection string wherever {{PASSWORD}} appears in the string (as shown in the figure above). Alternatively, you may enter the password directly into the Connection string (e.g., Pwd=MySecretPassword), in which case you would not enter the password here. It is recommended that you use the Password field so that the password is not stored in plain text in the chart definition file.
Connection string	If you selected the driver name from the ADO;OLE DB Provider drop-down list, a default connection string was created for you. Edit the connection string as appropriate for your ADO provider.
Prompt for user/password each session	Select this if you want CHARTrunner to prompt for the user login name and password each time the chart initially opens the data source.

For more information on using specific ADO data sources, see Appendix D, **Data Sources**.



## Step 3: Data definition tab

The Step 3: Data definition tab is where you tell CHARTrunner whether to fetch data from a table, query or view, stored procedure, or custom SQL query. You can specify how the data will be ordered (for a table), how to filter records, set up Advanced Row Selection to perform sampling or grouping of the data rows, and how to treat the data source columns. When using a stored procedure that accepts input parameters, you can specify the input values to be passed into the stored procedure.

CHARTrunner - Measurement control chart 17 (mfg)

Step 1: Chart name/type | Step 2: Data source | **Step 3: Data definition** | Limits/specs | Control chart | Titles | Misc.

Source for data records:

- ☐ Table
- ☐ Query or view
- ☐ Stored procedure
- ☒ Custom query

☒ Keep columns

☐ Filtering

☐ SQL settings

☐ Advanced >>

☐ Parameters

Result records to include: All

☒ Prompt for parameters

How to treat the columns:

Column name	Data type	Treat as	Label
DateTime	Date / Time	Identifier	DateTime
Operator	Text	Identifier	Operator
Diameter1	Numeric	Measurement	Diameter1
Diameter2	Numeric	Measurement	Diameter2
Diameter3	Numeric	Measurement	Diameter3

Refresh Columns | Validate Chart Data | Clear all

View data | Save as default | OK | Cancel

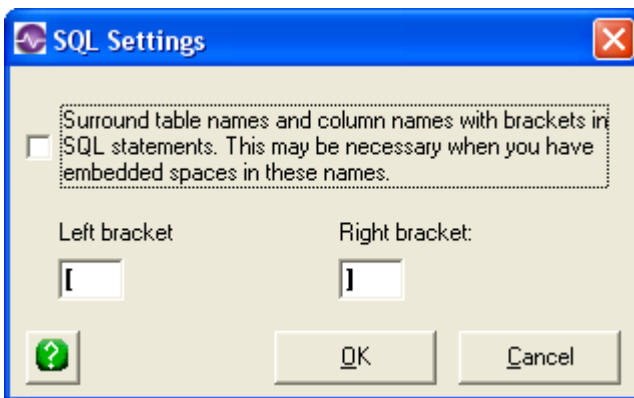
- Source for data records – Select one of the following four sources of data records:
  - Table – This option tells CHARTrunner to get the records for this chart from a named table in the data source.

- For databases such as Access, SQL Server and Oracle, the tables found in the database will be listed in the Table drop-down list. Select the table that contains the data for the chart.
- If you chose Microsoft Excel on the *Step 2: Data source* tab, the Table drop-down list contains the worksheets and named regions found in the Excel file. Select the worksheet or named region that contains the data for the chart.
- If you chose Text File on the *Step 2: Data source* tab, the Table drop-down list contains the text files found in the folder you specified. Only files with a .TXT file extension are listed. Select the text file that contains the data for the chart.
- If you chose dBase or Paradox on the *Step 2: Data source* tab, the *Table* drop-down list contains the table files found in the folder you specified. Select the table that contains the data for the chart.
- Column to use for Order By – When you choose Table, you should also specify the column that you want to use to establish the order of the records from the table. This entry is not required; however, with most relational databases, it is difficult to know exactly what order the records will have if you do not make this selection. Thus, it is *highly recommended* that you specify the column name to use in ordering the table data. The resulting data records will be ordered in ascending order.
- Query or view – This option allows you to use queries that have already been defined in the database as a source of records for this chart. If you select this option, the queries found in the database will be listed in the Query drop-down list box. Note that some databases call these *queries* and others call them *views*. Your database may not have any pre-defined queries, so it is possible the drop-down list box will be empty. These queries are created and saved using your database program. It is a good idea to treat one of the columns from the query or view as the *Unique identifier* to facilitate using multiple control limits or attaching annotations to subgroups.
  - Query (drop-down list) – The queries or views found in the database will be listed in the Query drop-down list. Select the name of the query or view that fetches the data for the chart. The order of the data records will be determined by the definition of the query or view.
- Stored procedure – This option is very similar to the Query or view option. A stored procedure can specify a series of database commands that are processed in order to fetch the data records. In addition, you can pass input parameters into a stored procedure in order to have some control over the rows that are returned. Stored procedures are created and saved using your database program. If nothing is listed in this field, either your database does not support stored procedures or these procedures have not been defined. It is a good idea to treat one of the columns from the stored procedure as the *Unique identifier* to facilitate using multiple control limits or attaching annotations to subgroups.
  - Stored procedure (drop-down list) – The stored procedures found in the database will be listed in the Stored procedure drop-down list. Select the name of the stored procedure that fetches the data for the chart. The order of the data records will be determined by the definition of the stored procedure.
- Custom query – If you select this option, the Edit Query button appears, which allows you to enter your own SQL statement to query the database. Using this option requires knowledge of both SQL and the structure of the database that you are accessing. See **Custom query** (on page 99) for more information. It is a good idea to treat one of the columns from the stored procedure as the *Unique identifier* to facilitate using multiple control limits or attaching annotations to subgroups. The order of the data records will be determined by the ORDER BY clause of the custom query.

- **Edit Query** – Click this button to open an editor that allows you to edit your custom query. Because SQL is powerful and flexible, it can also be complicated. A complete description of SQL is beyond the scope of this user guide. If you have trouble with SQL, refer to one of the resources listed in the topic “SQL Query.”

NOTE: The Custom query is a powerful feature; care must be taken to form a correct SQL statement that does not unintentionally result in thousands of records being returned. Or, worse yet, results in the modification or deletion of data.

- **Keep columns** – If this is checked, you can change the Source for data records selection and/or change the name of the table, query/view, or stored procedure without losing your existing How to treat the columns settings. If this field is unchecked and you change any of these fields, the How to treat the columns settings will be cleared.
- **Filtering** – The Filtering button and check box allow you to filter the data from your data source so that only those rows that “pass through the filter” are considered for your chart. If a filter is defined, is it active only when a check mark appears in the check box. See the **Filtering chart data** topic for more information.
- **SQL settings** – Some databases allow embedded spaces in the names of objects like tables and columns. As a result, these names must be enclosed in special characters in order to avoid database query errors. Click the SQL settings button to specify whether or not to enclose these names with the indicated special characters. Note that for an Oracle database you always want to leave this feature turned off; i.e., not checked.



- **Surround table names ...** – Select this option to surround table names and column names with the bracket characters specified by the Left bracket and Right bracket fields. This is typically used when a table or column name contains one or more embedded spaces as part of the name, and is required in that situation for text files, Microsoft Access, Excel, and SQL Server. Other types of data source, such as Oracle, do not use this option.
- **Left bracket** – Enter the left bracket character to use. For text files, Microsoft Access, Excel, and SQL Server, you must use the “[” character.
- **Right bracket** – Enter the right bracket character to use. For text files, Microsoft Access, Excel, and SQL Server, you must use the “]” character.

NOTE: If you get an error while trying to fetch data that resides in a text file, an Excel worksheet, an Access database, or SQL Server, click on the SQL Settings button. The Surround table names and column names with brackets option should be selected. If not, select it and click the OK button.

- **Advanced>>** – Click this button to open the *Advanced Row Selection* dialog, which allows you either to sample or group the rows from your data source. For more information, see **Advanced row selection**.
- **Parameters** – Some databases, such as Access, SQL Server, and Oracle, allow you to define queries or stored procedures that require you to provide one or more input parameters so that the proper data is selected. In addition, you can specify a *Custom Parameter* in the SQL of a custom query. If the Parameters button is visible this means that your data source allows you to provide values for these query parameters. See **Query Parameters** for more information.
- **Results records to include** – Use this field to specify which data points should be used. Options are All, First N, or Last N. If you select First N or Last N, enter a value for N in the field provided. CHARTrunner processes this setting after it processes *Filtering* and *Advanced Row Selection* settings. If, for example, a filter is set to include only 8:00 am data, and Result records to include is set at Last N=100, CHARTrunner would first separate 8:00 am data. Then, it would pull out the last 100 of the 8:00 am filtered data points. Likewise, if Advanced Row Selection is used to group the data into days and Result records to include is set to Last 30, then the chart will show the last 30 days' worth of data, not the last 30 rows of the original data.

**How to treat the columns** – This is where you tell CHARTrunner how to treat each column (or field) from your data source. After you have specified a table, stored procedure, query or view, or custom query, the grid at the bottom of the form will list information about the columns found in the data source. This grid consists of 4 columns: Column name, Data type, Treat as, and Label. The *Treat as* column provides a drop-down list of options you can set for each data column. The options available on this list depend on the chart type. Use the Treat as column to specify how you want CHARTrunner to handle each field of data that you want to chart. This grid consists of the following four columns:

- **Column name** – The column (or field) name found in the data source is displayed in this column.
- **Data type** – The type of data stored in this column of the data source is shown here.
- **Treat as** – This column provides a drop-down list of options you can set for each column of the data source. The options available in this list depend upon the chart type. Use the Treat as column to specify how you want CHARTrunner to handle each field of data that you want to chart. Each option type is discussed below.
- **Label** - Use the Label column to specify how each data source column will be labeled in the grid-above-the-chart or the web page data table.

**NOTE:** Depending on the chart type that you select, CHARTrunner expects certain columns to be defined. For example, to do an X-bar chart you must treat at least 2 columns from your data as measurements. An individual chart requires only one column to be treated as a measurement. To do a Pareto chart, you must designate at least one of your data columns as categories. For a scatter diagram, both a dependent variable and an independent variable column must be specified. CHARTrunner will warn you if the required column mappings are not present for the selected chart type.

The following options are available for the Treat as column:

- **Ignore** – (default value) This tells CHARTrunner to ignore the column for this chart.
- **Identifier** – This makes the column available for use in labeling the chart or identifying each subgroup.

- Unique identifier – Select Unique identifier if the column contains a unique value for every row in the data set. Only one column can be mapped as the Unique identifier. *Having a Unique identifier column allows you to attach a chart annotation to a particular subgroup on the chart. It also allows control limits to be able to “remember” the range of data over which they were calculated when the data comes from a Query or view, Stored procedure, or Custom query.* Being able to “remember” the range of data over which each limit was calculated is important when multiple control limits are displayed on the chart because it allows each set of limits to be positioned at the proper location along the x-axis. When Query or view, Stored procedure, or Custom query is used, CHARTrunner makes the assumption that the underlying order of the data is specified by the column that you select as the Unique identifier.
- Upper spec – If the upper specification for what you are measuring is contained in the data source, you may treat the column as an *Upper spec*. Note that there is only one number that can be the *Upper spec*. If your data selection returns an *Upper spec* value in every data row, only the last non-NULL value encountered will be used as the *Upper spec*.
- Target spec – If the target or nominal specification for what you are measuring is contained in the data source, you may treat the column as a *Target spec*. Note that there is only one number that can be the *Target*. If your data selection returns a target value in every data row, only the last non-NULL value encountered will be used as the Target.
- Lower spec – If the lower specification for what you are measuring is contained in the data source, you may treat the column as a *Lower spec*. Note that there is only one number that can be the *Lower spec*. If your data selection returns a *Lower spec* value in every data row, only the last non-NULL value encountered will be used as the *Lower spec*.

NOTE: Additional information on fetching specification values from the data source:

- If the Upper, Target, and Lower specifications are contained in a different table from the data, then you will have to use a custom query, query or view, or stored procedure in order to join your data table with your specifications table in order to use the Target spec, Upper spec, and Lower spec Treat as options.
- When a specification value is entered on the Limits/specs tab, and the same specification is fetched from the data source, the value fetched from the data source takes precedence and is used on the chart. For example, if the target spec is defined as 10.0 on the Limits/specs tab, and Target spec is specified for a data source column that contains 9.0 in row 1, NULL in rows 2 - 28, 9.5 in row 29, and NULL in row 30, then 9.5 will be the target spec value that is used for the chart.
- Measurement – (variables charts only) This tells CHARTrunner that the column contains measurements that you are interested in charting. If you mark three columns as *Measurement*, then the subgroup size (if you are making a control chart) will be three.
- Number inspected – (attributes charts only) This tells CHARTrunner that the column contains a *number inspected* count that is used for attributes control charts.
- Count – Tells CHARTrunner that the column contains counts that can be used for attributes control charts and Pareto charts.
- Cause – For control chart definitions, you may define one of your columns as an *assignable cause*. This means that the column contains information that might explain unusual conditions that will cause data to be excluded from the chart and from certain calculations, such as computing control limits. You can choose to display *cause* information on the chart on the X-axis Y-axis sub-tab.
- Note – This tells CHARTrunner to treat the column as a note. Notes are textual information that may explain some aspect of the data being charted. You can choose to display *note* information on the chart on the X-axis Y-axis sub-tab.
- Categories – (Pareto charts only) When you are creating Pareto charts, you will normally designate one of your data columns as *categories*. Usually, this will be a text column and all the unique entries in the column will form the categories for your Pareto chart.
- Group by – (Pareto charts only) Use *Group by* to create multiple Pareto charts based on groups formed by this column.
- Independent variable – (scatter diagram only) When doing a scatter diagram, you must define one of your data columns as the independent variable (x-axis).
- Dependent variable – (scatter diagram only) When doing a scatter diagram, you must define one of your data columns as the dependent variable (y-axis).
- Data 1 to Data 10 – (Multi-line chart) When defining a multi-line chart (a run chart with up to 10 data lines), you will use these settings to describe which columns from your data source will be used for each of the lines on the Multi-line chart.
- Percent – (attributes charts only) When defining a p-chart, if your data source has already calculated a percent, map the column as percent, where you would normally map a “count” column.
- Ratio – (attributes charts only) When defining a u-chart, if your data source has already calculated a ratio, map the column as ratio - where you normally would map a “count” column.

- **Product-** (Short-run SPC charts only) When defining short-run SPC charts, you have the option to treat a column as a *product*. When you are measuring many different products, this allows you to specify a column containing the product name or product type. A *Product* is similar to an identifier. However, in short-run SPC there is generally a target specification associated with each product. For example, you may have a short-run SPC chart looking at 4-inch bars and 8-inch bars being cut on the same machine. In this case the *Product* column (in your data) could contain either “4-inch” or “8-inch.” Depending on which Product you are measuring, the target will be either 8 or 4. Think of a Product as an identifier with a Target spec attached.
- **Clear all** – Click this button to clear all of your How to treat the columns choices.
- **Refresh columns** – When you edit an existing chart definition, CHARTrunner does not automatically fetch information about the data source columns, and does not display the columns that were marked as Ignored. Click this button to make CHARTrunner get current information about the columns available in the data source. This is useful if you copied a chart definition and want to map different data columns.

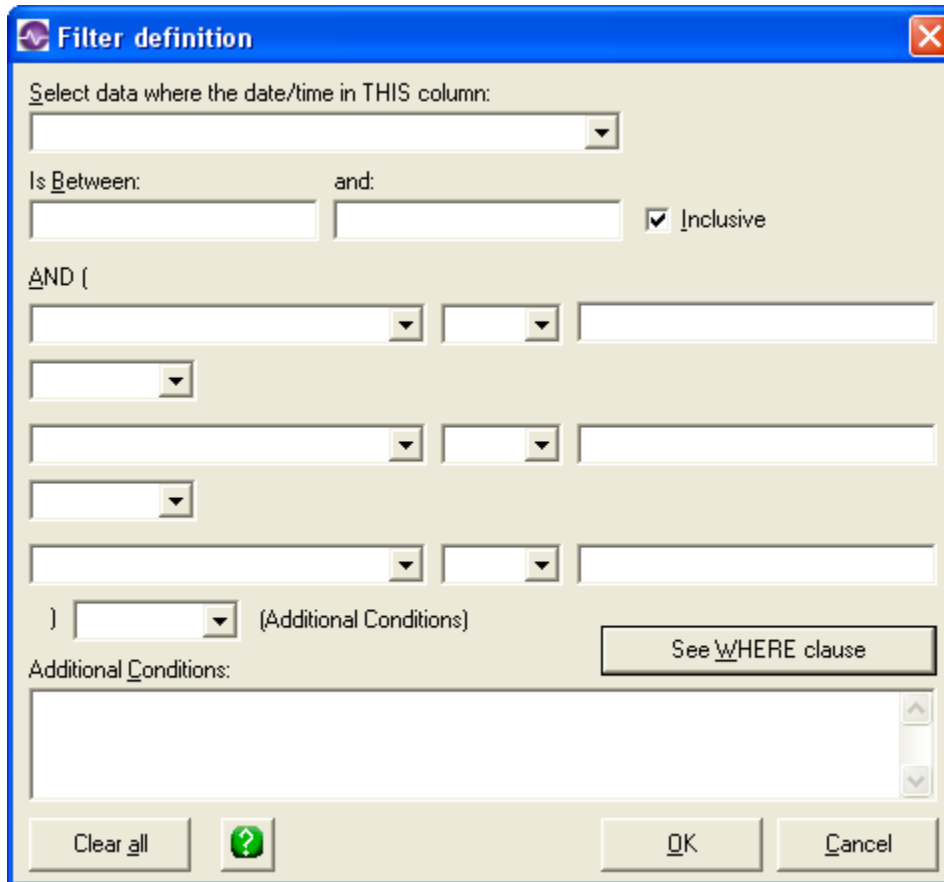
NOTE: If you are defining charts for use with CHARTrunner-e and the data source is not accessible to the computer that is used to set up the chart definition, do not click on the Refresh columns button.

- **Validate chart data** – Click on the Validate chart data button to confirm that CHARTrunner can use the data as mapped. If the data is not valid, you will get a message explaining why CHARTrunner cannot validate the data. Click the OK button to close the message box.
- **View data** – To confirm the results of your column mapping, click on View Data. The View Data window displays (300 rows maximum) the data that will be used for your chart. Click the OK button to close the window.
- **Save as default** – Click this button to save the current chart definition as the *default chart*. When you create a new chart definition, the properties of the *default chart* are used as the “starting point” for the new chart.

## Filtering chart data

The Filtering button and check box on the *Step 3: Data definition* tab allow you to filter the data from your data source so that only those rows of data that “pass through the filter” are considered for your chart. If the chart definition includes a filter definition, then either “Filter defined, not used,” or “Filter in use” will appear in blue below the Filtering button.

When you click on the Filtering button on the *Step 3: Data definition* tab, the filter definition form will open as shown below.



The dialog box is titled "Filter definition" and contains the following fields and controls:

- A label "Select data where the date/time in THIS column:" followed by a drop-down menu.
- Labels "Is Between:" and "and:" followed by two text input fields.
- A checked checkbox labeled "Inclusive".
- A label "AND (" followed by a group of three fields: a drop-down menu, a text input field, and another drop-down menu.
- A second group of three fields: a drop-down menu, a text input field, and another drop-down menu.
- A third group of three fields: a drop-down menu, a text input field, and another drop-down menu.
- A label ")" followed by a drop-down menu and the text "(Additional Conditions)".
- A button labeled "See WHERE clause".
- A label "Additional Conditions:" followed by a large text area.
- Buttons at the bottom: "Clear all", a green question mark icon, "OK", and "Cancel".

- Select data where the date/time in THIS column

If your data source includes a date/time column and you want to filter based on that column, then select the column name from the drop-down list. This is an optional field.

If you selected a date/time column name, then enter a date/time range in the Is between: and and: fields. To include the dates selected, Inclusive must be selected.

NOTE: Some databases require delimiters for date values. Consult the documentation for your database to determine which delimiters are required. Microsoft Access, for example, requires # delimiters to query dates in the US date format and 'delimiters for the international date formats. US-formatted dates would be entered as #10/18/2000#. An international date would be entered as '18/10/2000'.



If the date range is the only filtering criterion, click the OK button. If not, enter additional conditions in the comparison fields between the AND (and). To do this:

1. Select a column name from the drop-down menu.
2. Specify the type of comparison. Options are:

=	Equal to
<	Less than
>	Greater than
< >	Inclusive
> =	Greater than or equal to
< =	Less than or equal to
LIKE	Similar to
3. In the third field, enter the data on which you want to make this comparison. See the illustration on the previous page for an example.
4. For additional filtering, select AND or OR from the drop-down menu and repeat Steps A - C.
5. Use the Additional conditions field if you have more than three arguments. You must enter a valid SQL SELECT "WHERE" clause.
  - See WHERE clause – Click this button to see the filter conditions that you have entered as they will be used in a SQL SELECT "WHERE" clause. To review the filter clause, click on the See WHERE clause button. Click the OK button to close the window.

## Query parameters

Databases such as SQL Server and Oracle allow you to define stored procedures that require input parameters, such as a date range. Similarly, Microsoft Access allows you to define queries with input parameters. Other data sources, such as Excel, text files, and databases that use the Microsoft Jet database engine allow you to specify query parameters in the WHERE clause of the SELECT statement in a custom query. CHARTrunner can generate charts for any of these situations.

In addition, you can specify one or more *Custom Parameters* as part of the SQL SELECT statement in a custom query. The *Custom Parameters* feature can be used for *any* data source. Consider the SELECT statement shown below, where two *Custom Parameters* are used, one to specify which table to use and the other to specify the minimum ID value.

```
SELECT * from {{Table name}} WHERE ID >= {{Minimum ID}} ORDER BY ID
```

When CHARTrunner examines the custom query shown above, it treats anything enclosed by {{ and }} as the name of a *Custom Parameter* that can be dealt with via the Parameters button on the Step 3: Data definition tab. As CHARTrunner fetches the data for the chart, it substitutes the appropriate *Custom Parameter* value in place of {{Table name}} and {{Minimum ID}}. For example, if the value of the *Table name* parameter is MyFineTable and the value of the *Minimum ID* parameter is 10, then the query that is actually passed to the database engine is:

```
SELECT * from MyFineTable WHERE ID >= 10 ORDER BY ID
```

Consider what happens while you are in the process of defining the chart definition that uses the query shown above. When you click the OK button on the Custom query editor window, CHARTrunner adds the *Table name* and *Minimum ID* parameters to its list of parameters used by the chart. When CHARTrunner adds a new parameter, it defaults the parameter's value to be the NULL value. Then CHARTrunner attempts to verify that the custom query you have entered is valid by passing the query to the database engine to see if it reports any errors. But, when NULL is substituted in place of {{Table name}} and {{Minimum ID}}, the resulting query (shown below) is not a valid query:

```
SELECT * from NULL WHERE ID >= NULL ORDER BY ID
```

When CHARTrunner detects an error in a custom query that has one or more *Custom Parameters*, it will automatically display the "Query parameters" window that allows you to assign valid values to your query parameters.

To chart data that requires parameter input:

1. On the *Step 3: Data definition* tab, specify a source for data records: Query or view, Stored procedure, or Custom query.
2. Select a Query or Stored procedure from the drop-down menu or click on the Enter query button to enter a Custom query.

3. If the data source requires input parameters, CHARTrunner will display the Parameters button and a Prompt for parameters check box on the Step 3: Data definition tab, as shown below.

The screenshot shows the CHARTrunner - Measurement control chart 18 (mfg) dialog box, Step 3: Data definition tab. The 'Source for data records' section has 'Query or view' selected, with 'ParameterQuery2' in the dropdown. The 'Keep columns' checkbox is checked. The 'Result records to include' dropdown is set to 'All'. The 'Prompt for parameters' checkbox is checked. The 'How to treat the columns' table is as follows:

Column name	Data type	Treat as	Label
Operator	Text	Identifier	Operator
Diameter1	Numeric	Measurement	Diameter1
Diameter2	Numeric	Measurement	Diameter2
Diameter3	Numeric	Measurement	Diameter3
DateOnly	Text	Identifier	Date

Buttons at the bottom include 'View data', 'Save as default', 'Parameters' (highlighted with a green question mark), 'OK', and 'Cancel'.

4. Click on the Parameters button to display the Query Parameters form.

The screenshot shows the Query Parameters dialog box. It contains a table with the following data:

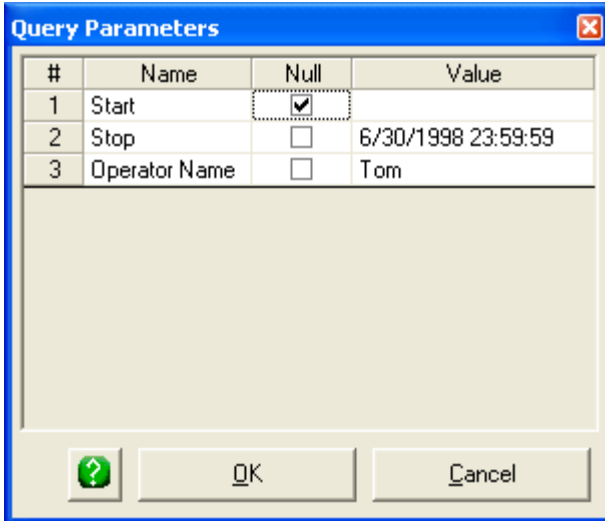
#	Name	Null	Value
1	Start	<input type="checkbox"/>	1/1/1998
2	Stop	<input type="checkbox"/>	6/30/1998 23:59:59
3	Operator Name	<input type="checkbox"/>	Tom

Buttons at the bottom include 'OK' and 'Cancel'.

5. In the figure shown, a stored procedure has been defined that requires three input parameters: Start, Stop, and Operator Name. The chart definition has been set up so that 1/1/1998 is the default starting date, 6/30/1998 23:59:59 is the default ending date, and Sam is the default operator.

6. If Prompt for parameters is unchecked, CHARTrunner will use the default parameters to retrieve data.  
If Prompt for parameters is checked, CHARTrunner will display the Query Parameters form so you can change the parameter values as needed.
7. Click the OK button to save the default parameters.

To pass the Null value into a query parameter, check the Null checkbox as shown below. If Null is selected for a parameter, you will not be able to enter a value for that parameter.



The image shows a 'Query Parameters' dialog box with a blue title bar and a close button. It contains a table with three columns: '#', 'Name', 'Null', and 'Value'. The table has three rows: 1. 'Start' with 'Null' checked and 'Value' empty. 2. 'Stop' with 'Null' unchecked and 'Value' '6/30/1998 23:59:59'. 3. 'Operator Name' with 'Null' unchecked and 'Value' 'Tom'. Below the table is a large empty text area. At the bottom are three buttons: a green question mark icon, 'OK', and 'Cancel'.

#	Name	Null	Value
1	Start	<input checked="" type="checkbox"/>	
2	Stop	<input type="checkbox"/>	6/30/1998 23:59:59
3	Operator Name	<input type="checkbox"/>	Tom

## Custom query

By selecting Custom query in the *Step 3: Data definition* tab, the user can supply an SQL query to fetch the chart's data.

Queries take the form of SQL statements. SQL stands for structured query language, a standard way of asking a database for information. Some queries are quite simple and use only a single table, as in the following example:

```
SELECT MfgDate, Length_1, Length_2, Length_3 FROM DailyProduction
```

Some queries are more complicated and use a WHERE clause to ask for a subset of the data, as in this example:

```
SELECT * FROM DailyProduction WHERE MfgDate > '1/1/1999' and MfgDate < '1/31/1999'
```

The \* in this example means that I want ALL the columns from the table.

When you need to query information from two or more tables, you must create a slightly more complex query called a join query. This type of query allows you to take advantage of multiple tables that are linked or related.

Here is an example of a join query that can be used with Microsoft Access:

```
SELECT * FROM Orders INNER JOIN Customers ON Orders.CustomerNumber =  
Customers.CustomerNumber
```

This query joins the Customers and Orders tables. The resulting table contains all the columns from both tables in what looks like a single table.

Because SQL is powerful and flexible, it can also be complicated. Teaching SQL is beyond the scope of this document; however, the key point as it relates to CHARTrunner is that any SQL query from a database can be the data source for a CHARTrunner chart. For more information on SQL, try a Web site such as <http://www.w3schools.com/sql/> (<http://www.w3schools.com/sql/>) or <http://www.sqlcourse.com/> (<http://www.w3schools.com/sql/>) or a reference book such as Philip J. Pratt's *A Guide to SQL*, 1995, Boyd & Fraser Pub Co. or Martin Gruber's *Understanding SQL*, 1990, Sybex.



## CHAPTER 7

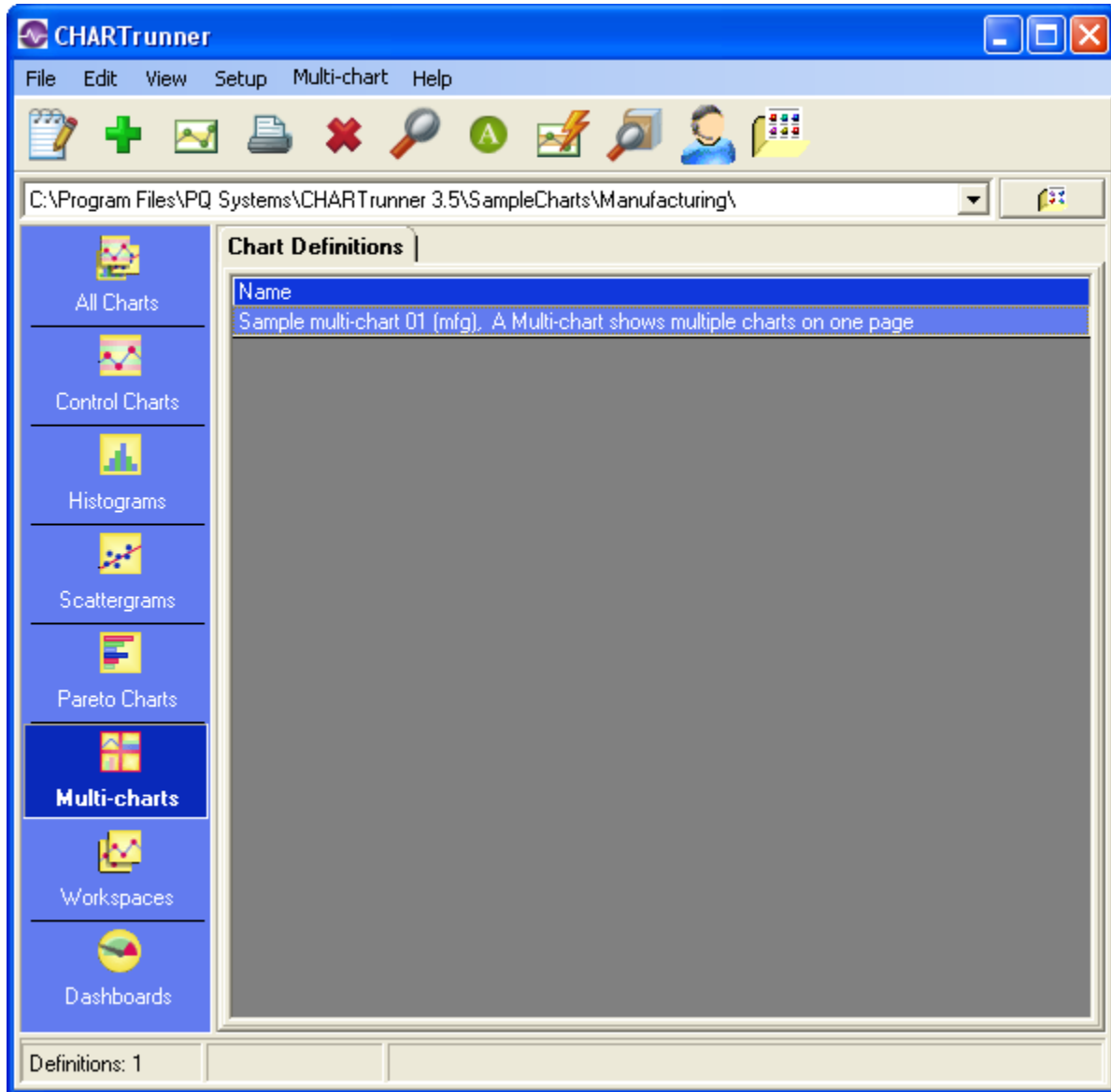
# Multi-charts and Workspaces

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## Multi-charts (multiple charts on one page)

A multi-chart is a chart that acts as a container for one or more regular charts. Multi-charts are used when you need to see more than one chart displayed in the same window or printed on the same page. On the CHARTrunner definitions list, all of the multi-charts in the current chart folder are shown in the list as shown below:

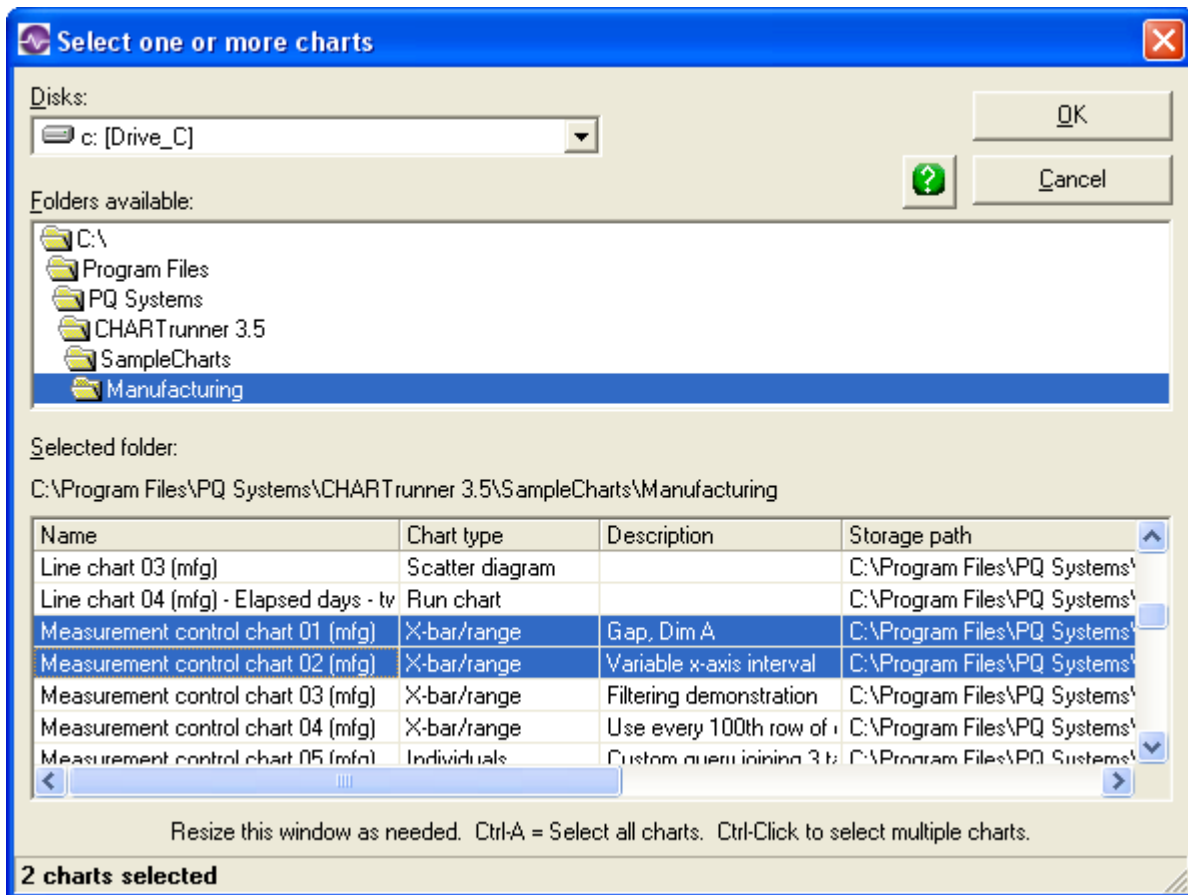


- Print a multi-chart – To print a multi-chart, right-click on the chart in the CHARTrunner definitions list and select one of the printing options. With a multi-chart, you have these two options for printing:
  1. Print (1 page) – Print all the child charts on a single printer page.
  2. Print (1 page per chart) – Print each child chart on a separate printer page.



- Display a multi-chart – To display a multi-chart, right-click on the chart in the CHARTrunner definitions list and select Display. While a multi-chart is displayed, you may right-click on a child chart and select the Zoom In or Zoom Out option. These options allow you to toggle between viewing the entire multi-chart and viewing just one child chart.
- Edit a multi-chart – To make changes to an existing multi-chart, right-click on the chart in the CHARTrunner definitions list and select Edit. This will display the multi-chart definition form and allow you to edit the chart definition and save your changes.
- Create a new multi-chart – To create a new multi-chart, right-click in the Multi-charts section of the CHARTrunner definitions list and select New multi-chart. The new multi-chart definition form will appear.

Enter a name and description for the new multi-chart. Use the Add charts button to select from the list of regular charts each chart that you want to include on the multi-chart. In the example below, two charts have been selected.



You may select as many charts as you like; however, legibility can suffer when you place too many charts in a multi-chart. Charts may be selected from any chart folder that contains charts. You may select multiple charts by holding down the Shift or the Control key and selecting charts with the mouse.

**Multi-chart**

Name:  Refresh interval (blank = none):  seconds

Description:

Charts | Titles | Misc.

#	Name	Chart type	Description	Chart definition
1	Attributes control chart 01 (mfg)	p-chart	Horizontal grid lines	C:\Program Files\
2	Attributes control chart 02 (mfg)	c-chart	Data above the chart	C:\Program Files\
3	Attributes control chart 03 (mfg)	u-chart	Displays data values n	C:\Program Files\
4	Attributes control chart 04 (mfg)	np-chart	Temporary limits	C:\Program Files\
5	Box & Whisker chart 02 (mfg)	Box and W	Average Dayton Temp	C:\Program Files\
6	Box & Whisker chart 04 (mfg)	Box and W	Average Dayton Temp	C:\Program Files\
7	Measurement control chart 01 (m	X-bar/rang	Gap, Dim A	C:\Program Files\

Chart tiling:  
☒ Horizontal Rows:   
☐ Vertical Columns:

You may resize this window as needed. CHARTrunner will remember the window size.

Once you have named your multi-chart and selected the charts you want to include, the multi-chart definition form will look similar to the sample shown above.

- Name – Enter the name for the chart definition.
- Description – Enter the description of the chart.
- Refresh interval – Enter the interval in seconds for the displayed chart to automatically perform a refresh in order to chart new data. Leave this field blank if you do not want the chart to automatically refresh.
- Chart tiling – This section describes how the child charts will be arranged in a grid when the Multi-chart is rendered.
  - Horizontal – Select this option for the child charts to tile left-to-right and up-to-down.
  - Vertical – Select this option for the child charts to tile up-to-down and left-to-right.
  - Rows – Specify the number of rows to allocate for the child charts to tile into.
  - Columns – Specify the number of columns to allocate for the child charts to tile into.
- Add charts – Click this button to open the *Select one or more charts* window where you can select the child charts to be added to the multi-chart.

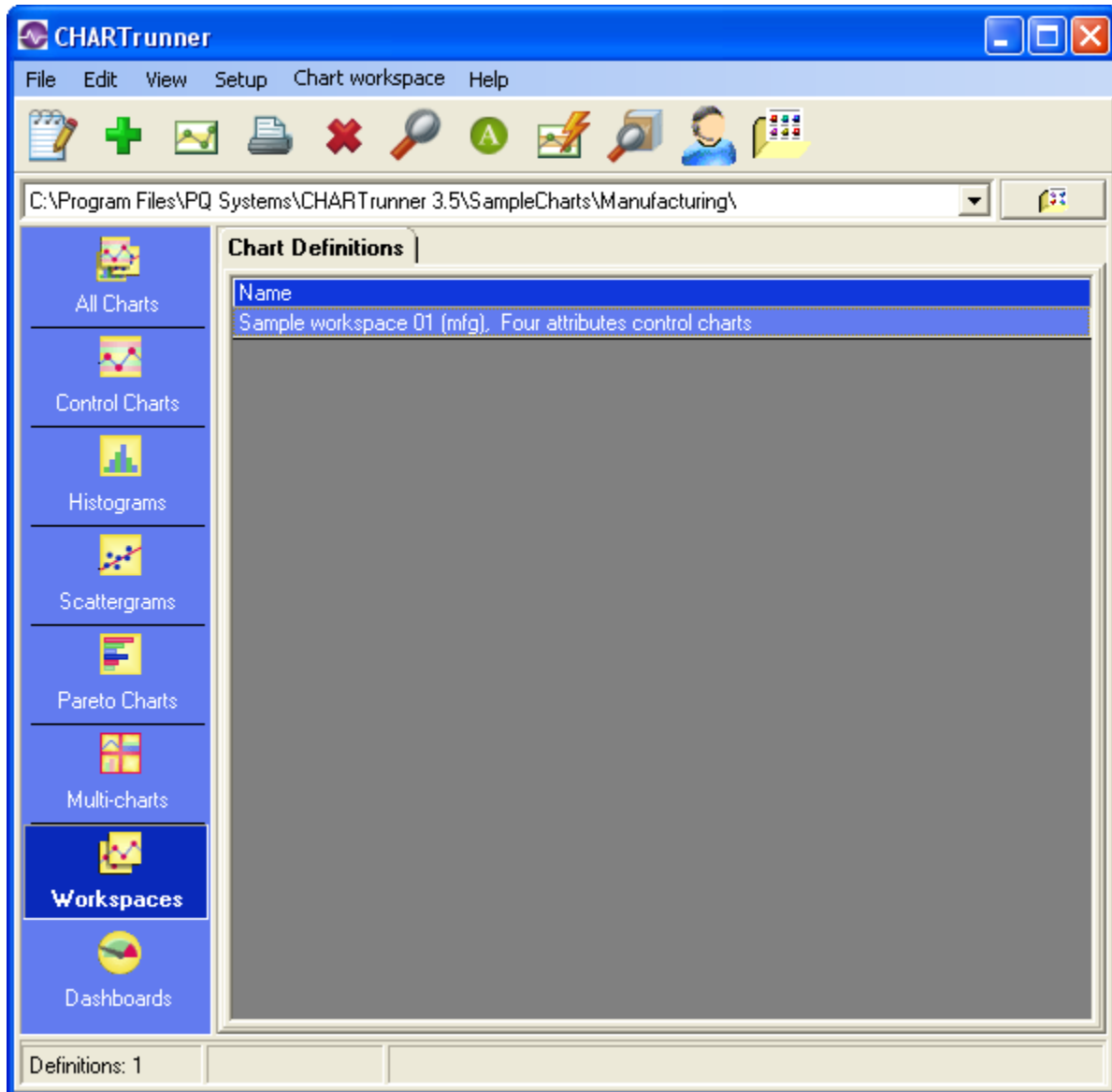
- Display chart – Click this button to display the currently selected child chart in the list of child charts.
- Modify chart – Click this button to edit the currently selected child chart in the list of child charts.
- Remove chart – Click this button to remove the currently selected child chart from the list of child charts. The child chart definition is not changed in any way; it is simply removed from the list of child charts for this multi-chart.

Use the Titles tab to set up chart titles the same way you do for all charts. For more information about this tab, see ***Titles tab - applies to all charts*** (on page 190).

The Misc. tab allows you to set print orientation, image defaults, and Web page defaults. For more information about this tab, see ***Misc. tab – Applies to all charts*** (see "Misc. tab - applies to all charts" on page 195).

## Workspaces (dealing with multiple charts)

A workspace is a chart that acts as a container for one or more member charts (a member chart cannot be another workspace). Workspaces are useful when you have two or more related charts that you work with at the same time. For example, imagine that you have six charts that you print and take to the Friday quality meeting. By putting these six charts into a workspace, you can print them all with a single command. Similarly, you can generate chart images from all six charts with a single command. On the CHARTrunner definitions list, all of the workspaces in the current chart folder are shown in the Chart workspaces section as shown below:



- **Print a workspace** – To print workspace, right-click on the workspace in the CHARTrunner definitions list and select Print. Each chart in the workspace will be printed on its own page.
- **Display a workspace** – You may display a chart workspace the same way you display any chart. However, each chart within the workspace will be displayed in its own window. If your workspace contains a large number of charts, you may want to avoid displaying it as the screen can become cluttered and it may take the computer a long time to display all the charts. To display the workspace, right-click on the chart in the CHARTrunner definitions list and select Display.
- **Chart review and workspaces** – If your workspace contains multiple charts, you can review each member chart in the workspace via a single chart display window. Right-click on the workspace in the CHARTrunner definitions list and select Chart Review, which causes the first chart in the workspace to be displayed. Use the chart review keys Ctrl-Home, Ctrl-End, PageDown and PageUp to navigate back and forth among the charts in the workspace.
  - **Chart slideshow** – Use the Review > Slideshow pull-down menu while reviewing a member chart to start a slideshow where each chart in the workspace is displayed in a round-robin fashion at the specified interval.
- **Workspace batch operations** – Several right-click menu choices allow you to perform a useful task on every member chart contained in the workspace. These commands all appear on the right-click menu when you have a workspace selected in the CHARTrunner definitions list.
  - **Save chart as clipCHART** – Save the workspace as a clipCHART.
  - **Save all charts as image to default folder** – Use this command to generate chart images from each chart in the workspace. The chart images will be stored where the chart definition is set to store them. This location is set on the chart definition form, on the *Misc.* tab, under Image file defaults.
  - **Save all charts as image to specified folder** – Use this command to generate chart images from each chart in the workspace. You will be prompted for the folder into which the chart images will be saved.
  - **Save all charts as Web pages to default folder** – Use this command to generate a Web page for each chart in the workspace. The Web pages will be stored where the chart definition is set to store them. This location is set on the chart definition form, on the *Misc.* tab under Web page defaults.
  - **Save all charts as Web pages to specified folder** – Use this command to generate a Web page for each chart in the workspace. You will be prompted for the folder into which these Web pages will be saved.
  - **Send all charts as e-mail** – Use this command to generate each chart in the workspace as an image, attach the images to an e-mail, and send the e-mail to one or more recipients. You will be prompted for e-mail addresses and other information related to the e-mail message.

- Edit a workspace – To make changes to an existing workspace, right-click on the workspace in the CHARTrunner definitions list and select Edit. The workspace definition form will appear to allow you to edit the workspace definition and save your changes.
- Create a new workspace – To create a new workspace, right-click in the *Chart workspaces* section of the CHARTrunner definitions list and select New chart workspace. The new chart workspace definition form will appear as shown below:

**Chart workspace**

Name:

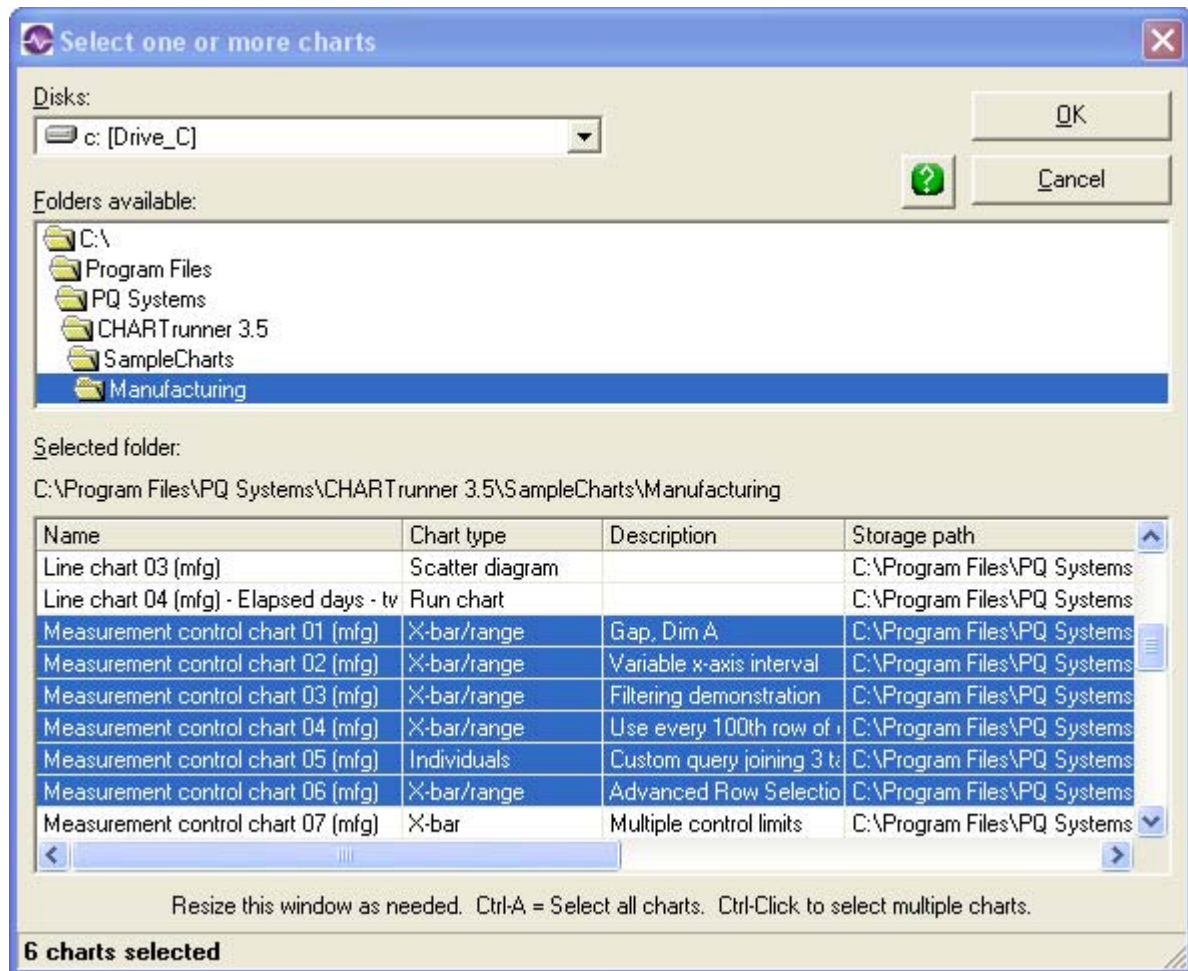
Description:

Charts

#	Name	Chart type	Description	Chart definition
---	------	------------	-------------	------------------

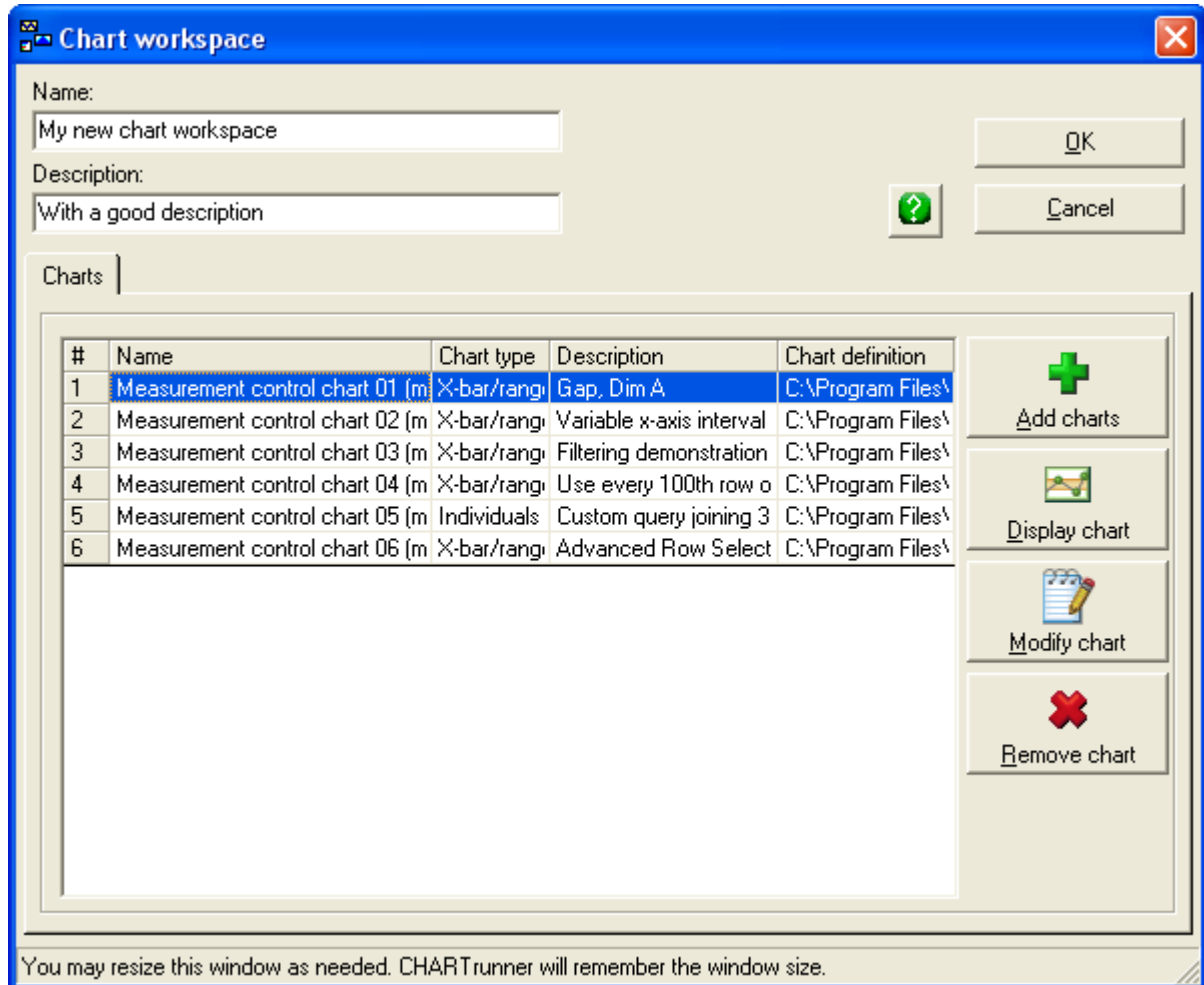
You may resize this window as needed. CHARTrunner will remember the window size.

Enter a name and description for the new workspace. Use the Add charts button to select from the list each member chart that you want to include in the workspace. In the example below, six charts are about to be selected.





You may select as many charts as you like. Charts may be selected from any chart folder that contains charts. You may select multiple charts by holding down the Shift or the Control key and selecting charts with the mouse.



**Chart workspace**

Name: My new chart workspace

Description: With a good description

Charts

#	Name	Chart type	Description	Chart definition
1	Measurement control chart 01 (m)	X-bar/rang	Gap, Dim A	C:\Program Files\
2	Measurement control chart 02 (m)	X-bar/rang	Variable x-axis interval	C:\Program Files\
3	Measurement control chart 03 (m)	X-bar/rang	Filtering demonstration	C:\Program Files\
4	Measurement control chart 04 (m)	X-bar/rang	Use every 100th row o	C:\Program Files\
5	Measurement control chart 05 (m)	Individuals	Custom query joining 3	C:\Program Files\
6	Measurement control chart 06 (m)	X-bar/rang	Advanced Row Select	C:\Program Files\

Add charts

Display chart

Modify chart

Remove chart

You may resize this window as needed. CHARTrunner will remember the window size.

Once you have named your workspace and selected the member charts you want to include, the workspace definition form will look similar to the sample shown above.

- Name – Enter the name for the chart definition.
- Description – Enter the description of the chart.
- Add charts – Click this button to open the *Select one or more charts* window where you can select the member charts to be added to the workspace.
- Display chart – Click this button to display the currently selected member chart in the list of member charts.
- Modify chart – Click this button to edit the currently selected member chart in the list of member charts.
- Remove chart – Click this button to remove the currently selected member chart from the list of member charts. The child chart definition is not changed in any way; it is simply removed from the list of member charts for this workspace.



## CHAPTER 8

# Customizing a chart definition

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## Measurement control charts

A measurement (or variables) control chart plots characteristics of your process that can be measured and expressed numerically, such as width, height, and thickness.

## Types of measurement control charts

Chart type options for measurement charts are shown below:

- X-bar
- X-bar/range
- X-bar/sigma
- Range
- Sigma
- Median
- Individuals
- Individuals/moving range
- Individuals/moving sigma
- Moving average
- Moving average/moving range
- Cusum chart
- Three-way chart.

When you select a measurement control chart, the following tabs allow you to customize your chart:

**Limits/specs tab** (see "Limits/specs tab - measurement charts" on page 115)

**Control chart tab** (see "Control chart tab - measurement charts" on page 117)

**Chart options sub-tab** (see "Chart options sub-tab - measurement charts" on page 117)

**X-axis Y-axis sub-tab** (see "X-axis Y-axis sub-tab - measurement charts" on page 120)

**Extra lines sub-tab** (see "Extra lines sub-tab - measurement charts" on page 122)

**Chart data display sub-tab** (see "Chart data display sub-tab - measurement charts" on page 124)

## Limits/specs tab - measurement charts

Control limit lines on a control chart are used as a basis for judging whether variation in data on a chart is due to special or common causes. The limits are calculated from data collected from the system under observation. CHARTrunner allows you to calculate a set of control limits by highlighting a set of data (subgroups) on a chart and selecting Compute limits via the right-click menu. Control limits are not specifications nor are they arbitrary limits set by customers or management.

Specifications are boundaries, usually set by management, engineering, or customers, within which a system must operate. They are sometimes called engineering tolerances.

The Control limits sub-tab allows you to select your control limit options and enter the specification limits for the process that the chart represents.

**CHARTrunner - Measurement control chart 07 (mfg)**

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | **Limits/specs** | Control chart | Titles | Misc.

**Control limits**

Control limits:

- ☐ None
- ☐ Use temporary limits computed from data in the chart
- ☒ Apply selected saved control limits (below) to the chart

Label limit lines with:  
Name and value

Specifications:

Upper:

Target:

Lower:

Saved control limits: (saved while viewing chart)

Name	Use	Extend	Xbar UCL	Xbar CL	Xbar LCL	Order by	Calc from	Calc to
Set 1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	82.04	78.35	74.66	SGNUM	1	15
Set 2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	76.84	73.15	69.46	SGNUM	21	37
Set 3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	73.78	70.09	66.40	SGNUM	71	92

View data | Save as default | | | OK | Cancel

## Control Limits

- None – No control limits are used on the chart.
- Use temporary limits computed from the data in the chart – CHARTrunner will calculate control limits based on all the data that you have selected for the chart, except for data that has a special cause. In general, this is not the best option to use.
- Apply selected saved control limits (below) to the chart – The chart will use the limits saved for this chart (shown in the Saved control limits table) that have a check mark in the Use column.
- Use the Lloyd Nelson limits option – This option is visible only for Individuals and Individuals/Moving Range control charts. Any control limits, including temporary limits, that are created or calculated when this option is selected will be calculated using the **Lloyd Nelson** (see "Lloyd Nelson limits option" on page 233) rules.
- Label limit lines with – Select one of the following options for labeling the limit lines:
  - Nothing
  - Name
  - Value
  - Name and value.

NOTE: Control limits can be calculated, edited, and saved from the chart display window. Control limits that have been saved in the display window appear in the Saved control limits table of this tab.

- Saved control limits table (saved while viewing chart) - Each set of control limits that have been computed on the chart display window are shown in this table.
  - Name – The name given to the set of control limits when the limits were computed on the chart display window.
  - Use – Place a check mark to cause this set of limits to be used on this chart.
  - Extend – Place a check mark to cause the limit lines for this set of limits to be extended to the next adjacent limit set on the chart, or to the edge of the chart if there is no adjacent limit set.
  - Order by – This specifies how the chart's data was ordered when the limit set was calculated. Limit sets are displayed on the chart only when the current order of the chart's data is the same as when the limit set was calculated. If no data order was specified for the chart's data when the limit set was calculated, this will be blank, and the Calc from and Calc to will be in terms of relative subgroup number. For more information on how the data order column is determined see ***Understanding the data order concept***.
  - Calc from – Specifies the leftmost boundary of the chart data that was selected when the limit set was calculated. If the Order by is blank, the Calc from will be in terms of relative subgroup number.
  - Calc to – Specifies the rightmost boundary of the chart data that was selected when the limit set was calculated. If the Order by is blank, the Calc to will be in terms of relative subgroup number.

### Specifications

- Enter values for Upper and Lower specifications and the Target (sometimes called the Nominal) value for the process. The specifications are optional. If your process has only one Upper or Lower specification, enter that value in the appropriate field and leave the other Upper or Lower field blank.

NOTE: When a specification value is entered on the Limits/specs tab, and the same specification is fetched from the data source using the Treat as field on the Step 3: Data definition tab, then the value fetched from the data source takes precedence. For example, if the target spec is defined as 10.0 on the Limits/specs tab, and the target spec is fetched from a data source column that contains 9.0 in row 1, NULL in rows 2 - 28, 9.5 in row 29, and NULL in row 30, then 9.5 will be the target spec value that is used for the chart.

## Control chart tab - measurement charts

Use this tab to customize the chart display.


### Chart options sub-tab - measurement charts

Use this tab to customize the chart display. Click the All button to select all chart options. Click the Clear button to unselect all chart options. Click the Default button to select the default options.



**CHARTrunner - Measurement control chart 01 (mfg)**

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Limits/specs | **Control chart** | Titles | Misc.

**Chart options** | X-axis | Y-axis | Extra lines | **Chart data display**

☒ Data line  
☒ Data line markers  
☒ Perform out-of-control tests  ☐ Reset out-of-control after each signal  
☒ Out-of-control test boxes  
☐ Out-of-control test lines  
☒ Out-of-control test numbers  
☐ Color 1,2,3 sigma zones  
☐ Sigma lines  
☐ Percent in 1,2,3 sigma title  
☐ Blank chart  
☐ Show negative limits  
  
☐ Vertical grid lines  
☐ Horizontal grid lines  
☐ Display data values near point

Decimal places for statistics:

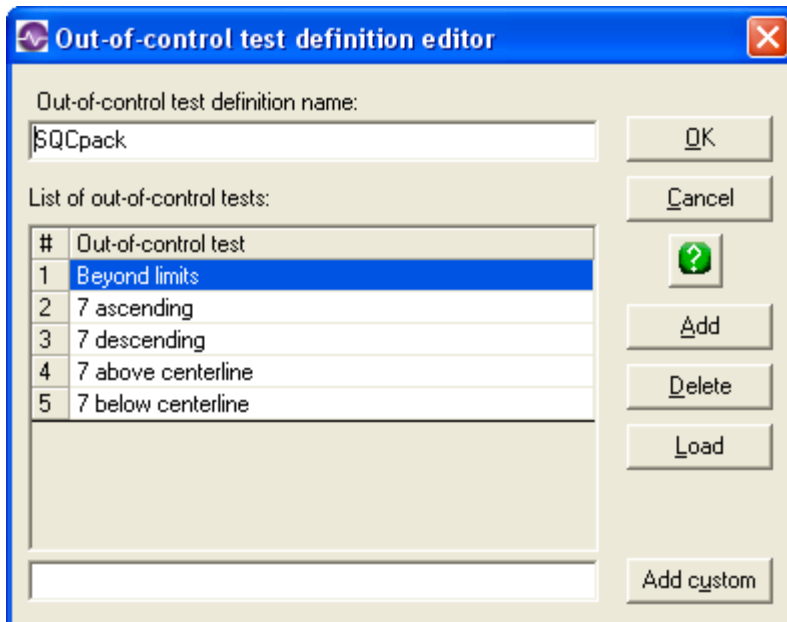



The following options may be specified on the Chart options sub-tab:

- Data line – Enable this to draw the line connecting data points.
- Data line markers – Enable this to display the marker for each data point.
- Perform out-of-control tests – Enable this to perform out-of-control testing for the chart using the current set of test rules. Test rules can be defined on a per-chart-definition basis, or one set of test rules can be applied to all charts. Use Setup > Preferences > "Use the same out-of-control tests for all charts" to enable or disable using the same set of test rules for all charts. Use Setup > "Out-of-control tests" to specify which set of test rules is used when the same set of rules is applied to all charts.
  - Out-of-control test boxes – Draws a box around a set of out-of-control points. The box will be labeled with the test that failed.
  - Out-of-control test lines – Draws a line near the top of the chart for each test that has at least one failure. The line is labeled with the test that failed. Using test lines rather than test boxes can be useful when test boxes make the chart look too crowded.
  - Out-of-control test numbers – Labels the chart with a numeric code for each out-of-control test that failed. The numeric code corresponds to the position of the test in the set of test rules that is used for the chart. See the discussion above for Perform out-of-control tests to determine which set of test rules is in effect for the chart.
  - Reset out-of-control after each signal – If this option is enabled, the out-of-control test engine will reset itself after each primary out-of-control point on the chart. This results in the rules for testing subsequent points being applied as though the subsequent points are in a new series. It is recommended that this option NOT be enabled unless you really want this behavior.



- Color 1,2,3 sigma zones – Shows the 1, 2, and 3 sigma zones in different colors on the chart. The three sigma zones are determined by dividing the region between the control limit and the center line into three equal regions. Thus, if you are using 3.0 sigma limits, then these zones will correspond to 1.0, 2.0, and 3.0 sigma.
- Sigma lines – Shows lines at the 1, 2, and 3 sigma zone boundaries. This is similar to Color 1,2,3 sigma zones, but instead of coloring the zones, only a boundary line between each zone is shown.
- Percent in 1,2,3 sigma title – Shows in the titles area the percentage of data points within the 1, 2, and 3 sigma zones.
- Blank chart – Enable this option to draw a blank chart that has no chart data displayed. This feature is used to print a blank chart form for plotting data manually.
- Show negative limits – Enable this to display negative limits on the chart. If your process can have data values that fall below zero, you should enable this option.
- Vertical grid lines – Enable this to show vertical grid lines on the chart.
- Horizontal grid lines – Enable this to show horizontal grid lines on the chart.
- Display data values near point – Enable this to place a small label showing the data value next to each data point on the chart.
- Subgroups in moving range – Enter the number of data points to use for the moving range, moving sigma, or moving average calculation. This field is visible only for individuals data, which means that on the *Step 3: Data definition* tab, you have mapped only one data column as a *measurement*. The recommended value is 2.
- Decimal places for statistics – Specifies how many decimal places to display for calculated statistics.
- Annotations – Click this button to open a window that displays the annotations that are attached to this chart. This allows you to remove annotations from the chart. Sometimes, when an annotation is attached to a subgroup that no longer appears on the chart, this is the only way to delete the annotation from the chart definition.
- Test rules – Click the Test rules button to open the *Out-of-control test definition editor* window shown below, which allows you to define the out-of-control tests that are stored in this chart definition. See the discussion above for Perform out-of-control tests to determine whether this set of test rules is used for evaluating out-of-control conditions for this chart, or whether one set of rules is applied to all charts.



- Enter a name in the Out-of-control test definition name field to identify this set of out-of-control test rules.
- Click on the Add button to add a predefined test rule. The *Select an out-of-control test* window opens to display the predefined test rules you may select from. Highlight the test rule or rules you desire to use (select multiple rules with Ctrl-Click) and click the OK button.
- Click on the Add custom button to add the custom rule you entered in the field to the left of the button into the list of rules.
- Added rules are placed below the currently selected row in the list. Arrange the order of the test rules by clicking and dragging the rule number with the mouse.
- Click on the Load button to load an existing set of rules that have been defined in Setup > “Out-of-control tests” into the list. The loaded set of rules will replace any rules currently in the list.
- Highlight a test rule in the list and click the Delete button to remove the rule from the list.

## X-axis Y-axis sub-tab - measurement charts

Here you define the options that determine how CHARTrunner labels the X-axis (the horizontal axis) and establishes the scaling for the Y-axis (the vertical axis).

The screenshot shows the 'CHARTrunner - Measurement control chart 17 (mfg)' dialog box. The 'X-axis Y-axis' sub-tab is selected. The 'X-axis' section includes a 'Label x-axis with:' dropdown set to 'DateTime', radio buttons for 'Label every subgroup', 'Place n labels across the chart' (selected), and 'Label every n subgroups' (with 'n' set to 30). There is a checkbox for 'Scale x-axis with variable interval based on x-axis label'. The 'Y-axis' section has radio buttons for 'Automatic scale' (selected) and 'User scale'. On the right, there are checkboxes for 'Enable horizontal x-axis scrolling' and 'Chart width in subgroups, blank = all:' with options 'Start at left' and 'Start at right'. Below these are dropdowns for 'Causes' and 'Notes', both set to 'Display nothing'. The bottom of the dialog has buttons for 'View data', 'Save as default', a user icon, a help icon, 'OK', and 'Cancel'.

### X-axis

- In the Label x-axis with field, select a label option from the drop-down menu. The default value is Nothing. Other options are Numbers and specific identifier fields. Identifier fields in this menu are those mapped in the Step 3: Data definition tab. Select the option you want.
- Select an option to determine the number and type of labels you want to appear on the chart's X-axis. Options are:
  - Label every subgroup – Displays a label on each subgroup or data point. For charts with a large number of data points, this option may cause the labels to overlap.
  - Place n labels across the chart – Displays only the number of labels that you specify across the chart. Enter the number of labels in the n = field.
  - Label every n subgroups – Displays a label on every nth subgroup or data point. - Label every n units – Displays a label on every nth unit. This option is available only if you have selected a date/time field for the Label x-axis with option. If you select this option, you must specify the units, such as Days, Months, or Quarters in the units = field and the number of time units in the n = field.
- If you want to Scale x-axis with variable interval based on x-axis label, select this option. It tells the chart to set the spacing between the data points on the chart to reflect where each data point falls along the timeline (or number line) established by the identifier used to label the X-axis. This option is available only when the X-axis is labeled with a date/time or numeric identifier, and the data source is ordered by the identifier used to label the X-axis.

NOTE: How is the order of the data source determined? On the *Step 3: Data definition* tab, when the data source is a "Table" the Column to use for Order By field determines the order of the data. When a "Query or view," "Stored procedure," or "Custom query" is used as the data source, it is assumed that the data is ordered by the "Unique identifier" column.

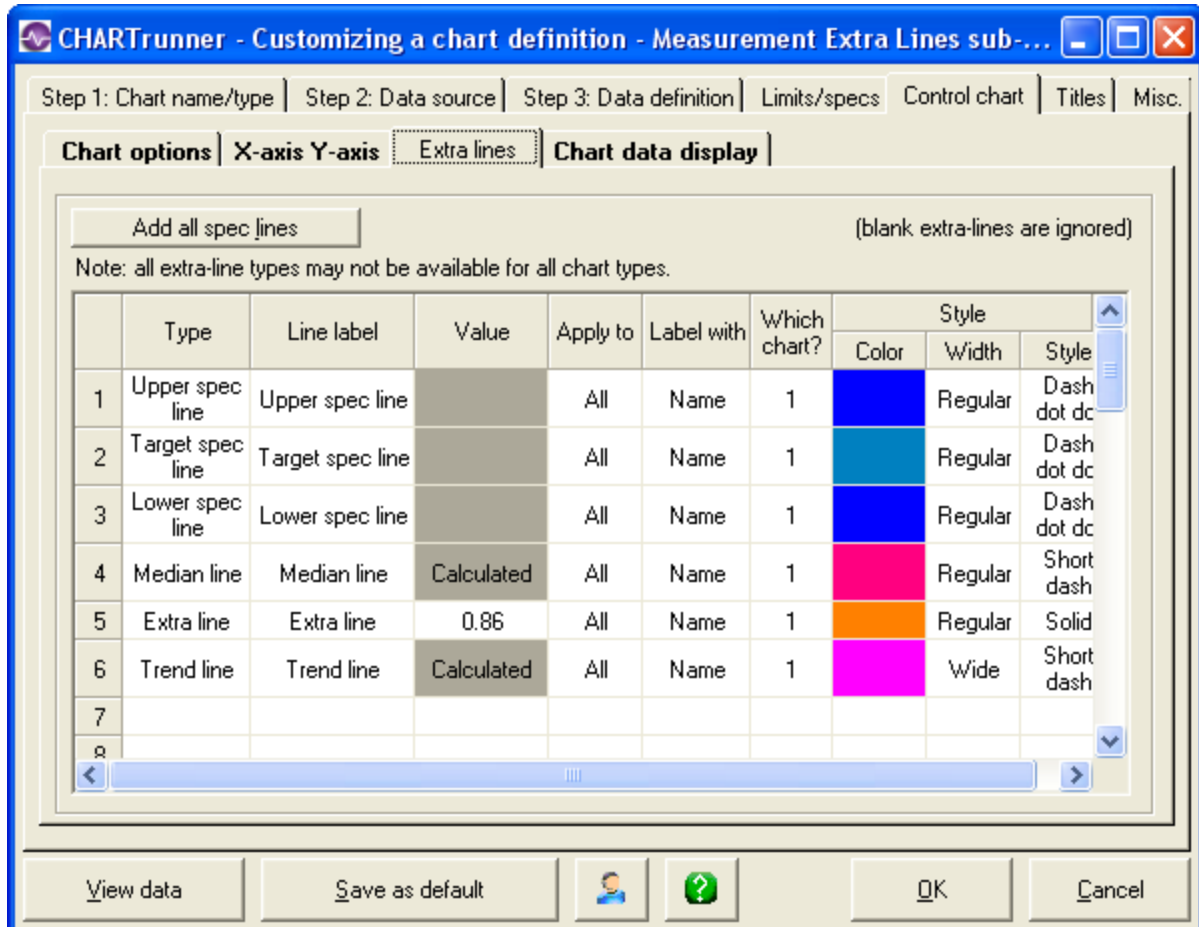
- Select Enable horizontal x-axis scrolling if you want the ability to scroll the chart through the data points using the mouse. The Chart width in subgroups field specifies the number of data points to display across the chart. Specify whether the chart initially displays the specified number of data points from the beginning of the data source (Start at left) or from the end of the data source (Start at right). When the mouse hovers near the X-axis, a slider bar will appear that allows you to scroll through the data or change the displayed chart width in data points.
- Causes and Notes – If you want causes and/or notes to be indicated on the chart, make a selection from the respective drop-down menus. Your options are:
  - Display nothing
  - Do not display the cause or note (default).
  - Display a single letter indication – The letter C will be used for a cause, and the letter N will be used for a note.
  - Display abbreviated text – A short portion of the cause or note text will be displayed on the chart.
  - Display full text – The full text of the cause or note will be displayed on the chart.

### Y-axis

- Automatic scale – Select this for CHARTrunner to determine the appropriate values for scaling the Y-axis.
- User scale – Select this to specify the Max, Min, and Increment values to use for scaling the Y-axis. If you leave a field blank, CHARTrunner will automatically select an appropriate value.

## Extra lines sub-tab - measurement charts

Here you define the extra lines you want to appear on the chart. You can define as many extra lines as you desire.

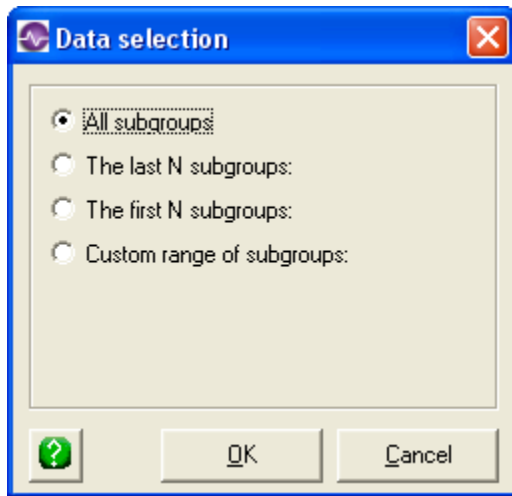


To define a new line, click the Type column and choose from the following list of line types:

Extra line – You must enter the Y-axis value for the line in the Value column.

- Mean line
- Median line
- Mode line
- Trend line – A simple linear regression line will be drawn.
- Upper spec line
- Target spec line
- Lower spec line.

Enter in the Line label column the text you want to label the line with.



When you click in the Apply to column, you can choose from the options shown above to determine what subgroups (or data points) the extra line will be applied to. See ***Applying an extra line to specific subgroups*** for more information on applying the extra line to a specific range of subgroups.

- Label with – You can specify to label the extra line with:
  - Nothing
  - Name
  - Value
  - Name and value
- Which chart? – Specify 1, 2, or 3 to indicate which sub-chart on the chart the extra line applies to.
- Style : Color – Click here to open the color dialog to choose the color for the extra line.
- Style : Width – Specify the width of the extra line as Regular, Wide, or Thick.
- Style : Style – Select from the drop-down list to specify the line style for the extra line.

Right-click on a row in the extra-lines grid to delete that extra-line from the list.

## Chart data display sub-tab - measurement charts

CHARTrunner - Measurement control chart 01 (mfg)

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Limits/specs | Control chart | Titles | Misc.

Chart options | X-axis Y-axis | Extra lines | Chart data display

Above Chart?	Web Table?	Name	Type	Label
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Date	Identifier	Date
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Shift	Identifier	Shift
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Gap1	Data	Gap1
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Gap2	Data	Gap2
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Gap3	Data	Gap3
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Gap4	Data	Gap4
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Gap5	Data	Gap5
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Subgroup	Identifier	Subgroup
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Sum	Statistic	Sum
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	X-bar	Statistic	X-bar
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Range	Statistic	Range

☒ Show identifier values      Maximum data length:   
☒ Show data values  
☒ Show statistic values

View data    Save as default    ?    OK    Cancel

Here you define what information you want to appear in these areas:

- In the "Data above the chart" grid that appears above the chart.
  - Place a check mark in the Above Chart? column for each row of identifiers, data, or statistics that you want to appear above the chart.
- In the "Chart data" table when a chart is saved as a Web page.
- Place a check mark in the Web Table? column for each row that you want to appear in the "Chart data" table of the Web page.
  - The "Chart data" table of the Web page is a grid that is displayed below the chart on the Web page. It displays information in a similar fashion to the "Data above the chart" grid. One of the advantages is that this data can be highlighted and copied whereas the data appearing in the grid above the chart on a Web page cannot, as it is simply an image.
  - The "Chart data" table of the Web page is a grid that is displayed below the chart on the Web page. It displays information in a similar fashion to the "Data above the chart" grid. One of the advantages is that this data can be highlighted and copied whereas the data appearing in the grid above the chart on a Web page cannot, as it is simply an image.
  - For more information on saving charts as web pages, see the topics **Save chart as web page dialog** and **Web page defaults sub-tab - misc. tab - applies to all charts**.

Edit the contents of the Label column if you want to change the text that appears for an identifier, data value, or statistic.

Place a check mark in the Show identifier values field to display identifier values in the “Data above the chart” grid.

Place a check mark in the Show data values field to display data values in the “Data above the chart” grid.

Place a check mark in the Show statistic values field to display statistic values in the “Data above the chart” grid.

The Maximum data length field is used to limit the length of text that appears in each cell of the “Data above the chart” grid. Leave this blank unless you want to apply a length limit. Typically you enter a value here to prevent long identifier text from overwhelming a cell. Note that the decimal point in a numeric value will count as one character. For example, in order to display the entire value of 38.49 you would need to enter a maximum data length of 5.

If Maximum data length is used it will truncate any value entered that is longer than the maximum data length textbox. This will display a value that could potentially be misconstrued. For example, if the date value was 11/07/2008 and the maximum data length was set to 5, the date would appear as “11/07” which could be misconstrued as November, 2007. Also, if your data spans across several years, entering a maximum data length will often truncate the years off of the end of the date, making it difficult to interpret the data.

## Attributes control charts

A measurement (or variables) control chart plots characteristics of your process that can be measured and expressed numerically, such as width, height, and thickness. If you cannot represent a quality characteristic numerically, or if it is impractical to do so, then often you resort to using a quality characteristic to sort or classify an item that is inspected into one of two *buckets*.

An example of classifying into buckets would be designating units as “conforming units” or “nonconforming units.” Another example would be assigning units into either “defective” or “non-defective” buckets. Quality characteristics of this type are called *attributes*.

Attributes data is data that can be classified and counted. There are two types of attributes data:

1. Nonconformities – Counts of defects per item or group of items, and counts of defective items.
2. Nonconforming – For example, yes/no, good/bad, pass/fail, and go/no go.

An attributes control chart can be one of the following four types:

- p-chart – An attributes control chart that plots the percentage of items possessing a characteristic of interest. The subgroup size may vary for this type of chart.
- np-chart – An attributes control chart that plots the number of items that are defective or possess a characteristic of interest. The subgroup size must remain constant for this type of chart.
- c-chart – An attributes control chart that is used to monitor the number of nonconformities, such as defects per subgroup. The subgroup size must remain constant for this type of chart.
- u-chart – An attributes control chart that is used to monitor the number of nonconformities per unit, such as defects per item. The subgroup size may vary for this type of chart.

## Limits tab - attributes charts

Control limit lines on a control chart are used as a basis for judging whether variation in data on a chart is due to special or common causes. The limits are calculated from data collected from the system under observation. CHARTrunner allows you to calculate a set of control limits by highlighting a set of data (subgroups) on a chart and selecting *Compute limits* via the right-click menu. Control limits are not specifications nor are they arbitrary *limits* set by customers or management.

The screenshot shows the 'Limits' tab of the 'CHARTrunner - Attributes control chart 01 (mfg)' dialog box. The 'Control limits' section has three radio buttons: 'None', 'Use temporary limits computed from data in the chart', and 'Apply selected saved control limits (below) to the chart'. The third option is selected. Below this, there is a text box for 'Adjust limits if number inspected changes more than:' with the value '25' and a '%' symbol. To the right is a label 'Label limit lines with:' followed by a dropdown menu showing 'Name'. Below this is a section titled 'Saved control limits: (saved while viewing chart)' containing a table with one row of data.

Name	Use	Extend	P UCL	P CL	P LCL	Order by	Calc from	Calc to
Set 1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	2.08	1.13	0.19	roupNumber	1	8

At the bottom of the dialog box are buttons for 'View data', 'Save as default', a help icon (a green circle with a question mark), 'OK', and 'Cancel'.



### Control Limits

- None - No control limits are used on the chart.
- Use temporary limits computed from the data in the chart - CHARTrunner will calculate control limits based on all the data that you have selected for the chart, except for data that has a special cause. In general, this is not the best option to use.
- Apply selected saved control limits (below) to the chart - The chart will use the limits saved for this chart (shown in the Saved control limits table) that have a check mark in the Use column.
- Adjust Limits If Number Inspected Changes More Than - Specify the percentage of change for the "Number inspected" that will cause the control limits to be adjusted. When doing p-charts and u-charts, your "Number inspected" often varies. For example, one month you may have data for 150 patients and the next month you may have data for 190 patients. The "Number inspected" is used to calculate the upper and lower control limits. If you always have the same "Number inspected," the control limit lines are straight. In other words, they are the same for every subgroup. However, if your "Number inspected" varies each month, control limits which never change can be misleading. The software allows you to decide when control limits should be adjusted because the "Number inspected" has changed. If you enter 25%, then control limits will be adjusted for any subgroup where the "Number inspected" changes (from the average Number inspected) by 25 percent or more. The higher you make this number, the less likely it will be that your chart has the adjusted (stair step) control limits.
- Label Limit Lines With: - Select one of the following options for labeling the limit lines:
  - Nothing
  - Name
  - Value
  - Name and value

NOTE: Control limits can be calculated, edited, and saved from the chart display window. Control limits that have been saved in the display window appear in the Saved control limits table of this tab.

- Saved Control Limits Table (Saved While Viewing Chart) - Each set of control limits that have been computed on the chart display window are shown in this table.
  - Name - The name given to the set of control limits when the limits were computed on the chart display window.
  - Use - Place a check mark to cause this set of limits to be used on this chart.
  - Extend - Place a check mark to cause the limit lines for this set of limits to be extended to the next adjacent limit set on the chart, or to the edge of the chart if there is no adjacent limit set.
  - Order by - This specifies how the chart's data was ordered when the limit set was calculated. Limit sets are displayed on the chart only when the current order of the chart's data is the same as when the limit set was calculated. If no data order was specified for the chart's data when the limit set was calculated, this will be blank; and the Calc from and Calc to will be in terms of relative subgroup number. For more information on how the data order column is determined see ***Understanding the data order concept.***
  - Calc from - Specifies the leftmost boundary of the chart data that was selected when the limit set was calculated. If the Order by is blank, the Calc from will be in terms of relative subgroup number.
  - Calc to - Specifies the rightmost boundary of the chart data that was selected when the limit set was calculated. If the Order by is blank, the Calc to will be in terms of relative subgroup number.

## Step 1: Chart name/type tab - attributes chart

For attribute control charts you have the option of entering text for names which get used in the chart type title. You make the chart type title visible by checking a box on the Titles tab. When you enter text for these names it will be used in the chart type title. For example, on a p-chart, you might enter the following:

- Inspected count name: bills checked
- Special count name: number with errors

This will cause the chart-type title to read like this:

p chart (Number with errors / Bills checked)

This can make the chart more clear and allows you to express either a positive or negative metric based on what you are charting.

Depending on the type of attributes chart selected, (p, np, c, or u) you will be able enter one or both of these names. If you leave these optional names blank, the chart type title will contain only the chart type; for example – p chart.

CHARTrunner - Attributes control chart 04 (health)

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Limits | Control chart | Titles | Misc.

Chart name: Attributes control chart 04 (health)

Chart style: Default control chart style

Description: Proportion of medical bills with mistakes

Refresh interval (blank = none): seconds

Chart categories:

- ☐ Measurement control charts
- ☒ Count (attribute) control charts
- ☐ Pareto charts - category data
- ☐ Distribution and capability analysis
- ☐ Line charts
- ☐ Advanced charts
- ☐ Short run control charts
- ☐ Rare event control charts

Chart types:

- ☒ p-chart
- ☐ np-chart
- ☐ c-chart
- ☐ u-chart

Sample chart image:

Inspected count name: Bills checked

Special count name: Number with errors

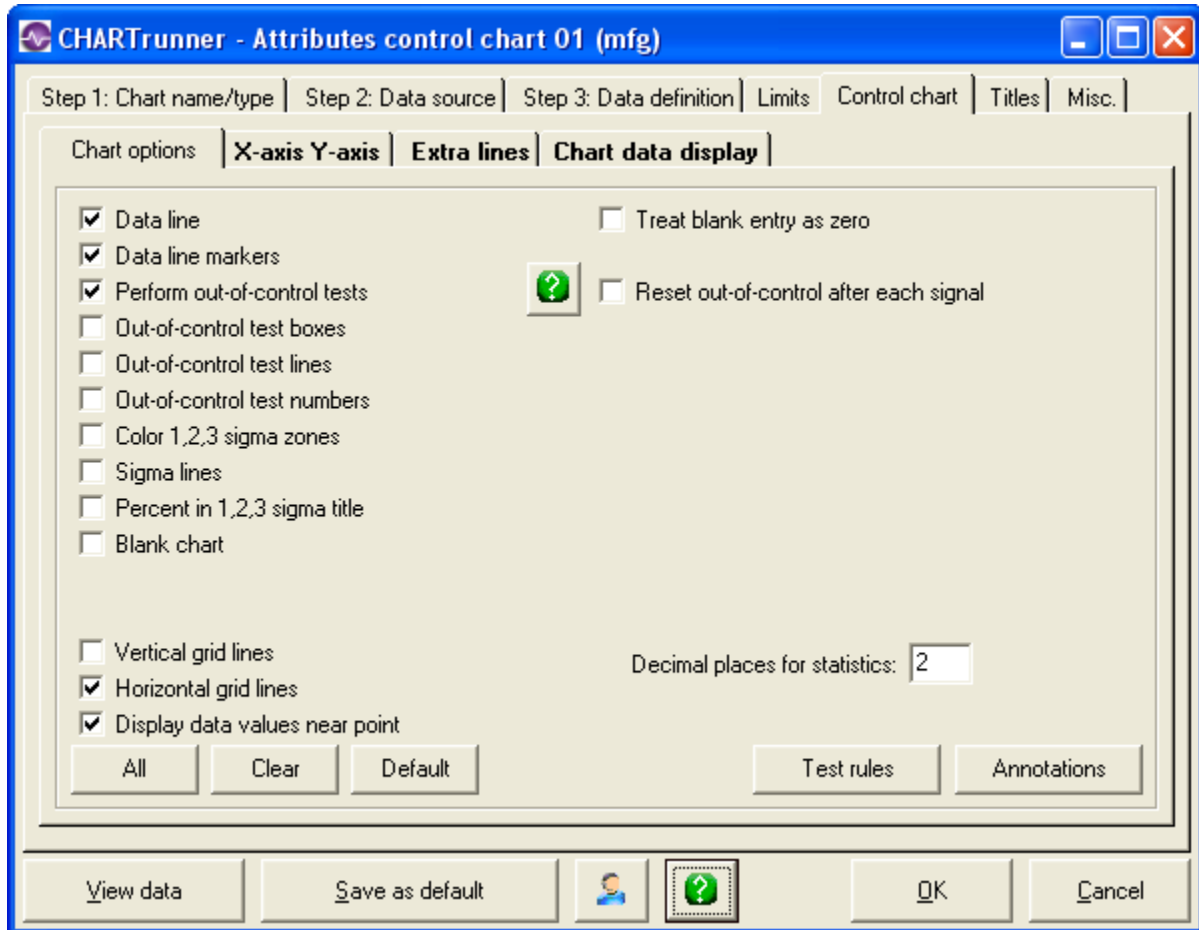
View data | Save as default | ? | OK | Cancel

## Control chart tab - attributes charts

Use this tab to customize the chart display.

## Chart options - sub-tab attributes charts

Use this tab to customize the chart display. Click the All button to select all chart options. Click the Clear button to unselect all chart options. Click the Default button to select the default options.

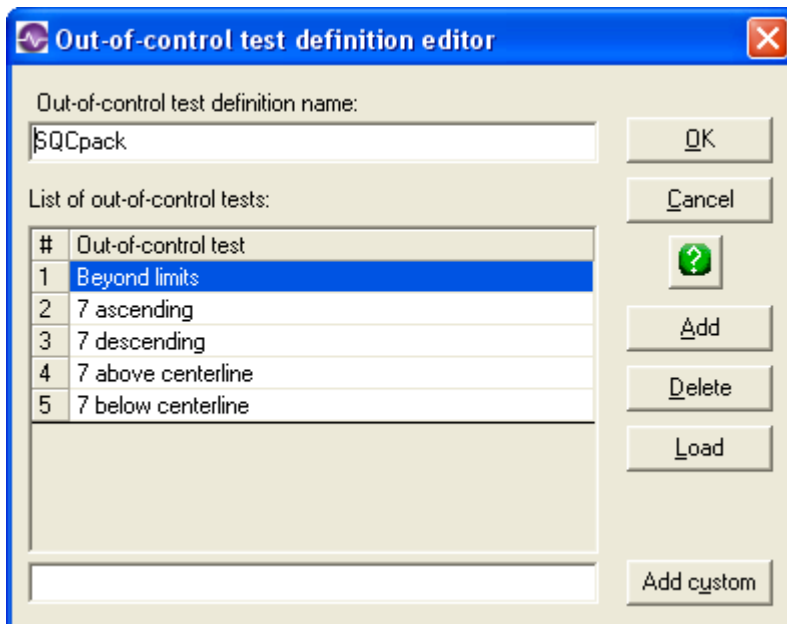


The following options may be specified on the Chart options sub-tab:

- Data line – Enable this to draw the line connecting data points.
- Data line markers – Enable this to display the marker for each data point.
- Perform out-of-control tests – Enable this to perform out-of-control testing for the chart using the current set of test rules. Test rules can be defined on a per-chart-definition basis, or one set of test rules can be applied to all charts. Use Setup > Preferences > “Use the same out-of-control tests for all charts” to enable or disable using the same set of test rules for all charts. Use Setup > “Out-of-control tests” to specify which set of test rules is used when the same set of rules is applied to all charts.
  - Out-of-control test boxes – Draws a box around a set of out-of-control points. The box will be labeled with the test that failed.

- Out-of-control test lines – Draws a line near the top of the chart for each test that has at least one failure. The line is labeled with the test that failed. Using test lines rather than test boxes can be useful when test boxes make the chart look too crowded.
- Out-of-control test numbers – Labels the chart with a numeric code for each out-of-control test that failed. The numeric code corresponds to the position of the test in the set of test rules that is used for the chart. See the discussion above for Perform out-of-control tests to determine which set of test rules is in effect for the chart.
- Reset out-of-control after each signal – If this option is enabled, the out-of-control test engine will reset itself after each primary out-of-control point on the chart. This results in the rules for testing subsequent points being applied as though the subsequent points are in a new series. It is recommended that this option NOT be enabled unless you really want this behavior.

- Color 1,2,3 sigma zones – Shows the 1, 2, and 3 sigma zones in different colors on the chart. The three sigma zones are determined by dividing the region between the control limit and the center line into three equal regions. Thus, if you are using 3.0 sigma limits, then these zones will correspond to 1.0, 2.0, and 3.0 sigma.
- Sigma lines – Shows lines at the 1, 2, and 3 sigma zone boundaries. This is similar to Color 1,2,3 sigma zones, but instead of coloring the zones, only a boundary line between each zone is shown.
- Percent in 1,2,3 sigma title – Shows in the titles area the percentage of data points within the 1, 2, and 3 sigma zones.
- Blank chart – Enable this option to draw a blank chart that has no chart data displayed. This feature is used to print a blank chart form for plotting data manually.
- Vertical grid lines – Enable this to show vertical grid lines on the chart.
- Horizontal grid lines – Enable this to show horizontal grid lines on the chart.
- Display data values near point – Enable this to place a small label showing the data value next to each data point on the chart.
- Treat blank entry as zero – Enable this to treat a blank data value as zero.
- Decimal places for statistics – Specifies how many decimal places to display for calculated statistics.
- Annotations – Click this button to open a window that displays the annotations that are attached to this chart. This allows you to remove annotations from the chart. Sometimes, when an annotation is attached to a subgroup that no longer appears on the chart, this is the only way to delete the annotation from the chart definition.
- Test rules – Click the Test rules button to open the *Out-of-control test definition editor* window shown below, which allows you to define the out-of-control tests that are stored in this chart definition. See the discussion above for Perform out-of-control tests to determine whether this set of test rules is used for evaluating out-of-control conditions for this chart, or whether one set of rules is applied to all charts.



- Enter a name in the Out-of-control test definition name field to identify this set of out-of-control test rules.
- Click on the Add button to add a predefined test rule. The Select an out-of-control test window opens to display the predefined test rules you may select from. Highlight the test rule or rules you desire to use (select multiple rules with Ctrl-Click) and click the OK button.

- Click on the Add custom button to add the custom rule you entered in the field to the left of the Add custom button into the list of rules.
- Added rules are placed below the currently selected row in the list. Arrange the order of the test rules by clicking and dragging the rule number with the mouse.
- Click on the Load button to load an existing set of rules that have been defined in Setup > “Out-of-control tests” into the list. The loaded set of rules will replace any rules currently in the list.
- Highlight a test rule in the list and click the Delete button to remove the rule from the list.

## X-axis Y-axis - sub-tab attributes charts

Here you define the options that determine how CHARTrunner labels the X-axis (the horizontal axis) and establishes the scaling for the Y-axis (the vertical axis).

**CHARTrunner - Attributes control chart 04 (mfg)**

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Limits | Control chart | Titles | Misc.

**Chart options** | **X-axis Y-axis** | Extra lines | Chart data display

**X-axis:**

Label x-axis with:

☐ Label every subgroup  
☒ Place n labels across the chart  
☐ Label every n subgroups

n =

☐ Scale x-axis with variable interval based on x-axis label

☒ Enable horizontal x-axis scrolling  
 Chart width in subgroups, blank = all:   
☒ Start at left  
☐ Start at right

Causes:

Notes:

**Y-axis:**

☒ Automatic scale  
☐ User scale

### X-axis

- In the Label x-axis with field, select a label option from the drop-down menu. The default value is Nothing. Other options are Numbers and specific identifier fields. Identifier fields in this menu are those mapped in the Step 3: Data definition tab. Select the option you want.
- Select an option to determine the number and type of labels you want to appear on the chart's X-axis. Options are:
  - Label every subgroup – Displays a label on each subgroup or data point. For charts with a large number of data points, this option may cause the labels to overlap.
  - Place n labels across the chart – Displays only the number of labels that you specify across the chart. Enter the number of labels in the n = field.
  - Label every n subgroups – Displays a label on every nth subgroup or data point.
  - Label every n units – Displays a label on every nth unit. This option is available only if you have selected a date/time field for the Label x-axis with option. If you select this option, you must specify the units – such as Days, Months, or Quarters – in the units = field, and the number of time units in the n = field.
- If you want to Scale x-axis with variable interval based on x-axis label, select this option. It tells the chart to set the spacing between the data points on the chart to reflect where each data point falls along the timeline (or number line) established by the identifier used to label the X-axis. This option is available only when the X-axis is labeled with a date/time or numeric identifier, and the data source is ordered by the identifier used to label the X-axis.

NOTE: How is the order of the data source determined? On the Step 3: Data definition tab, when the data source is a "Table" the Column to use for Order By field determines the order of the data. When a "Query or view," "Stored procedure," or "Custom query" is used as the data source, it is assumed that the data is ordered by the "Unique identifier" column.

- Select Enable horizontal x-axis scrolling if you want the ability to scroll the chart through the data points using the mouse. The Chart width in subgroups field specifies the number of data points to display across the chart. Specify whether the chart initially displays the specified number of data points from the beginning of the data source (Start at left) or from the end of the data source (Start at right). When the mouse hovers near the X-axis, a slider bar will appear that allows you to scroll through the data or change the displayed chart width in data points.
- Causes and Notes – If you want causes and/or notes to be indicated on the chart, make a selection from the respective drop-down menus. Your options are:
  - Display nothing – Do not display the cause or note (default)
  - Display a single letter indication – The letter C will be used for a cause, and the letter N will be used for a note.
  - Display abbreviated text – A short portion of the cause or note text will be displayed on the chart.
  - Display full text – The full text of the cause or note will be displayed on the chart.

### Y-axis

- Automatic scale – Select this for CHARTrunner to determine the appropriate values for scaling the Y-axis.
- User scale – Select this to specify the Max, Min, and Increment values to use for scaling the Y-axis. If you leave a field blank, CHARTrunner will automatically select an appropriate value.

## Extra lines sub-tab - attributes charts

Here you define the extra lines you want to appear on the chart. You can define as many extra lines as you desire.

**CHARTrunner - Customizing a chart definition - Attributes Extra Lines sub-tab**

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Limits | Control chart | Titles | Misc.

**Chart options** | X-axis Y-axis | **Extra lines** | Chart data display

Add all spec lines (blank extra-lines are ignored)

Note: all extra-line types may not be available for all chart types.

	Type	Line label	Value	Apply to	Label with	Which chart?	Style		
							Color	Width	Style
1	Mean line	Mean line	Calculated	All	Name	1		Regular	Short dash
2	Extra line	Extra line	0.95	All	Name	1		Regular	Solid
3	Trend line	Trend line	Calculated	All	Name	1		Wide	Short dash
4									
5									
6									
7									
8									
9									
10									
11									

View data Save as default [User Icon] [Help Icon] OK Cancel

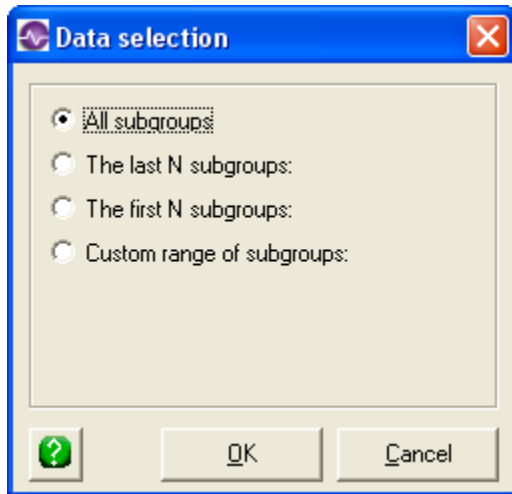


To define a new line, click the Type column and choose from the list of line types.

Extra line – You must enter the Y-axis value for the line in the Value column.

- Mean line
- Trend line – A simple linear regression line will be drawn.

Enter in the Line label column the text with which you want to label the line.



When you click in the Apply to column, you can choose from the options shown above to determine what subgroups (or data points) the extra line will be applied to. See ***Applying an extra line to specific subgroups*** for more information on applying the extra line to a specific range of subgroups.

- Label with – You can specify to label the extra line with:
  - Nothing
  - Name
  - Value
  - Name and value
- Which chart? – Specify 1, 2, or 3 to indicate which sub-chart on the chart the extra line applies to.
- Style : Color – Click here to open the color dialog to choose the color for the extra line.
- Style : Width – Specify the width of the extra line as Regular, Wide, or Thick.
- Style : Style – Select from the drop-down list to specify the line style for the extra line.

Right-click on a row in the extra-lines grid to delete that extra line from the list.

## Chart data display sub-tab - attributes charts

CHARTrunner - Attributes control chart 01 (mfg)

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Limits | Control chart | Titles | Misc.

Chart options | X-axis Y-axis | Extra lines | Chart data display

Above Chart?	Web Table?	Name	Type	Label
<input type="checkbox"/>	<input checked="" type="checkbox"/>	SubgroupNumber	Identifier	SubgroupNumber
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Inspected	Data	Inspected
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Count	Data	Count
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Percent	Statistic	Percent

☒ Show identifier values      Maximum data length:   
☒ Show data values  
☒ Show statistic values

View data | Save as default | [User Icon] | [Help Icon] | OK | Cancel

Here you define what information you want to appear in these areas:

- In the “Data above the chart” grid that appears above the chart.
  - Place a check mark in the Above Chart? column for each row of identifiers, data, or statistics that you want to appear above the chart.
- In the “Chart data” table when a chart is saved as a Web page.
  - Place a check mark in the Web Table? column for each row that you want to appear in the “Chart data” table of the Web page.
  - The “Chart data” table of the Web page is a grid that is displayed below the chart on the Web page. It displays information in a similar fashion to the “Data above the chart” grid. One of the advantages is that this data can be highlighted and copied whereas the data appearing in the grid above the chart on a Web page cannot, as it is simply an image.
  - For more information on saving charts as web pages, see the topics **Save chart as web page dialog** and **Web page defaults sub-tab - misc. tab - applies to all charts**.

The Maximum data length field is used to limit the length of text that appears in each cell of the “Data above the chart” grid. Leave this blank unless you want to apply a length limit. Typically you enter a value here to prevent long identifier text from overwhelming a cell. Note that the decimal point in a numeric value will count as one character. For example, in order to display the entire value of 38.49 you would need to enter a maximum data length of 5.

If Maximum data length is used it will truncate any value entered that is longer than the maximum data length textbox. This will display a value that could potentially be misconstrued. For example, if the date value was 11/07/2008 and the maximum data length was set to 5, the date would appear as “11/07” which could be misconstrued as November, 2007. Also, if your data spans across several years, entering a maximum data length will often truncate the years off of the end of the date, making it difficult to interpret the data.

## Cusum control charts

Cusum (cumulative sum) charts, while not as intuitive and simple to operate as Shewhart charts, have been shown to be more efficient in detecting small shifts in the mean of a process.

A visual procedure, known as the V-Mask, is used to determine whether a process is out of control. A V-Mask is an overlay shape in the form of a V on its side that is superimposed on the graph of the cumulative sums. The origin point of the V-Mask is placed on top of the latest cumulative sum point and past points are examined to see if any fall above or below the sides of the V. As long as all the previous points lie between the sides of the V, the process is in control. Otherwise (even if one point lies outside), the process is suspected of being out of control.

The **Cusum chart** (see “Cusum chart tab” on page 138) and **Control chart** (see “Control chart tab - cusum charts” on page 139) tabs allow you to customize your Cusum chart.

## Cusum chart tab

This tab, shown below, allows you to set the options that are specific to a Cusum chart.

The screenshot shows a software window titled "CHARTrunner - Measurement control chart 19 (mfg)". It has a tabbed interface with tabs for "Step 1: Chart name/type", "Step 2: Data source", "Step 3: Data definition", "Cusum chart" (which is selected), "Control chart", "Titles", and "Misc.". The "Cusum Options" section contains the following fields and controls:

- Amount of concern:** A text box containing the value "3". To its right are two radio buttons: "Sigma" (which is selected) and "Value".
- Consumer risk:** A text box containing the value "0.01".
- Producer risk:** A text box containing the value "0.01".
- Target:** A text box containing the value "0.6".

At the bottom of the dialog, there are several buttons: "View data", "Save as default", a user icon, a help icon (a green circle with a question mark), "OK", and "Cancel".

- **Amount of concern** – Enter a value for the amount of concern. This is the amount of shift in the process average for CHARTrunner to consider when constructing the V-mask. It is the distance by which the values are to move before they show as out-of-control. The number you enter in this field can be either the standard deviation or a measurement value. Type the number and select either Sigma or Value.
- **Sigma** – Select this radio button when the Amount of concern is expressed as the number of standard deviations or sigmas.
- **Value** – Select this radio button when the Amount of concern is expressed as measurement values.
- **Consumer risk** – Enter the percentage of consumer's risk. The consumer's risk is the probability that the process will shift by the level of concern and not be detected as out of control by the chart (Type II error). This is generally a value between .01 and .05.
- **Producer risk** – Enter the percentage of producer's risk. Producer's risk is the probability that the process will indicate that the process is out of control when it is in control (Type I error). This is generally a value between .01 and .05.
- **Target** – Enter the target value in this field. The calculation of Cusum requires a reference or target value. This may be the actual process average or the target value for the process. Cusums are the sums of the deviations from this value.

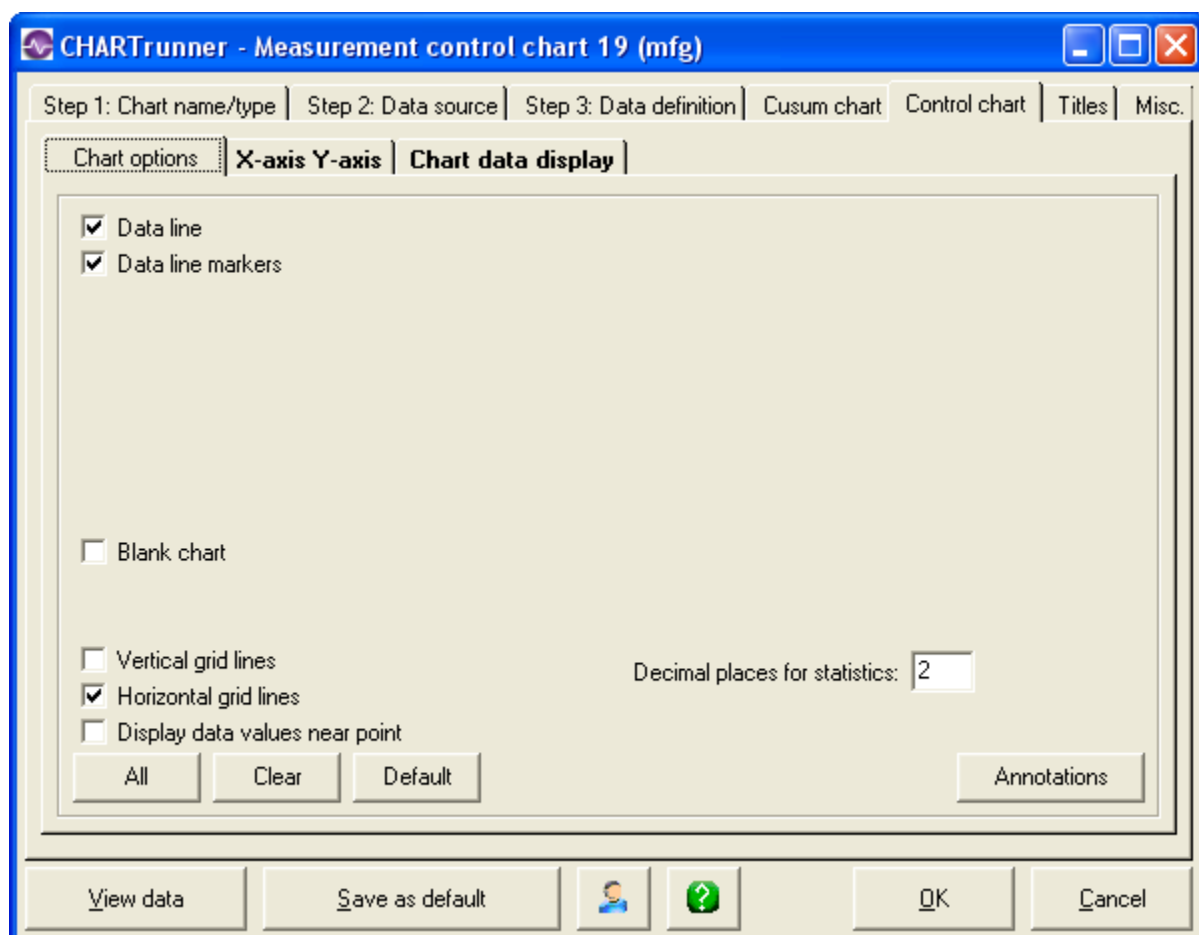
## Control chart tab - cusum charts

The following sub-tabs of the Control chart tab allow you to customize various aspects of your Cusum chart:

- **Chart options** (see "Chart options sub-tab - cusum charts" on page 139)
- **X-axis Y-axis** (see "X-axis Y-axis sub-tab - cusum charts" on page 141)
- **Chart Data Display**.

## Chart options sub-tab - cusum charts

Use this tab to customize the chart display. Click the All button to select all chart options. Click the Clear button to unselect all chart options. Click the Default button to select the default options.



The following options may be specified on the Chart options sub-tab:

- Data line – Enable this to draw the line connecting data points.
- Data line markers – Enable this to display the marker for each data point.
- Blank chart – Enable this option to draw a blank chart that has no chart data displayed. This feature is used to print a blank chart form for plotting data manually.
- Show negative limits – Enable this to display negative limits on the chart. If your process can have data values that fall below zero, you should enable this option.
- Vertical grid lines – Enable this to show vertical grid lines on the chart.
- Horizontal grid lines – Enable this to show horizontal grid lines on the chart.
- Display data values near point – Enable this to place a small label showing the data value next to each data point on the chart.
- Decimal places for statistics – Specifies how many decimal places to display for calculated statistics.
- Annotations – Click this button to open a window that displays the annotations that are attached to this chart. This allows you to remove annotations from the chart. Sometimes, when an annotation is attached to a subgroup that no longer appears on the chart, this is the only way to delete the annotation from the chart definition.

## X-axis Y-axis sub-tab - cusum charts

Here you define the options that determine how CHARTrunner labels the X-axis (the horizontal axis) and establishes the scaling for the Y-axis (the vertical axis):

The screenshot shows the CHARTrunner - Measurement control chart 19 (mfg) dialog box. The 'X-axis Y-axis' sub-tab is selected. The 'X-axis' section includes a 'Label x-axis with:' dropdown menu set to 'Numbers', three radio buttons for 'Label every subgroup' (selected), 'Place n labels across the chart', and 'Label every n subgroups', and a checkbox for 'Scale x-axis with variable interval based on x-axis label'. The 'Y-axis' section has radio buttons for 'Automatic scale' and 'User scale' (selected). Below the 'User scale' radio button is a table for 'Cusum chart' settings.

	Cusum chart
Max	3.0
Min	-.2
Increment	.2

Other options include 'Enable horizontal x-axis scrolling' (checked), 'Chart width in subgroups, blank = all:' (set to 1), 'Causes:' (set to 'Display nothing'), and 'Notes:' (set to 'Display nothing'). The bottom of the dialog has buttons for 'View data', 'Save as default', a help icon, 'OK', and 'Cancel'.

### X-axis

- In the Label x-axis with field, select a label option from the drop-down menu. The default value is Nothing. Other options are Numbers and specific identifier fields. Identifier fields in this menu are those mapped in the Step 3: Data definition tab. Select the option you want.
- Select an option to determine the number and type of labels you want to appear on the chart's X-axis. Options are:
  - Label every subgroup – Displays a label on each subgroup or data point. For charts with a large number of data points, this option may cause the labels to overlap. -
  - Place n labels across the chart – Displays only the number of labels that you specify across the chart. Enter the number of labels in the n = field.
  - Label every n subgroups – Displays a label on every nth subgroup or data point.
  - Label every n units – Displays a label on every nth unit. This option is available only if you have selected a date/time field for the Label x-axis with option. If you select this option, you must specify the units, such as Days, Months, or Quarters in the units = field and the number of time units in the n = field.

- Scale x-axis with variable interval based on x-axis label – This option is disabled for Cusum charts.
- Select Enable horizontal x-axis scrolling if you want the ability to scroll the chart through the data points using the mouse. The Chart width in subgroups field specifies the number of data points to display across the chart. Specify whether the chart initially displays the specified number of data points from the beginning of the data source (Start at left) or from the end of the data source (Start at right). When the mouse hovers near the X-axis, a slider bar will appear that allows you to scroll through the data or change the displayed chart width in data points.
- Causes and Notes – If you want causes and/or notes to be indicated on the chart, make a selection from the respective drop-down menus. Your options are:
  - Display nothing
  - Do not display the cause or note (default).
  - Display a single letter indication – The letter C will be used for a cause, and the letter N will be used for a note.
  - Display abbreviated text – A short portion of the cause or note text will be displayed on the chart.
  - Display full text – The full text of the cause or note will be displayed on the chart.

#### Y-axis

- Automatic scale – Select this for CHARTrunner to determine the appropriate values for scaling the Y-axis.
- User scale – Select this to specify the Max, Min, and Increment values to use for scaling the Y-axis. If you leave a field blank, CHARTrunner will automatically select an appropriate value.



## Chart data display sub-tab - cusum charts

CHARTrunner - Measurement control chart 19 (mfg)

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Cusum chart | Control chart | Titles | Misc.

Chart options | X-axis Y-axis | Chart data display

Above Chart?	Web Table?	Name	Type	Label
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Subgroup	Identifier	Subgroup
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Date	Identifier	Date
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Shift	Identifier	Shift
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Gap1	Data	Gap1
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Difference from target	Statistic	Difference from target
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Cumulative sum values	Statistic	Cumulative sum values

☒ Show identifier values      Maximum data length:   
☒ Show data values  
☒ Show statistic values

View data | Save as default | | | OK | Cancel

Here you define what information you want to appear in these areas:

- In the "Data above the chart" grid that appears above the chart.
  - Place a check mark in the Above Chart? column for each row of identifiers, data, or statistics that you want to appear above the chart.
- In the "Chart data" table when a chart is saved as a Web page.

Place a check mark in the Web Table? column for each row that you want to appear in the "Chart data" table of the Web page.

- The "Chart data" table of the Web page is a grid that is displayed below the chart on the Web page. It displays information in a similar fashion to the "Data above the chart" grid. One of the advantages is that this data can be highlighted and copied whereas the data appearing in the grid above the chart on a Web page cannot, as it is simply an image.
- The "Chart data" table of the Web page is a grid that is displayed below the chart on the Web page. It displays information in a similar fashion to the "Data above the chart" grid. One of the advantages is that this data can be highlighted and copied whereas the data appearing in the grid above the chart on a Web page cannot, as it is simply an image.
- For more information on saving charts as web pages, see the topics **Save chart as web page dialog** and **Web page defaults sub-tab - misc. tab - applies to all charts**.

Edit the contents of the Label column if you want to change the text that appears for an identifier, data value, or statistic.

Place a check mark in the Show identifier values field to display identifier values in the "Data above the chart" grid.

Place a check mark in the Show data values field to display data values in the "Data above the chart" grid.

Place a check mark in the Show statistic values field to display statistic values in the "Data above the chart" grid.

The Maximum data length field is used to limit the length of text that appears in each cell of the "Data above the chart" grid. Leave this blank unless you want to apply a length limit. Typically you enter a value here to prevent long identifier text from overwhelming a cell. Note that the decimal point in a numeric value will count as one character. For example, in order to display the entire value of 38.49 you would need to enter a maximum data length of 5.

If Maximum data length is used it will truncate any value entered that is longer than the maximum data length textbox. This will display a value that could potentially be misconstrued. For example, if the date value was 11/07/2008 and the maximum data length was set to 5, the date would appear as "11/07" which could be misconstrued as November, 2007. Also, if your data spans across several years, entering a maximum data length will often truncate the years off of the end of the date, making it difficult to interpret the data.

## Short-run control charts

Short-run control charts use special statistical methods that allow you to monitor processes that cannot be monitored using traditional statistical process control techniques. Whether you make only one part per run; small runs of many similar parts; or large, complex parts over a long period of time, short-run charts provide an effective way to realize all the benefits of statistical process control.

### Types of short-run control charts

Chart type options for short-run charts are shown below:

- Differences from target, moving range
- Zed, W
- Zed\*, W\*
- Differences from target (X-bar), range Zed bar, W
- Zed bar\*, W\*
- Mean ranges.

## Limits/Targets tab - short-run charts

The following sub-tabs of the Limits/Targets tab allow you to customize these aspects of your short-run chart:

- Control limits
- Short-run targets.

The screenshot shows the 'CHARTrunner - Short run SPC chart 02 (mfg)' dialog box. The 'Limits/targets' tab is selected, and the 'Control limits' sub-tab is active. The 'Control limits' section has three radio buttons: 'None', 'Use temporary limits computed from data in the chart' (which is selected), and 'Apply selected saved control limits (below) to the chart'. Below these is a 'Label limit lines with:' dropdown menu set to 'Name and value'. The 'Saved control limits: (saved while viewing chart)' section contains a table with columns: Name, Use, Extend, Zed UCL, Zed CL, Zed LCL, W UCL, W CL, and W LCL. The table is currently empty. At the bottom of the dialog are buttons for 'View data', 'Save as default', a user icon, a help icon (a green circle with a question mark), 'OK', and 'Cancel'.

CHARTrunner - Short run SPC chart 02 (mfg)

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Limits/targets | Control chart | Titles | Misc.

Control limits | Short run targets

Control limits:

☐ None

☒ Use temporary limits computed from data in the chart

☐ Apply selected saved control limits (below) to the chart

Label limit lines with:

Name and value

Saved control limits: (saved while viewing chart)

Name	Use	Extend	Zed UCL	Zed CL	Zed LCL	W UCL	W CL	W LCL
------	-----	--------	---------	--------	---------	-------	------	-------

View data | Save as default | User icon | Help icon (?) | OK | Cancel

## Control limits sub-tab - short-run charts

Control limit lines on a control chart are used as a basis for judging whether variation in data on a chart is due to special or common causes. The limits are calculated from data collected from the system under observation. CHARTrunner allows you to calculate a set of control limits by highlighting a set of data (subgroups) on a chart and selecting *Compute limits* via the right-click menu. Control limits are not specifications nor are they arbitrary *limits* set by customers or management.

The screenshot shows the 'Control limits' sub-tab of the 'CHARTrunner - Short run SPC chart 02 (mfg)' dialog. The 'Control limits' section has three radio buttons: 'None', 'Use temporary limits computed from data in the chart' (which is selected), and 'Apply selected saved control limits (below) to the chart'. Below these is a 'Label limit lines with:' dropdown menu set to 'Name and value'. The 'Saved control limits: (saved while viewing chart)' section contains a table with columns: Name, Use, Extend, Zed UCL, Zed CL, Zed LCL, W UCL, W CL, and W LCL. The table is currently empty. At the bottom of the dialog are buttons for 'View data', 'Save as default', a help icon, 'OK', and 'Cancel'.

Name	Use	Extend	Zed UCL	Zed CL	Zed LCL	W UCL	W CL	W LCL
------	-----	--------	---------	--------	---------	-------	------	-------

### Control Limits

- None - No control limits are used on the chart.
- Use temporary limits computed from the data in the chart - CHARTrunner will calculate control limits based on all the data that you have selected for the chart, except for data that has a special cause. In general, this is not the best option to use.
- Apply selected saved control limits (below) to the chart - The chart will use the limits saved for this chart (shown in the Saved control limits table) that have a check mark in the Use column.
- Label limit lines with:
  - Nothing
  - Name
  - Value

- Name and value

NOTE: Control limits can be calculated, edited, and saved from the chart display window. Control limits that have been saved in the display window appear in the Saved control limits table of this sub-tab.

- Saved Control Limits Table (Saved While Viewing Chart) - Each set of control limits that have been computed on the chart display window are shown in this table.
  - Name - The name given to the set of control limits when the limits were computed on the chart display window.
  - Use - Place a check mark to cause this set of limits to be used on this chart.
  - Extend - Place a check mark to cause the limit lines for this set of limits to be extended to the next adjacent limit set on the chart, or to the edge of the chart if there is no adjacent limit set.
  - Order by - This specifies how the chart's data was ordered when the limit set was calculated. Limit sets are displayed on the chart only when the current order of the chart's data is the same as when the limit set was calculated. If no data order was specified for the chart's data when the limit set was calculated, this will be blank; and the Calc from and Calc to will be in terms of relative subgroup number. For more information on how the data order column is determined see ***Understanding the data order concept.***
  - Calc from - Specifies the leftmost boundary of the chart data that was selected when the limit set was calculated. If the Order by is blank, the Calc from will be in terms of relative subgroup number.
  - Calc to - Specifies the rightmost boundary of the chart data that was selected when the limit set was calculated. If the Order by is blank, the Calc to will be in terms of relative subgroup number.

## Short-run targets sub-tab - short-run charts

A short-run chart needs the target value for each product that is produced. The target values can come from the data source, or they can be entered in the chart definition.

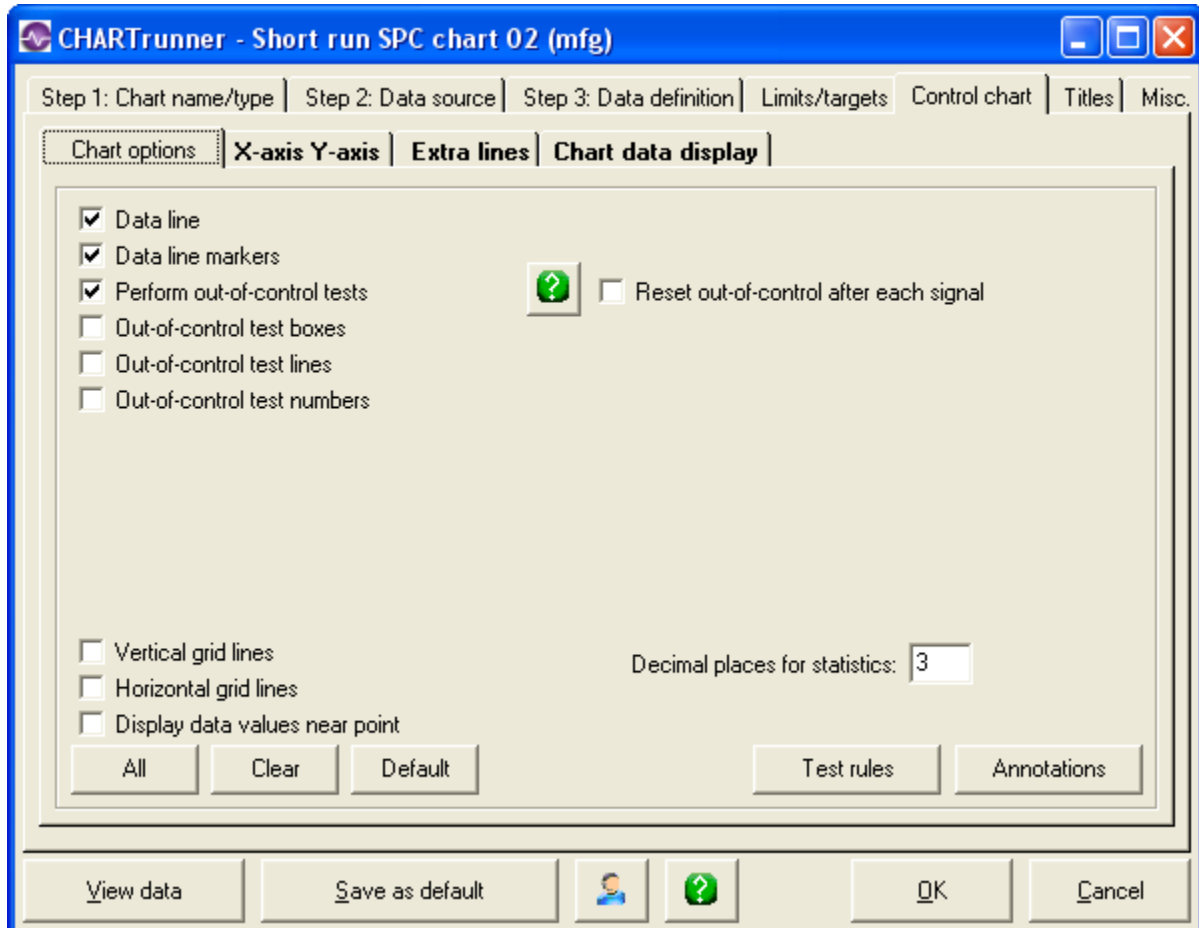
The screenshot shows the CHARTrunner - Short run SPC chart 02 (mfg) dialog box. The 'Short run targets' sub-tab is selected. It contains a 'Control limits' section with three radio buttons: 'Case sensitive product names' (unchecked), 'Target values from database' (checked), and 'User entered target values' (unchecked). Below these is a table with two columns: 'Product (Product)' and 'Target value'. The table has 8 rows, with the first row containing the number '1' in the 'Product' column. A 'Get products from data source' button is located below the table. At the bottom of the dialog are buttons for 'View data', 'Save as default', a user icon, a help icon, 'OK', and 'Cancel'.

	Product (Product)	Target value
1		
2		
3		
4		
5		
6		
7		
8		

- Case sensitive product names – Select this option if your product names differ in case, e.g., “Product A” and “Product a” are two different product names.
- Target values from database – Select this option to fetch target values from the data source, in which case you must map one column on the *Step 3: Data definition* tab as the Target column.
- User entered target values – Select this option to enter the target value for each product name in the grid. The product names you enter will be matched against the names from the Product column on the *Step 3: Data definition* tab. You can right-click on one or more selected rows of the grid to delete the rows. Use Shift-click or Ctrl-click to select multiple rows.
  - Product – Enter the product name.
  - Target value – Enter the target value for the product name.
  - Get products from data source – Click this button to populate the Product column of the grid with the product names that are found in the Product column of the data source.

## Chart options sub-tab - short-run charts

Use this sub-tab to customize the chart display. Click the All button to select all chart options. Click the Clear button to unselect all chart options. Click the Default button to select the default options.



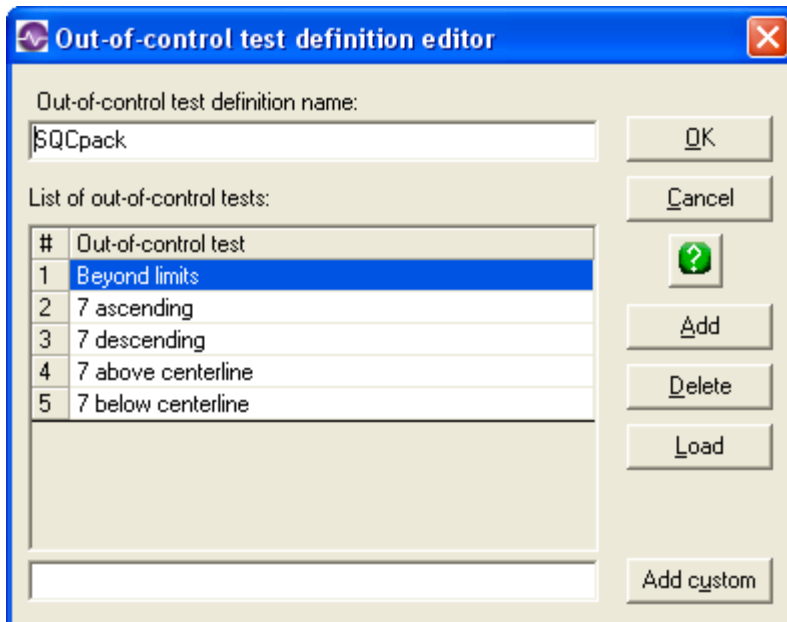
The following options may be specified on the Chart options sub-tab:

- Data line – Enable this to draw the line connecting data points.
- Data line markers – Enable this to display the marker for each data point.
- Perform out-of-control tests – Enable this to perform out-of-control testing for the chart using the current set of test rules. Test rules can be defined on a per-chart-definition basis, or one set of test rules can be applied to all charts. Use Setup > Preferences > “Use the same out-of-control tests for all charts” to enable or disable using the same set of test rules for all charts. Use Setup > “Out-of-control tests” to specify which set of test rules is used when the same set of rules is applied to all charts.
  - Out-of-control test boxes – Draws a box around a set of out-of-control points. The box will be labeled with the test that failed.
  - Out-of-control test lines – Draws a line near the top of the chart for each test that has at least one failure. The line is labeled with the test that failed. Using test lines rather than test boxes can be useful when test boxes make the chart look too crowded.

- Out-of-control test numbers – Labels the chart with a numeric code for each out-of-control test that failed. The numeric code corresponds to the position of the test in the set of test rules that is used for the chart. See the discussion above for Perform out-of-control tests to determine which set of test rules is in effect for the chart.
- Reset out-of-control after each signal – If this option is enabled, the out-of-control test engine will reset itself after each primary out-of-control point on the chart. This results in the rules for testing subsequent points being applied as though the subsequent points are in a new series. It is recommended that this option NOT be enabled unless you really want this behavior.



- Color 1,2,3 sigma zones – Shows the 1, 2, and 3 sigma zones in different colors on the chart. The three sigma zones are determined by dividing the region between the control limit and the center line into three equal regions. Thus, if you are using 3.0 sigma limits, then these zones will correspond to 1.0, 2.0, and 3.0 sigma.
- Sigma lines – Shows lines at the 1, 2, and 3 sigma zone boundaries. This is similar to Color 1,2,3 sigma zones, but instead of coloring the zones, only a boundary line between each zone is shown.
- Percent in 1,2,3 sigma title – Shows in the titles area the percentage of data points within the 1, 2, and 3 sigma zones.
- Blank chart – Enable this option to draw a blank chart that has no chart data displayed. This feature is used to print a blank chart form for plotting data manually.
- Show negative limits – Enable this to display negative limits on the chart. If your process can have data values that fall below zero, you should enable this option.
- Vertical grid lines – Enable this to show vertical grid lines on the chart.
- Horizontal grid lines – Enable this to show horizontal grid lines on the chart.
- Display data values near point – Enable this to place a small label showing the data value next to each data point on the chart.
- Subgroups in moving range – Enter the number of data points to use for the moving range, moving sigma, or moving average calculation. This field is visible only for individuals data, which means that on the *Step 3: Data definition* tab, you have mapped only one data column as a *measurement*. The recommended value is 2.
- Decimal places for statistics – Specifies how many decimal places to display for calculated statistics.
- Annotations – Click this button to open a window that displays the annotations that are attached to this chart. This allows you to remove annotations from the chart. Sometimes, when an annotation is attached to a subgroup that no longer appears on the chart, this is the only way to delete the annotation from the chart definition.
- Test rules – Click the Test rules button to open the *Out-of-control test definition editor* window shown below, which allows you to define the out-of-control tests that are stored in this chart definition. See the discussion above for Perform out-of-control tests to determine whether this set of test rules is used for evaluating out-of-control conditions for this chart, or whether one set of rules is applied to all charts.



- Enter a name in the Out-of-control test definition name field to identify this set of out-of-control test rules.
- Click on the Add button to add a predefined test rule. The Select an out-of-control test window opens to display the predefined test rules you may select from. Highlight the test rule or rules you desire to use (select multiple rules with Ctrl-click) and click the OK button.
- Click on the Add custom button to add the custom rule you entered in the field to the left of the Add custom button into the list of rules.
- Added rules are placed below the currently selected row in the list. Arrange the order of the test rules by clicking and dragging the rule number with the mouse.
- Click on the Load button to load an existing set of rules that have been defined in Setup > “Out-of-control tests” into the list. The loaded set of rules will replace any rules currently in the list.
- Highlight a test rule in the list and click the Delete button to remove the rule from the list.

## X-axis Y-axis sub-tab - short-run charts

Here you define the options that determine how CHARTrunner labels the X-axis (the horizontal axis) and establishes the scaling for the Y-axis (the vertical axis):

The screenshot shows the 'CHARTrunner - Short run SPC chart 02 (mfg)' dialog box. The 'X-axis Y-axis' sub-tab is selected. The 'X-axis' section includes a 'Label x-axis with:' dropdown set to 'Date', four radio button options for labeling (with 'Label every n units' selected), a text field for 'n' set to '1', a 'units' dropdown set to 'Years', a checkbox for 'Scale x-axis with variable interval based on x-axis label' which is checked, and a section for 'Enable horizontal x-axis scrolling' with a checkbox and two radio button options ('Start at left' and 'Start at right', with 'Start at right' selected). The 'Causes' and 'Notes' dropdowns are both set to 'Display full text'. The 'Y-axis' section has two radio button options: 'Automatic scale' (selected) and 'User scale'. The bottom of the dialog features buttons for 'View data', 'Save as default', a help icon, a green checkmark icon, 'OK', and 'Cancel'.

### X-axis

- In the Label x-axis with field, select a label option from the drop-down menu. The default value is Nothing. Other options are Numbers and specific identifier fields. Identifier fields in this menu are those mapped in the Step 3: Data definition tab. Select the option you want.
- Select an option to determine the number and type of labels you want to appear on the chart's X-axis. Options are:
  - Label every subgroup – Displays a label on each subgroup or data point. For charts with a large number of data points, this option may cause the labels to overlap.
  - Place n labels across the chart – Displays only the number of labels that you specify across the chart. Enter the number of labels in the n = field.
  - Label every n subgroups – Displays a label on every nth subgroup or data point.
  - Label every n units – Displays a label on every nth unit. This option is available only if you have selected a date/time field for the Label x-axis with option. If you select this option, you must specify the units, such as Days, Months, or Quarters in the units = field and the number of time units in the n = field.
- If you want to Scale x-axis with variable interval based on x-axis label, select this option. It tells the chart to set the spacing between the data points on the chart to reflect where each data point falls along the timeline (or number line) established by the identifier used to label the X-axis. This option is available only when the X-axis is labeled with a date/time or numeric identifier, and the data source is ordered by the identifier used to label the X-axis.

NOTE: How is the order of the data source determined? On the Step 3: Data definition tab, when the data source is a "Table" the Column to use for Order By field determines the order of the data. When a "Query or view," "Stored procedure," or "Custom query" is used as the data source, it is assumed that the data is ordered by the "Unique identifier" column.

- Select Enable horizontal x-axis scrolling if you want the ability to scroll the chart through the data points using the mouse. The Chart width in subgroups field specifies the number of data points to display across the chart. Specify whether the chart initially displays the specified number of data points from the beginning of the data source (Start at left) or from the end of the data source (Start at right). When the mouse hovers near the X-axis, a slider bar will appear that allows you to scroll through the data or change the displayed chart width in data points.
- Causes and Notes – If you want causes and/or notes to be indicated on the chart, make a selection from the respective drop-down menus. Your options are:
  - Display nothing - Do not display the cause or note (default)
  - Display a single letter indication – The letter C will be used for a cause, and the letter N will be used for a note.
  - Display abbreviated text – A short portion of the cause or note text will be displayed on the chart.
  - Display full text – The full text of the cause or note will be displayed on the chart.

### Y-axis

- Automatic scale – Select this for CHARTrunner to determine the appropriate values for scaling the Y-axis.
- User scale – Select this to specify the Max, Min, and Increment values to use for scaling the Y-axis. If you leave a field blank, CHARTrunner will automatically select an appropriate value.

## Extra lines sub-tab - short-run charts

Here you define the extra lines you want to appear on the chart

**CHARTrunner - Customizing a chart definition - Short Run Extra Lines sub-tab**

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Limits/targets | Control chart | Titles | Misc.

**Chart options** | **X-axis** | **Y-axis** | **Extra lines** | **Chart data display**

Add all spec lines (blank extra-lines are ignored)

Note: all extra-line types may not be available for all chart types.

	Type	Line label	Value	Apply to	Label with	Which chart?	Style		
							Color	Width	Style
1	Extra line	Extra line	3	All	Name	1		Regular	Solid
2	Mean line	Mean line	Calculated	All	Name	1		Regular	Short dash
3									
4									
5									
6									
7									
8									
9									
10									
11									

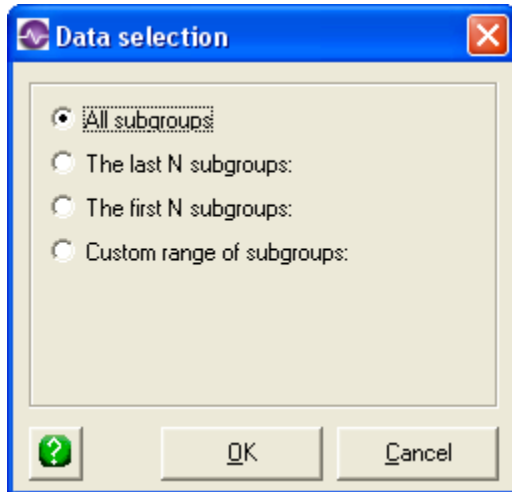
View data | Save as default | ? | OK | Cancel

To define a new line, click the Type column and choose from the list of line types.

Extra line – You must enter the Y-axis value for the line in the Value column.

- Mean line

Enter in the Line label column the text you want to label the line with.



When you click in the Apply to column, you can choose from the options shown above to determine what subgroups (or data points) the extra line will be applied to. See ***Applying an extra line to specific subgroups*** for more information on applying the extra line to a specific range of subgroups.

- Label with – You can specify to label the extra line with:
  - Nothing
  - Name
  - Value
  - Name and value
- Which chart? – Specify 1 or 2 to indicate which sub-chart on the chart the extra line applies to.
- Style : Color – Click here to open the color dialog to choose the color for the extra line.
- Style : Width – Specify the width of the extra line as Regular, Wide, or Thick.
- Style : Style – Select from the drop-down list to specify the line style for the extra line.

Right-click on a row in the extra-lines grid to delete that extra-line from the list.

## Chart data display sub-tab - short run charts

CHARTrunner - Customizing a chart definition - Short Run Extra Lines sub-tab

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Limits/targets | Control chart | Titles | Misc.

Chart options | X-axis Y-axis | **Extra lines** | Chart data display

Above Chart?	Web Table?	Name	Type	Label
<input type="checkbox"/>	<input type="checkbox"/>	Date	Identifier	Date
<input type="checkbox"/>	<input type="checkbox"/>	Product	Identifier	Product
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Length	Data	Length
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Target	Statistic	Target
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Difference	Statistic	Difference
<input type="checkbox"/>	<input type="checkbox"/>	Sigma	Statistic	Sigma
<input type="checkbox"/>	<input type="checkbox"/>	Zed	Statistic	Z
<input type="checkbox"/>	<input type="checkbox"/>	Weight	Statistic	Weight

☐ Show identifier values      Maximum data length:

☒ Show data values

☒ Show statistic values

View data    Save as default    ?    OK    Cancel

Here you define what information you want to appear in these areas:

- In the "Data above the chart" grid that appears above the chart.

Place a check mark in the Above Chart? column for each row of identifiers, data, or statistics that you want to appear above the chart.

- In the "Chart data" table when a chart is saved as a Web page.
  - Place a check mark in the Web Table? column for each row that you want to appear in the "Chart data" table of the Web page.
  - The "Chart data" table of the Web page is a grid that is displayed below the chart on the Web page. It displays information in a similar fashion to the "Data above the chart" grid. One of the advantages is that this data can be highlighted and copied whereas the data appearing in the grid above the chart on a Web page cannot, as it is simply an image.
  - For more information on saving charts as web pages, see the topics **Save chart as web page dialog** and **Web page defaults sub-tab - misc. tab - applies to all charts**.

Edit the contents of the Label column if you want to change the text that appears for an identifier, data value, or statistic.

Place a check mark in the Show identifier values field to display identifier values in the "Data above the chart" grid.

Place a check mark in the Show data values field to display data values in the "Data above the chart" grid.

Place a check mark in the Show statistic values field to display statistic values in the "Data above the chart" grid.

The Maximum data length field is used to limit the length of text that appears in each cell of the "Data above the chart" grid. Leave this blank unless you want to apply a length limit. Typically you enter a value here to prevent long identifier text from overwhelming a cell. Note that the decimal point in a numeric value will count as one character. For example, in order to display the entire value of 38.49 you would need to enter a maximum data length of 5.

If Maximum data length is used it will truncate any value entered that is longer than the maximum data length textbox. This will display a value that could potentially be misconstrued. For example, if the date value was 11/07/2008 and the maximum data length was set to 5, the date would appear as "11/07" which could be misconstrued as November, 2007. Also, if your data spans across several years, entering a maximum data length will often truncate the years off of the end of the date, making it difficult to interpret the data.

## Rare event control charts

Control charts for rare events allow you to use control charting techniques when the process you are monitoring does not produce many data points. For example, say you want to monitor the number of times you have a power failure. This does not happen very often. If you use a traditional control chart it will show lots of days with a zero data point and an occasional day with a one data point. The chart is not very interesting but more importantly it does not give you a sense of what is happening. Is there more or less variation? Rare event control charts solve this problem by monitoring the amount of time or the number of units between rare events.

## Types of rare event control charts

There are two types of control charts for rare events:

- t-chart – Use this to monitor the amount of time that passes between rare events. Time might be measured in minutes, hours, days, months, etc.
- g-chart – Use this to monitor a number of units that get produced between rare events. The units can be things like the number of customers served, the number parts manufactured, the number of orders processed, or the number of patients admitted.

## Describing the rare event

When you create a t-chart or a g-chart, on the chart type/name tab, you have two additional fields where you may describe the rare event being charted. The fields are optional. The text you type in these fields will be used in the chart type title that appears above the chart. This title becomes the general description of what the chart is showing.

For a t-chart, you may provide these two fields:

- Time unit: Select from the drop-down list one of the options minutes, hours, days, etc.
- Special event name: This is where you name the rare event you are monitoring.

For example, if your time unit is 'Days' and your special event name is 'Power failures' then the chart type title will look like this:

INSERT t-chart (Days between Power failures)

For a g-chart, you may provide these two fields.

- Normal event name: This is where you name the units you are counting between each rare event.
- Special event name: This is where you name the rare event you are monitoring.

For example, if your Normal event name is 'Customers Served' and your Special event name is 'Complaints' then the chart type title will look like this:

INSERT g-chart (Customers Served between Complaints)

## Step 1: Chart name/type tab

When you create a new chart, on the Step 1: Chart name/type tab, select the category named Rare event control charts. This will make the t-chart and g-chart options visible under Chart types. Once you select t-chart or g-chart, enter your descriptions in the fields near the bottom of the Chart types section of this tab.

## Pareto charts

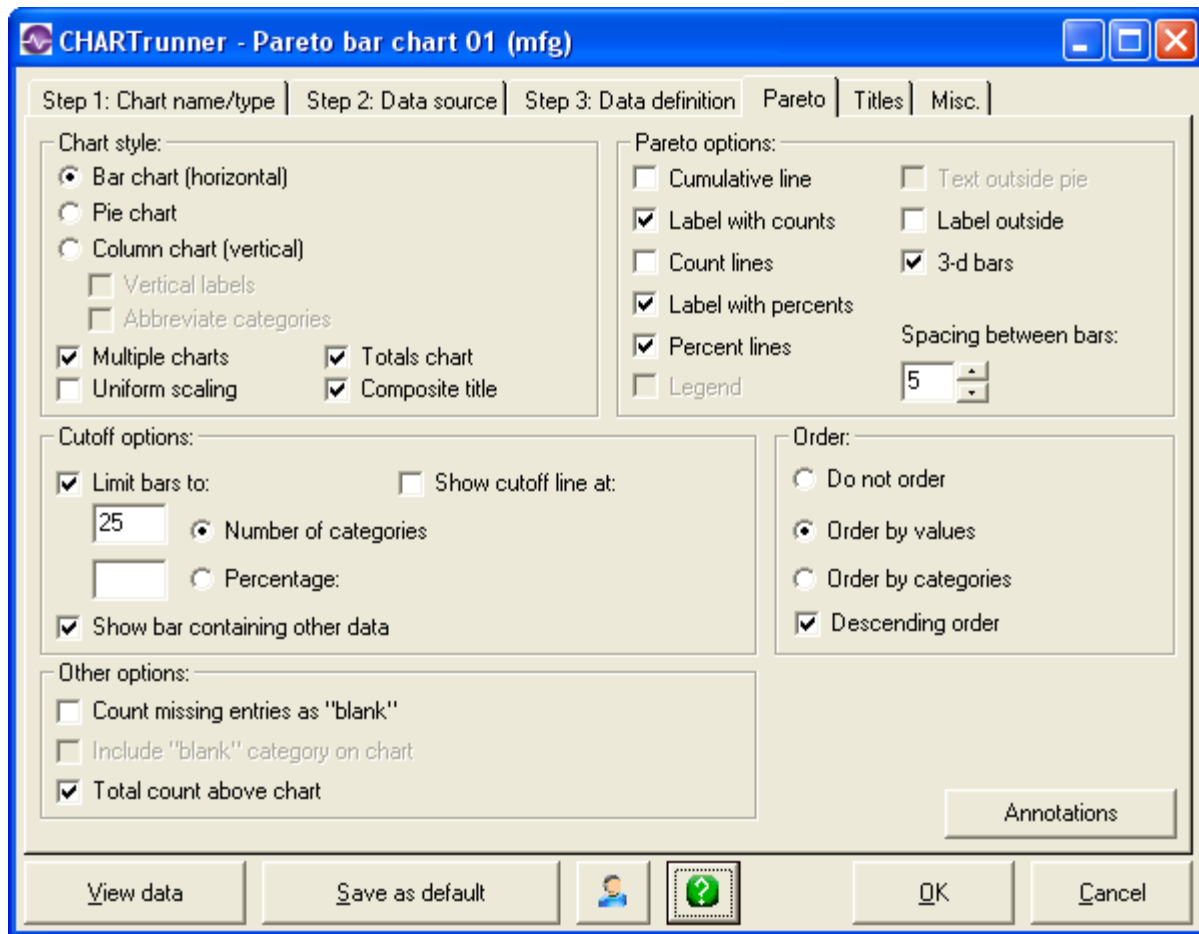
A Pareto chart is a simple bar chart that ranks related measures in order of occurrence. (In addition to bar charts, CHARTrunner also lets you create pie charts.) The principle was developed by Vilfredo Pareto, an Italian economist and sociologist who conducted a study in Europe in the early 1900s on wealth and poverty. He found that wealth was concentrated in the hands of the few and poverty in the hands of the many. The principle is based on the unequal distribution of things in the universe. It is the law of the "significant few versus the trivial many." The significant few things will generally make up 80% of the whole, while the trivial many will make up about 20%.

The purpose of a Pareto chart is to separate the significant aspects of a problem from the trivial ones. By graphically separating the aspects of a problem, a team will know where to direct its improvement efforts. Reducing the largest bars identified in the diagram will do more for overall improvement than reducing the smaller ones.



## Pareto tab - pareto charts

The Pareto tab allows you to customize many features of your bar or pie charts.



### Chart Style

The next three options allow you to select the type of Pareto chart to create:

- Bar chart (horizontal) – Create a bar chart with horizontal bars.
- Pie chart – Create a pie chart.
- Column chart (vertical) – Create a bar chart with vertical bars. You can select one of the following options to adjust how the category bars are labeled. This can be helpful if the labels along the bottom of the chart collide with each other.
  - Vertical labels – The category labels are drawn vertically rather than horizontally.
  - Abbreviate categories – The category labels are drawn horizontally but are abbreviated to require less space.

Multiple detail charts – You have the option of drawing or summarizing multiple detail charts if on the Step 3: Data definition tab you specified one of the following two situations:

1. A Group by column. Each detail chart would consist only of data having the same Group by column value.

2. A Categories column along with multiple Count columns. Each detail chart would consist only of data from one Count column.

When multiple detail charts are possible the following four variations on the resulting chart are possible:

1. Multiple charts only is selected. Each detail chart is shown separately on the chart.
  2. Totals chart only is selected. A single Totals chart that shows a summary of the data from the detail charts is shown.
  3. Both Multiple charts and Totals chart are selected. Each detail chart is shown separately plus the Totals chart is shown as well.
  4. Neither Multiple charts nor Totals chart is selected. This results in a single chart with multiple sets of detail bars representing each of the detail charts. This option is not available for Pie charts.
- Multiple charts – Select this option to display each detail chart separately on the chart. This option is enabled only if multiple detail charts is possible.
    - Uniform scaling – Select this option to use the same category scaling for the bars of each detail chart. This option is not enabled for Pie charts. This option is enabled only when Multiple charts is selected.
  - Totals chart – Select this option to display a Totals chart that shows a summary of the data from the detail charts.
  - Composite title – When this option is selected, the chart title reflects the range of titles from the multiple detail charts. For example, if the detail chart titles are “January,” “February,” and “March,” then the composite title would be “January – March.” This option is enabled only in these two situations:
    - When the Multiple charts and Totals chart options are selected. If Composite title is selected, the Totals chart title reflects the range of the detail charts. Otherwise, the Totals chart has a title of “Total Counts.”
    - When multiple detail charts are possible and the Multiple charts option is not selected. If Composite title is selected, the chart title reflects the range of the detail charts, even though the detail charts are not displayed.

## Pareto Options

These options allow you to customize the look of the chart:

- Cumulative line – Select this option to draw a cumulative line. (Enabled if either Bar or Column chart is selected)
- Label with counts – Select this option to label each bar or slice with the number of counts.
- Count lines – Select this option to draw lines across the chart from the major tick marks along the count axis. (Enabled if Label with counts is selected)
- Label with percents – Select this option to label each bar or slice with the percentage of the total counts for that bar or slice.
- Percent lines – Select this option to draw lines across the chart from the major tick marks along the percentage axis. (Enabled if Label with percents is selected)
- Legend – Select this option to draw a legend on the chart. (Enabled if Pie chart is selected)
- Text outside pie – Select this option to draw labels outside of the pie. (Enabled if Pie chart is selected)
- Label outside – Select this option to draw labels outside of the bars. (Enabled if either Bar or Column chart is selected)
- 3-d bars – Select this option to draw 3-dimensional bars. (Enabled if either Bar or Column chart is selected)
- Spacing between bars – Enter the spacing between the bars of a bar or column Pareto chart. The specified number is in percentage.

## Cutoff Options

Cutoff options let you take advantage of the Pareto principle and display a chart showing the categories occurring most frequently. This function is useful if you have a large number of categories and want to look only at the top percent or top number of categories. Depending on whether you have selected the pie or bar/column chart type, some of the options in this frame will say “pie” or “bar.”

- Limit bars/slices to – Select this option to limit the number of bars or pie slices to the specified Number of categories or Percentage.
- Show cutoff line at – The cutoff line displays a line on the chart at the specified location (Number of categories or Percentage). For example, if you set up the chart to show a cutoff line at 25%, the chart will draw a line indicating the top 25% of counts.
- Number of categories – Select this option to display no more than the specified number of bars or pie slices on the chart.
- Percentage – Select this option to display enough bars or pie slices to represent the specified percentage of the counts.
- Show bar/slice containing other data – Select this option to display an Other bar or pie slice that represents the data from the categories that were “cut off” from the chart. This option is enabled only when Limit bars/slices to is selected.

## Order

The order options let you specify the order of the bars or pie slices on the chart.

- Do not order – Select this option to impose no order.
- Order by values – Select this option to order the bars or pie slices based upon the value of each bar or pie slice.
- Order by categories – Select this option to order the bars or pie slices based upon the category label.

- **Descending order** – Select this option to specify descending order for Order by values or Order by categories. If this option is not selected, then ascending order is used.

#### Other Options

- **Count missing entries as "blank"** – Select this option if you want missing data to be counted as the (*blank*) category. For instance, assume that on the *Step 3: Data definition* tab you mapped a single column of data as the *Categories* column, and there are 5 rows within that column that have missing data; then the (*blank*) category will have a value of 5 counts.

NOTE: In database terminology, the data is considered to be *missing* if it contains the Null value, contains zero length text, or results in zero length text when the data field is converted to text.

- **Include "blank" category on chart** – Select this option to include the (*blank*) category as a bar or pie slice on the chart.
- **Total count above chart** – Select this option to include the total count in the title area above the chart. If Multiple charts is selected, the total count will be shown above each detail chart. If Count missing entries as "blank" is selected, the total count will distinguish between blank and non-blank counts.

## Histogram charts

A histogram is a bar chart that represents the frequency distribution of data. The height of each bar corresponds to the number of items in the class or cell. The width of each bar represents a measurement interval. The histogram shows basic information such as central location, shape, and spread of the data being examined.

### Histogram tab - histogram charts

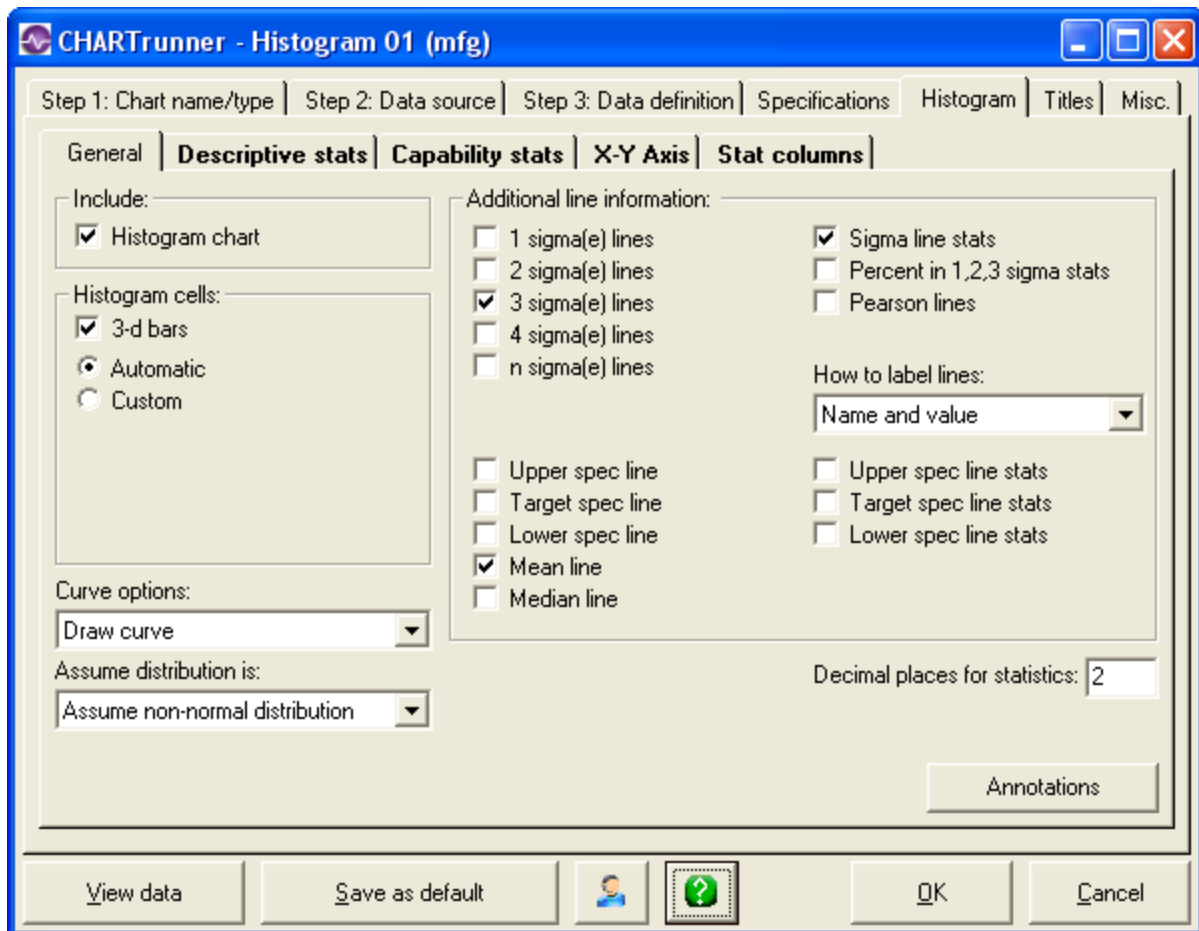
The following sub-tabs allow you to customize histogram charts:

- **General** (see "General sub-tab - histogram charts" on page 163)
- **Descriptive stats** (see "Descriptive stats sub-tab - histogram charts" on page 165)
- **Capability stats** (see "Capability stats sub-tab - histogram charts" on page 167)
- **X-Y Axis** (see "X-Y Axis sub-tab - histogram charts" on page 170)
- **Stat columns** (see "Stat columns sub-tab - histogram charts" on page 171).

In addition, the **Specifications** (see "Specifications tab - histogram charts" on page 172) tab is where you enter the Target (or Nominal) value, the Upper specification and/or the Lower specification values. These values are used in calculating many histogram statistics and may be displayed as lines on the histogram chart.

## General sub-tab - histogram charts

The General sub-tab allows you to customize many features of your histogram chart, as explained below.



- Histogram chart – Select this option to include the histogram bar chart itself on the chart. Do not select this option if you only want the histogram statistics to appear on the chart.
- Curve options – Select from the drop-down list to specify an option for drawing the distribution curve on the histogram chart:
  - Draw curve – Always draw the distribution curve.
  - Do not draw curve – Never draw the distribution curve.
  - Draw curve if it fits distribution – Draw the distribution curve only if the chart's data matches the curve type specified by Assume distribution is.
- Assume distribution is – Select from the drop-down list to specify the type of distribution curve to assume the chart's data follows:
  - Assume normal distribution
  - Assume that the chart data follows the normal distribution.
  - Assume non-normal distribution
  - Assume that the chart data does not follow the normal distribution.

- Decimal places for statistics – Specifies how many decimal places to display for calculated statistics.
- Annotations – Click this button to open a window that displays the annotations that are attached to this chart. This allows you to remove annotations from the chart.

#### Histogram Cells

- 3-d bars – Select this option to draw 3-dimensional bars.
- Automatic – Select this option to have CHARTrunner automatically calculate the *Cell start*, *Cell width*, and *Number of cells* parameters.
- Custom – Select this option to manually specify the *Cell start*, *Cell width*, and *Number of cells* parameters.
  - Cell start – This specifies the X-axis value of the left edge of the leftmost bar on the histogram.
  - Cell width – This specifies the width of each bar on the histogram.
  - Number of cells – This specifies the number of bars on the histogram.

When specifying Custom histogram cells, you must specify one of the following combinations:

1. The *Number of cells* only.
2. The *Cell start* and *Cell width*.
3. All three settings: *Cell start*, *Cell width*, and *Number of cells*.

#### Additional Line Information

To draw additional lines on the histogram, click on the line options you want. Sigma calculations for these lines will be either estimated or actual sigma, depending on whether you select Capability or Performance on the *Descriptive stats* sub-tab. For instance, the option to draw 1 sigma lines will appear as “1 sigma(e) lines” for Capability stats and “1 sigma(i) lines” for Performance stats.

- 1 sigma(e) lines – Select this option to draw 1 sigma lines.
- 2 sigma(e) lines – Select this option to draw 2 sigma lines.
- 3 sigma(e) lines – Select this option to draw 3 sigma lines.
- 4 sigma(e) lines – Select this option to draw 4 sigma lines.
- n sigma(e) lines – Select this option to draw n sigma lines. Specify the number of sigma for the lines in the n = field.
- Upper spec line – Select this option to draw the upper specification line.
- Target spec line – Select this option to draw the target specification line.
- Lower spec line – Select this option to draw the lower specification line.
- Mean line – Select this option to draw the mean line.
- Median line – Select this option to draw the median line.
- Sigma line stats – Select this option to include (on the right side of the chart) information about the sigma line(s) you have selected.
- Percent in 1,2,3 sigma stats – Select this option to include (on the right side of the chart) information about the percentage of the data points that fall within 1, 2, and 3 sigma.
- How to label lines – Select one of the following options for labeling the lines on the chart:
  - Nothing
  - Name
  - Value

- Name and value
- Upper spec line stats – Select this option to include (on the right side of the chart) information about the upper specification line.
- Target spec line stats – Select this option to include (on the right side of the chart) information about the target specification line.
- Lower spec line stats – Select this option to include (on the right side of the chart) information about the lower specification line.

## Descriptive stats sub-tab - histogram charts

The Descriptive stats sub-tab allows you to select the general statistics that you want to display on the histogram and the type of sigma you want to use in the calculations. Formulas for these statistics can be found in the Formulas section of the Appendix, or in the online Quality Advisor (<http://www.qualityadvisor.com> (<http://www.qualityadvisor.com>)).

The screenshot shows the 'CHARTrunner - Histogram 01 (mfg)' dialog box with the 'Descriptive stats' sub-tab selected. The dialog has a title bar with standard window controls and a tabbed interface with tabs for 'Step 1: Chart name/type', 'Step 2: Data source', 'Step 3: Data definition', 'Specifications', 'Histogram', 'Titles', and 'Misc.'. The 'Descriptive stats' sub-tab is active, showing two main sections: 'Statistics to display:' and 'Compute stats based on:'. The 'Statistics to display:' section contains a list of statistics with checkboxes: Number of data points (checked), Mean (checked), Median (unchecked), Min value (checked), Max value (checked), Sigma of the individuals (checked), Skewness (checked), Kurtosis (checked), Coefficient of variation (checked), Dpm (checked), Defects per x (unchecked), Actual % out-of-spec (checked), Average range (unchecked), Average sigma (unchecked), Estimated sigma (unchecked), Pearson stats (unchecked), and Show cell values (unchecked). The 'Compute stats based on:' section contains two radio buttons: 'Capability (estimated sigma)' (selected) and 'Performance (actual sigma)' (unchecked). Below these are checkboxes for 'Chi-Square at: 95 % confidence' (checked), 'Theoretical % out-of-spec' (unchecked), 'Z-upper' (unchecked), 'Target Z' (unchecked), and 'Z-lower' (unchecked). At the bottom of the sub-tab are three buttons: 'All', 'Clear', and 'Default'. The main dialog box has a footer with buttons for 'View data', 'Save as default', a user icon, a help icon, 'OK', and 'Cancel'.

- **Statistics To Display** - Select an option to include (on the right side of the chart) information about the selected statistic.
- **Compute Stats Based On**
  - **Capability (estimated sigma)** – Select this option to use estimated sigma in the statistic calculations such as the sigma lines on the histogram,  $+/-x$  sigma values, Theoretical % out of spec, Chi-Square value, the curve on the histogram (if drawn), and the defects per million (Dpm). Estimated sigma is an estimate of the standard deviation calculated by dividing the average range by the tabular constant d2 ( $R\text{-bar}/d2$ ). In addition, the estimated sigma is always used to calculate Cpk, Cp, Cpu, Cpl, and Cr.
  - **Performance (actual sigma)** – Select this option to use sigma of the individuals in the statistic calculations such as the sigma lines on the histogram,  $+/-x$  sigma values, Theoretical % out of spec, Chi-Square value, the curve on the histogram (if drawn), and the defects per million (Dpm). Sigma of the individuals is standard deviation calculated from the individual data values in a data set. It is also known as actual or calculated sigma. In addition, the actual sigma is always used to calculate Ppk, Pp, Ppu, Ppl, and Pr.
  - **Chi-Square at** – Select this option to include (on the right side of the chart) the Chi-Square analysis at the specified % of confidence. Chi-square is a test statistic used to determine if the distribution of the data can be accepted as not statistically different from the theoretical distribution (normal or non-normal).
  - **Theoretical % out-of-spec** – This shows how much data is estimated to be outside the specification(s) based on the theoretical distribution specified (normal or not-normal).
  - **Z-upper** – This is used to determine how many standard deviations exist between the mean and the upper specification. It is calculated by subtracting mean from the upper specification and dividing this by the standard deviation. This value is then used in the calculation of the Theoretical % above the upper specification.
  - **Target Z** – This is used as a measure to track improvements to being on the target specification. It is calculated by subtracting the target specification from the mean and dividing this by the standard deviation.
  - **Z-lower** – This is used to determine how many standard deviations exist between the mean and the lower specification. It is calculated by subtracting the lower specification from the mean and dividing this by the standard deviation. This value is then used in the calculation of the Theoretical % below the lower specification.
  - **All** – Click this button to select all options.
  - **Clear** – Click this button to un-select all options.
  - **Default** – Click this button to select the default set of options.



## Capability stats sub-tab - histogram charts

The Capability stats sub-tab allows you to specify the capability statistics you want to include on the chart. Formulas for these statistics can be found in the Formulas section of the Appendix, or in the online Quality Advisor (<http://www.qualityadvisor.com> (<http://www.qualityadvisor.com>)).

CHARTrunner - Histogram 01 (mfg)

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Specifications | Histogram | Titles | Misc.

General | Descriptive stats | **Capability stats** | X-Y Axis | Stat columns

Capability statistics to include:

☒ Cpk ☐ Cpk (sigma shift)

☒ Cp

☒ Cr

☐ Cpm

☐ Cpu

☐ Cpl

☐ Ppk

☐ Pp

☐ Pr

Size of sigma shift:

(enter 1.5 for 6 sigma Cpk)

Explain 'Use target' and 'Center distribution'

☐ Use target for capability, uses target to calculate sigma

☐ Center distribution on target, target substituted for mean

All Clear Default

View data Save as default ? OK Cancel

### Capability statistics to include

Select an option to include (on the right side of the chart) the capability statistic.

- **Cpk** – The Cpk capability index tells how well a system can meet one or two-sided specifications. Cpk calculations use estimated sigma ( $R\text{-Bar}/d2$ ) and, therefore, show the systems, “potential” to meet specifications. Since it takes the location of the process average into account, the process does not need to be centered on the target value for this index in order to be useful.

If Cpk is 1.0, the system is expected to produce at least 99.73% of its output within specifications. The larger the Cpk, the smaller the variation in the process output and the higher the percentage of output that can be expected to lie within the specifications. If Cpk is between 0 and 1.0, less than 99.73% of all process output is expected to meet specifications. Cpk should be used in conjunction with the Cp index. Cpk and Cp will be equal when the process average is centered between the upper and lower specifications. If they are not equal, the smaller the difference between these indices, the more centered the process.

- **Cpk (sigma shift)** – This is used to simulate the changes to Cpk, if the process average changes by x.x sigma values to the closest specification. X.x is the user-entered number of sigmas and should not be large enough to cause the process to center on the other side of the nominal value (center of the specification). Instead of looking at the Cpk in the traditional sense as a static number, you can simulate what the effect on Cpk would be by a shift in the process average.
- **Cp** – The Cp index is used to summarize a system's ability to meet two-sided specifications (upper and lower). Like Cpk, it uses estimated sigma and, therefore, shows the system's potential to meet the specifications. However, it ignores the process average and focuses on the spread. If the system is not centered within the specifications, Cp alone may be misleading. When there is a one-sided specification, Cp will be calculated the same as Cpk.
- **Cr** – The Cr capability ratio is used to summarize the estimated spread of the system compared to the spread of the specifications (upper and lower). The lower the Cr value, the smaller the output spread. Cr does not consider process centering. When the Cr value is multiplied by 100, the result shows the percent of the specifications that are being used by the variation in the process. Cr is calculated using an estimated sigma and is the reciprocal of Cp. In other words,  $Cr = 1 / Cp$ .
- **Cpm** – The Cpm index indicates how well the system can produce within specifications. Its calculation is similar to Cp, except that sigma is calculated using the target value instead of the mean. The larger the Cpm, the larger will be the percentage of the output that meets specifications.
- **Cpu** – The Cpu index compares the variation in the process to the upper specification. The estimated standard deviation is used to calculate Cpu. A Cpu greater than 1 indicates the process is capable of meeting the upper specification.
- **Cpl** – The Cpl index compares the variation in the process to the lower specification. The estimated standard deviation is used to calculate Cpl. A Cpl greater than 1 indicates the process is capable of meeting the lower specification.
- **Ppk** – The Ppk index of process performance tells how well a system is meeting one-or two-sided specifications. Ppk calculations use actual sigma (sigma of the individuals), and shows how the system is actually running when compared to the specifications. This index also takes into account how well the process is centered within the specifications. If Ppk is 1.0, the system is expected to produce at least 99.73% of its output within specifications. The larger the Ppk, the smaller the variation in the process output and the higher the percentage of output that can be expected to lie within the specifications. Ppk should be used in conjunction with the Pp index. Ppk and Pp will be equal when the process average is centered between the upper and lower specifications. If they are not equal, the smaller the difference between these indices, the closer the process is to being centered.
- **Pp** – The Pp index is used to summarize a system's performance in meeting two-sided specifications (upper and lower). Like Ppk, it uses actual sigma (sigma of the individuals), and shows how the system is actually running when compared to the specifications. However, it ignores the process average and focuses on the spread. If the system is not centered within the specifications, Pp alone may be misleading. The higher the Pp value - the smaller the spread of the system's output compared with the spread of the specifications. Pp is a measure of spread only. A process with a narrow spread (a high Pp) may not meet customer needs if it is not centered within the specifications. Pp should be used in conjunction with Ppk to account for both spread and centering. Pp and Ppk will be equal when the process is centered between the upper and lower specifications. If they are not equal, the smaller the difference between these indices, the more centered the process is. When there is a one-sided specification, Pp will be calculated the same as Ppk.
- **Pr** – The Pr performance ratio is used to summarize the actual spread of the system compared to the spread of the specifications (upper and lower). The lower the Pr value, the smaller the output spread. Pr does not consider process centering. When the Pr value is multiplied by 100, the result shows the percent of the specifications that are being used by the variation in the process. Pr is calculated using the actual sigma (sigma of the individuals) and is the reciprocal of Pp. In other words,  $Pr = 1 / Pp$ .
- **Explain 'Use target' and 'Center distribution'** – Click this button to open the help for an explanation of the Use target for capability and Center distribution on target options.

NOTE: CHARTrunner offers the following two choices for using target values in calculating capability:

1. Use target for capability, uses target to calculate sigma
2. Center distribution on target, target substituted for mean

You can select 1, 2, or neither. If you do not select either of these options, CHARTrunner will calculate capability statistics normally.

- Use target for capability, uses target to calculate sigma – CHARTrunner will use the target for capability instead of the mean to calculate actual sigma. Think of this sigma as sigma(t), although some texts refer to it as sigma(cpm). When this option is selected, capability statistics affected will be noted as such on the histogram:

- Cpk(t)
- Cp(t).

The statistics display will include a note that reads:

- (t) = uses target to calculate sigma.
- Center distribution on target, target substituted for mean – CHARTrunner will substitute the target for the mean in all of the capability statistics. When this option is selected, any of the capability statistics affected will be noted as such on the histogram:
  - Cpk(t)
  - Cp(t).

The statistics display will include a note that reads:

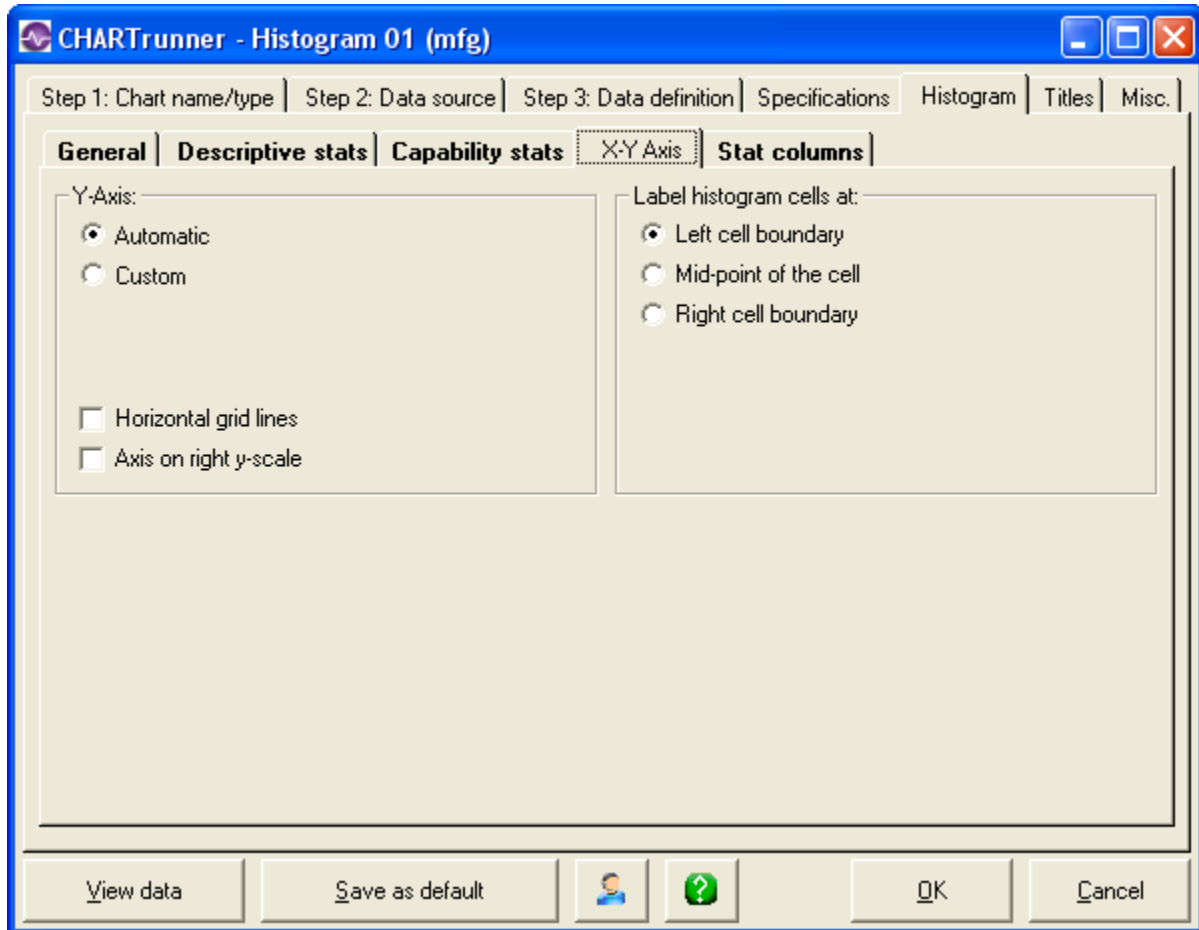
- (\*) = distribution center on target

Which sigma to use?

Estimated sigma and the related capability indices (Cp, Cpk, and Cr) are used to measure the potential capability of a system to meet customer needs. Use it when you want to analyze a system's potential performance. Actual or calculated sigma (sigma of the individuals) and the related indices (Pp, Ppk, and Pr) are used to measure the actual ability of a system to meet customer needs. Use these calculations when you want to measure a system's actual process performance. For more information on the capability and performance indices, visit <http://www.qualityadvisor.com> (<http://www.qualityadvisor.com>).

## X-Y Axis sub-tab - histogram charts

Here you define options for the X-axis (the horizontal axis) and the Y-axis (the vertical axis) of the histogram:



### Y-axis

- **Automatic** – Select this option to allow the software to automatically set the Y-axis scaling values. For histograms, the Y-axis represents a count of the number of data values falling into various cells or bars of the histogram. As a count, it always starts at zero.
- **Custom** – Select this option if you want to define the maximum value used on the Y-axis scale. This can be useful if you want to force two histograms to have the same Y-axis so they may be visually compared.
  - **Max** – If you select Custom, enter the maximum value for the Y-axis here. Remember that the Y-axis on a histogram starts at zero.

- Horizontal grid lines – Enable this option to have horizontal lines appear across the histogram. This allows you to line up a histogram bar with the Y-axis scale.
- Axis on right y-scale – Enable this option to duplicate the Y-axis scale on the right side of the plot area of the histogram.

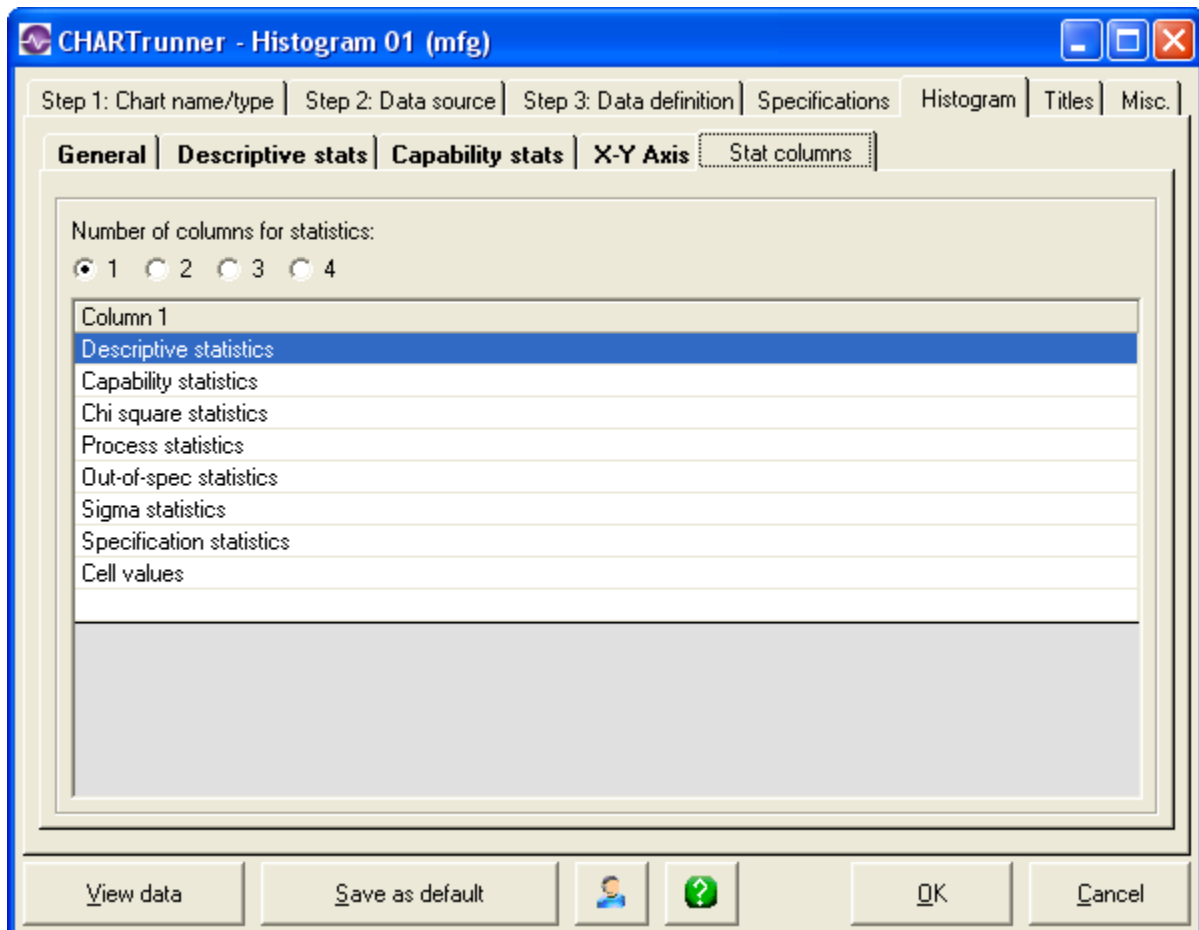
#### Label Histogram Cell At

Each cell or bar on a histogram represents a range of data values as depicted on the X-axis. The first bar might show numbers between 5 and 8, and the second bar might show numbers above 8 up to 11, etc. You have the following three options for where (along this range of values) to place the label for each histogram cell.

- Left cell boundary
- Mid-point of the cell
- Right cell boundary.

## Stat columns sub-tab - histogram charts

Along with the graphical histogram, CHARTrunner displays various statistics to describe the underlying data set. These statistics appear in one or more columns to the right of the histogram chart.



Use the Stat columns tab to describe how many columns of statistics you want and also to arrange the different groups of statistics among the columns. Select the appropriate Number of columns for statistics to set the number of columns. Use your mouse to drag-and-drop the *named* statistics groups into the columns where you want them to appear.

## Specifications tab - histogram charts

Specifications are boundaries, usually set by management, engineering, or customers, within which a system must operate. They are sometimes called engineering tolerances.

The screenshot shows the 'CHARRunner - Histogram 01 (mfg)' dialog box with the 'Specifications' tab selected. The dialog has a blue title bar and standard Windows window controls. Below the title bar is a tabbed interface with tabs for 'Step 1: Chart name/type', 'Step 2: Data source', 'Step 3: Data definition', 'Specifications', 'Histogram', 'Titles', and 'Misc.'. The 'Specifications' tab is active, displaying a 'Specifications:' section with three input fields: 'Upper:' with the value '0.9', 'Target:' with the value '0.7', and 'Lower:' with the value '0.5'. At the bottom of the dialog are several buttons: 'View data', 'Save as default', a user icon, a green question mark icon, 'OK', and 'Cancel'.

Enter values for Upper and Lower specifications and the Target (sometimes called the Nominal) value for the process. The specifications are optional; however, there are many histogram statistics that depend on one or more of these values. If your process has only one upper or lower specification, enter that value in the appropriate field and leave the other Upper or Lower field blank.

**NOTE:** When a specification value is entered on the Limits/specs tab, and the same specification is fetched from the data source using the Treat as field on the Step 3: Data definition tab, then the value fetched from the data source takes precedence. For example, if the target spec is defined as 10.0 on the Limits/specs tab, and the target spec is fetched from a data source column that contains 9.0 in row 1, NULL in rows 2 - 28, 9.5 in row 29, and NULL in row 30, then 9.5 will be the target spec value that is used for the chart.

## Box and whisker charts

A box and whisker chart is a floating bar chart where each bar (i.e., each box) represents a set of data. The minimum, maximum, range, 25th percentile, and 75th percentile of the data set are represented by the box and its whiskers. The whiskers are lines that extend vertically up and down from the box.

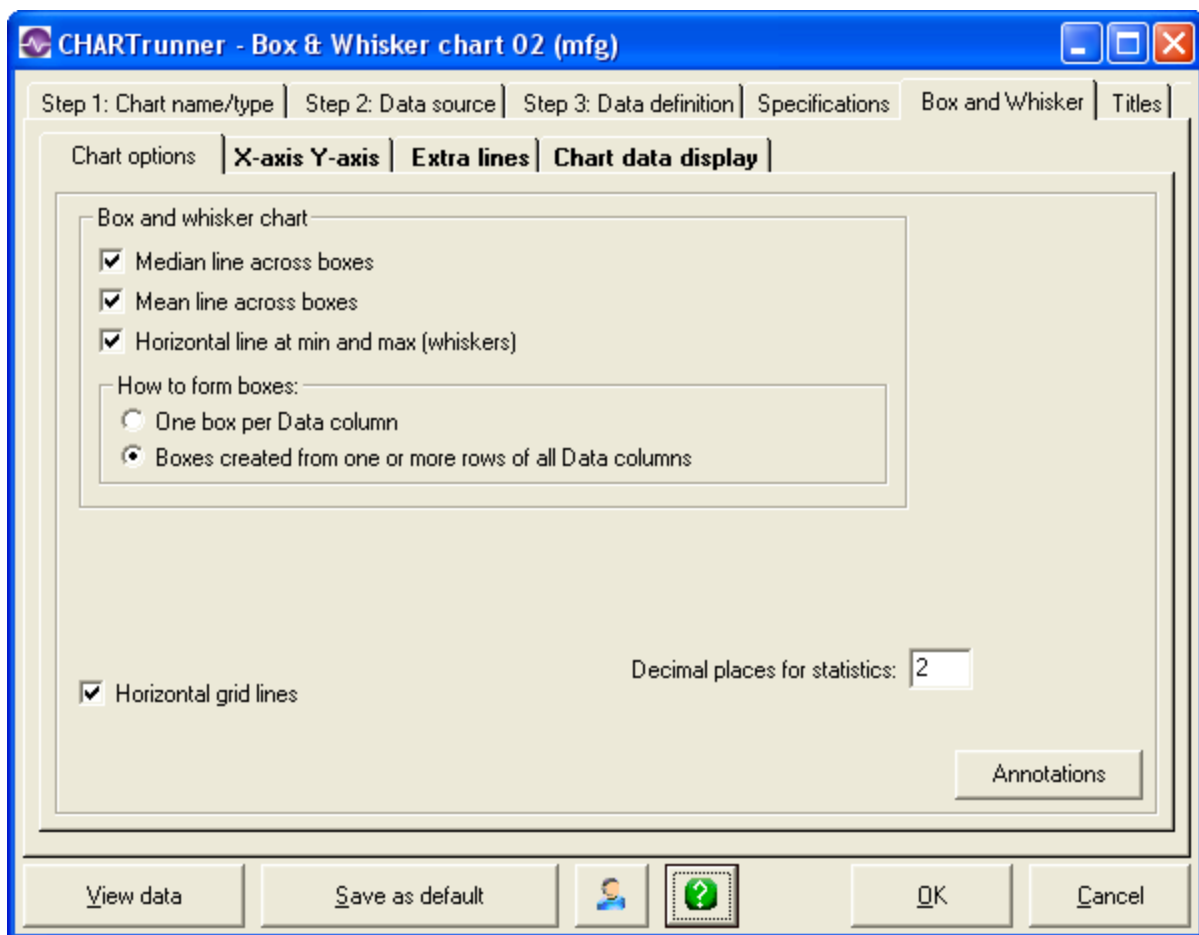
**Box and whisker tab** (see "Box and whisker tab - box and whisker charts" on page 173)

## Box and whisker tab - box and whisker charts

The following sub-tabs allow you to customize box and whisker charts.

## Chart options sub-tab - box and whisker charts

The Chart options sub-tab allows you to make selections affecting the overall appearance of the box and whisker chart.



### Box and Whisker Chart

- Median line across boxes – Enable this if you want a horizontal line drawn across the box at the *median* of the data set.
- Mean line across boxes – Enable this if you want a horizontal line drawn across the box at the *mean* of the data set.
- Horizontal line at min and max (whiskers) – Enable this if you want a horizontal line drawn at the end of each *whisker* line.

### How to Form Boxes

- One box per data column – If you enable this option, the box and whisker chart will contain one box for each column you have mapped as a Data column on the *Step 3: Data definition* tab. For example, if your data source has columns January, February, and March, and you treat each of these three columns as Data, the resulting box and whisker chart will have three boxes – one for each of the three data columns you treated as Data.
- Boxes created from one or more rows of all data columns – Enable this option if you want to form boxes based on some grouping of your data rows. For example, say you have 100 rows of data that cover March through June. If one of your columns contains the Date, you may set up the chart so that you will get four boxes; one each for March, April, May, and June.

NOTE: Selecting this option requires that you define your row grouping using the advanced row selection button on the Step 3: Data definition tab.

### Horizontal Grid Lines

Enable this option to have horizontal grid lines displayed across the chart.

### Decimal Places for Statistics

Set the number of decimals you want displayed. This setting affects the optional data grid which may appear above the chart.



## X-axis Y-axis sub-tab - box and whisker charts

Here you define the options that determine how CHARTrunner labels the X-axis (the horizontal axis) and establishes the scaling for the Y-axis (the vertical axis).

CHARTrunner - Box & Whisker chart 02 (mfg)

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Specifications | **Box and Whisker** | Titles

**Chart options** | X-axis Y-axis | Extra lines | Chart data display

X-axis:

Label x-axis with:

TheDate

☒ Label every box

Y-axis:

☐ Automatic scale ☒ User scale

Box and Whisker	
Max	20
Min	10
Increment	1

View data | Save as default | ? | OK | Cancel

### X-axis

- In the Label x-axis with field, select a label option from the drop-down menu. The default value is Nothing. Other options are Numbers and specific identifier fields. Identifier fields in this menu are those mapped in the Step 3: Data definition tab. Select the option you want.
- Label every subgroup – Box and whisker charts always label every box (or subgroup) on the chart.
- Scale x-axis with variable interval based on x-axis label – This option is not available for a box and whisker chart.

### Y-axis

- Automatic scale – Select this for CHARTrunner to determine the appropriate values for scaling the Y-axis.
- User scale – Select this to specify the Max, Min, and Increment values to use for scaling the Y-axis. If you leave a field blank CHARTrunner will automatically select an appropriate value.

## Extra lines sub-tab - box and whisker charts

Here you define the extra lines you want to appear on the chart. You can define as many extra lines as you desire.

**CHARTrunner - Customizing a chart definition - BoxWhisker Extra Lines sub-tab**

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Specifications | Box and Whisker | Titles

**Chart options** | **X-axis** | **Y-axis** | **Extra lines** | **Chart data display**

Add all spec lines (blank extra-lines are ignored)

Note: all extra-line types may not be available for all chart types.

	Type	Line label	Value	Apply to	Label with	Which chart?	Style		
							Color	Width	Style
1	Upper spec line	Upper spec line		All	Name	1		Regular	Dash dot dot
2	Target spec line	Target spec line		All	Name	1		Regular	Dash dot dot
3	Lower spec line	Lower spec line		All	Name	1		Regular	Dash dot dot
4	Mean line	Mean line	Calculated	All	Name	1		Regular	Short dash
5	Extra line	Extra line	14	All	Name	1		Regular	Solid
6									
7									
8									
9									
10									

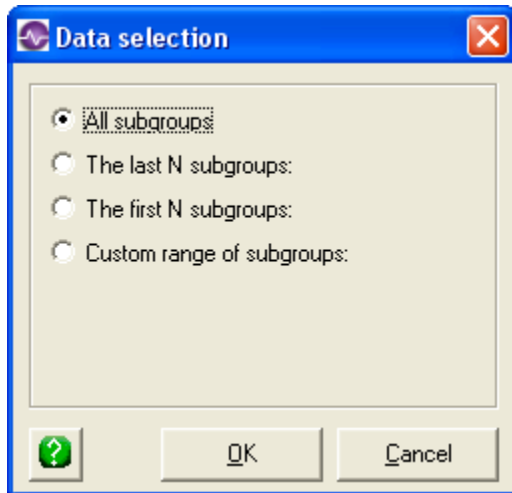
View data | Save as default | ? | OK | Cancel

To define a new line, click the Type column and choose from the list of line types.

Extra line – You must enter the Y-axis value for the line in the Value column.

- Mean line
- Median line
- Mode line
- Upper spec line
- Target spec line
- Lower spec line

Enter in the Line label column the text you want to label the line with.



When you click in the Apply to column, you can choose from the options shown above to determine what subgroups (or data points) the extra line will be applied to. See ***Applying an extra line to specific subgroups*** for more information on applying the extra line to a specific range of subgroups.

- Label with – You can specify to label the extra line with:
  - Nothing
  - Name
  - Value
  - Name and value
- Which chart? – Sub-chart 1 is the only choice for a Box and Whisker chart.
- Style : Color – Click here to open the color dialog to choose the color for the extra line.
- Style : Width – Specify the width of the extra line as Regular, Wide, or Thick.
- Style : Style – Select from the drop-down list to specify the line style for the extra line.

Right-click on a row in the extra-lines grid to delete that extra-line from the list.

## Chart data display sub-tab - box and whisker charts

The Chart options sub-tab allows you to make selections affecting the overall appearance of the box and whisker chart.

Above Chart?	Web Table?	Name	Type	Label
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Maximum	Statistic	Maximum
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	75th percentile	Statistic	75th percentile
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Median	Statistic	Median
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Mean	Statistic	Mean
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	25th percentile	Statistic	25th percentile
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Minimum	Statistic	Minimum

☒ Show statistic values

Unlike some of the other chart types, the box and whisker chart do not show identifier columns or data columns in the grid.

Here you define what information you want to appear in these areas:

- In the “Data above the chart” grid that appears above the chart. Place a check mark in the *Above Chart?* column for each row of statistics that you want to appear above the chart.
- The “Chart data” table of the Web page is a grid that is displayed below the chart on the Web page. It displays information in a similar fashion to the “Data above the chart” grid. One of the advantages is that this data can be highlighted and copied whereas the data appearing in the grid above the chart on a Web page cannot, as it is simply an image.
  - For more information on saving charts as web pages, see the topics ***Save chart as web page dialog*** and ***Web page defaults sub-tab - misc. tab- applies to all charts***.
- Edit the contents of the Label column if you want to change the text that appears for an identifier, data value, or statistic.
- Place a check mark in the Show statistic values field to display statistic values in the “Data above the chart” grid.

## Specifications tab - box and whisker charts

Specifications are boundaries, usually set by management, engineering, or customers, within which a system must operate. They are sometimes called engineering tolerances.

The screenshot shows a software window titled "CHARTrunner - Box & Whisker chart 02 (mfg)". It has a tabbed interface with the following tabs: "Step 1: Chart name/type", "Step 2: Data source", "Step 3: Data definition", "Specifications", "Box and Whisker", and "Titles". The "Specifications" tab is currently selected. Inside this tab, there is a section labeled "Specifications:" containing three input fields: "Upper:" with the value "25", "Target:" which is empty, and "Lower:" with the value "22". At the bottom of the window, there is a row of buttons: "View data", "Save as default", a help icon (a green circle with a white question mark), "OK", and "Cancel".

Enter values for Upper and Lower specifications and the Target (sometimes called the Nominal) value for the process. The specifications are optional. If your process has only one upper or lower specification, enter that value in the appropriate field and leave the other Upper or Lower field blank.

NOTE: When a specification value is entered on the Limits/specs tab, and the same specification is fetched from the data source using the Treat as field on the Step 3: Data definition tab, then the value fetched from the data source takes precedence. For example, if the target spec is defined as 10.0 on the Limits/specs tab, and the target spec is fetched from a data source column that contains 9.0 in row 1, NULL in rows 2 - 28, 9.5 in row 29, and NULL in row 30, then 9.5 will be the target spec value that is used for the chart.

## Multi-line charts

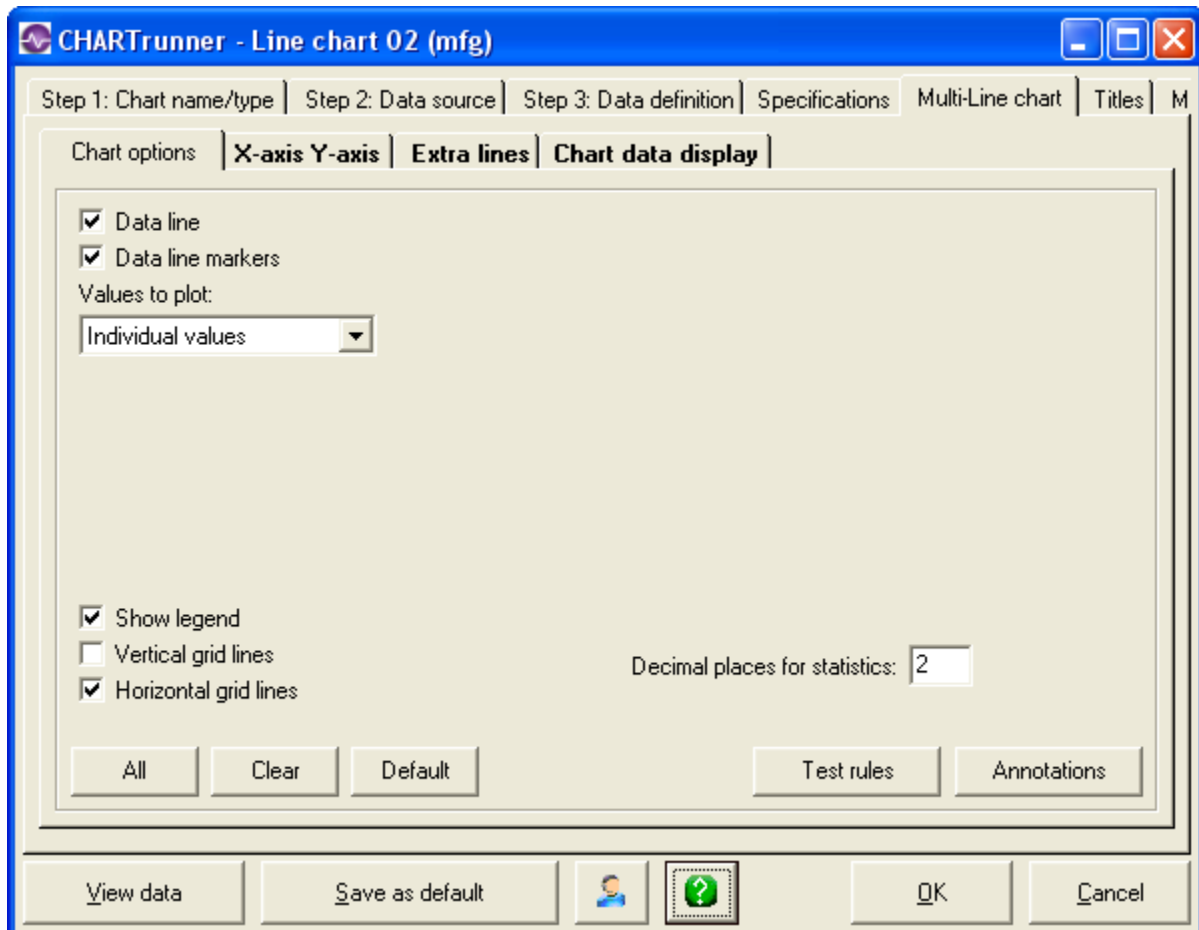
A multi-line chart can show up to 10 different data lines on one chart. Each line represents different data. Think of it as multiple run charts plotted in the same plot area.

## Multi-line chart tab - multi-line charts

The following sub-tabs allow you to customize multi-line charts.

### Chart options sub-tab - multi-line charts

The Chart options sub-tab allows you to select general options affecting the appearance of the multi-line chart.



- Data line – Enable this option to display a line connecting each plotted point.
- Data line markers – Enable this option to have a data marker displayed where each point is plotted.
- Values to plot:
  - Depending on how you specified Treat as for the data source columns on the *Step 3: Data definition* tab, you may plot Individual values (the most common option) or calculated statistics such as Average values, Range values, or Sigma values.
  - You will have the option to plot Average values, Range values, or Sigma values only if you have mapped multiple data source columns to the same numbered data line. For example, if Data 1 has been used three times on the *Step 3: Data definition* tab, then each point on line 1 of the chart could be the range of the data values from these three columns that are treated as Data 1.

- Show legend – Enable this option to display a legend below the multi-line chart that will help identify the data lines.
- Vertical grid lines – Enable this option to display vertical grid lines on the chart.
- Horizontal grid lines – Enable this option to display horizontal grid lines on the chart.
- Decimal places for statistics – Set the number of decimals you want to display with data in the optional grid above chart. Set this up on the *Chart data display* tab.

## X-axis Y-axis sub-tab - multi-line charts

Here you define the options that determine how CHARTrunner labels the X-axis (the horizontal axis) and establishes the scaling for the Y-axis (the vertical axis).

The screenshot shows the CHARTrunner - Line chart 02 (mfg) dialog box, Step 3: Data definition, X-axis Y-axis sub-tab. The dialog has tabs for Step 1: Chart name/type, Step 2: Data source, Step 3: Data definition, Specifications, Multi-Line chart, Titles, and M. The X-axis Y-axis sub-tab is active, showing options for labeling the X-axis and scaling the Y-axis.

**X-axis:**

Label x-axis with:

☐ Label every subgroup  
☐ Place n labels across the chart  
☒ Label every n subgroups

n =

☐ Scale x-axis with variable interval based on x-axis label

☒ Enable horizontal x-axis scrolling

Chart width in subgroups, blank = all:

☐ Start at left  
☒ Start at right

**Y-axis:**

☐ Automatic scale  
☒ User scale

Multi-Line chart	
Max	35
Min	24
Increment	.5

Buttons: View data, Save as default, User icon, Help icon, OK, Cancel

### X-axis

- In the Label x-axis with field, select a label option from the drop-down menu. The default value is Nothing. Other options are Numbers and specific identifier fields. Identifier fields in this menu are those mapped in the Step 3: Data definition tab. Select the option you want.
- Select an option to determine the number and type of labels you want to appear on the chart's X-axis. Options are:
  - Label every subgroup – Displays a label on each subgroup or data point. For charts with a large number of data points, this option may cause the labels to overlap.

- Place n labels across the chart – Displays only the number of labels that you specify across the chart. Enter the number of labels in the n = field.
- Label every n subgroups – Displays a label on every nth subgroup or data point.
- Label every n units – Displays a label on every nth unit. This option is available only if you have selected a date/time field for the Label x-axis with option. If you select this option, you must specify the units, such as Days, Months, or Quarters in the units = field and the number of time units in the n = field.
- If you want to Scale x-axis with variable interval based on x-axis label, select this option. It tells the chart to set the spacing between the data points on the chart to reflect where each data point falls along the timeline (or number line) established by the identifier used to label the X-axis. This option is available only when the X-axis is labeled with a date/time or numeric identifier, and the data source is ordered by the identifier used to label the X-axis.

NOTE: How is the order of the data source determined? On the *Step 3: Data definition* tab, when the data source is a "Table" the Column to use for Order By field determines the order of the data. When a "Query or view," "Stored procedure," or "Custom query" is used as the data source, it is assumed that the data is ordered by the "Unique identifier" column.

- Select Enable horizontal x-axis scrolling if you want the ability to scroll the chart through the data points using the mouse. The Chart width in subgroups field specifies the number of data points to display across the chart. Specify whether the chart initially displays the specified number of data points from the beginning of the data source (Start at left) or from the end of the data source (Start at right). When the mouse hovers near the X-axis, a slider bar will appear that allows you to scroll through the data or change the displayed chart width in data points.

#### Y-axis

- Automatic scale – Select this for CHARTrunner to determine the appropriate values for scaling the Y-axis.
- User scale – Select this to specify the Max, Min, and Increment values to use for scaling the Y-axis. If you leave a field blank, CHARTrunner will automatically select an appropriate value.



## Extra lines sub-tab - multi-line charts

Here you define the extra lines you want to appear on the chart. You can define as many extra lines as you desire.

**CHARTrunner - Customizing a chart definition - Multi-Line Extra lines sub-tab**

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Specifications | Multi-Line chart | Titles | M

**Chart options** | **X-axis** | **Y-axis** | **Extra lines** | **Chart data display**

Add all spec lines (blank extra-lines are ignored)

Note: all extra-line types may not be available for all chart types.

	Type	Line label	Value	Apply to	Label with	Which chart?	Style		
							Color	Width	Style
1	Upper spec line	Upper spec line		All	Name	1		Regular	Dash dot dot
2	Target spec line	Target spec line		All	Name	1		Regular	Dash dot dot
3	Lower spec line	Lower spec line		All	Name	1		Regular	Dash dot dot
4	Extra line	Extra line	12.35	All	Name	1		Regular	Solid
5									
6									
7									
8									
9									
10									

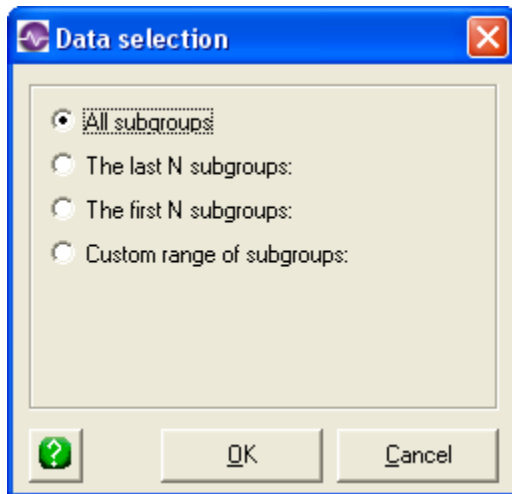
View data | Save as default | ? | OK | Cancel

To define a new line, click the Type column and choose from the list of line types.

Extra line – You must enter the Y-axis value for the line in the Value column.

- Upper spec line
- Target spec line
- Lower spec line

Enter in the Line label column the text you want to label the line with.



When you click in the Apply to column, you can choose from the options shown above to determine what subgroups (or data points) the extra line will be applied to. See ***Applying an extra line to specific subgroups*** for more information on applying the extra line to a specific range of subgroups.

- Label with – You can specify to label the extra line with:
  - Nothing
  - Name
  - Value
  - Name and value
- Which chart? – Sub-chart 1 is the only choice for a Multi-line chart.
- Style : Color – Click here to open the color dialog to choose the color for the extra line.
- Style : Width – Specify the width of the extra line as Regular, Wide, or Thick.
- Style : Style – Select from the drop-down list to specify the line style for the extra line.

Right-click on a row in the extra-lines grid to delete that extra-line from the list.

## Chart data display sub-tab - multi-line charts

CHARTrunner - Line chart 02 (mfg)

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Specifications | Multi-Line chart | Titles | M

Chart options | X-axis Y-axis | Extra lines | Chart data display

Above Chart?	Web Table?	Name	Type	Label
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ID	Identifier	ID
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Average mpg at 55 mph	Data	Average mpg at 55 mph
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Average mpg at 60 mph	Data	Average mpg at 60 mph
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Average mpg at 65 mph	Data	Average mpg at 65 mph
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Average mpg at 70 mph	Data	Average mpg at 70 mph
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Average mpg at 75 mph	Data	Average mpg at 75 mph

☒ Show identifier values      Maximum data length:

☒ Show data values

☒ Show statistic values

View data    Save as default          OK    Cancel

Here you define what information you want to appear in these areas:

- In the "Data above the chart" grid that appears above the chart.

Place a check mark in the Above Chart? column for each row of identifiers, data, or statistics that you want to appear above the chart.

- In the "Chart data" table when a chart is saved as a Web page.

Place a check mark in the Web Table? column for each row that you want to appear in the "Chart data" table of the Web page.

- The "Chart data" table of the Web page is a grid that is displayed below the chart on the Web page. It displays information in a similar fashion to the "Data above the chart" grid. One of the advantages is that this data can be highlighted and copied whereas the data appearing in the grid above the chart on a Web page cannot, as it is simply an image.
- For more information on saving charts as web pages, see the topics **Save chart as web page dialog** and **Web page defaults sub-tab - misc. tab - applies to all charts**.

Edit the contents of the Label column if you want to change the text that appears for an identifier, data value, or statistic.

Place a check mark in the Show identifier values field to display identifier values in the "Data above the chart" grid.

Place a check mark in the Show data values field to display data values in the "Data above the chart" grid.

Place a check mark in the Show statistic values field to display statistic values in the "Data above the chart" grid.

The Maximum data length field is used to limit the length of text that appears in each cell of the "Data above the chart" grid. Leave this blank unless you want to apply a length limit. Typically you enter a value here to prevent long identifier text from overwhelming a cell. Note that the decimal point in a numeric value will count as one character. For example, in order to display the entire value of 38.49 you would need to enter a maximum data length of 5.

If Maximum data length is used it will truncate any value entered that is longer than the maximum data length textbox. This will display a value that could potentially be misconstrued. For example, if the date value was 11/07/2008 and the maximum data length was set to 5, the date would appear as "11/07" which could be misconstrued as November, 2007. Also, if your data spans across several years, entering a maximum data length will often truncate the years off of the end of the date, making it difficult to interpret the data.

## Specifications tab - multi-line charts

Specifications are boundaries, usually set by management, engineering, or customers, within which a system must operate. They are sometimes called engineering tolerances.

The screenshot shows the 'CHARTrunner - Line chart 02 (mfg)' dialog box with the 'Specifications' tab selected. The dialog has a blue title bar and a tabbed interface. The tabs are: Step 1: Chart name/type, Step 2: Data source, Step 3: Data definition, Specifications (selected), Multi-Line chart, Titles, and M. The 'Specifications' tab contains a 'Specifications:' label and three input fields: 'Upper:' with the value '33.0', 'Target:' with the value '30.0', and 'Lower:' with the value '27.0'. At the bottom of the dialog are buttons for 'View data', 'Save as default', a user icon, a green question mark icon, 'OK', and 'Cancel'.

Enter values for Upper and Lower specifications and the Target (sometimes called the Nominal) value for the process. The specifications are optional. If your process has only one upper or lower specification, enter that value in the appropriate field and leave the other upper or lower field blank.

NOTE: When a specification value is entered on the Limits/specs tab, and the same specification is fetched from the data source using the Treat as field on the Step 3: Data definition tab, then the value fetched from the data source takes precedence. For example, if the target spec is defined as 10.0 on the Limits/specs tab, and the target spec is fetched from a data source column that contains 9.0 in row 1, NULL in rows 2 - 28, 9.5 in row 29, and NULL in row 30, then 9.5 will be the target spec value that is used for the chart.

## Scatter diagram charts

A scatter diagram is a specialized line chart used to explore the relationship between two variables. These are known as the dependant variable and the independent variable. They are usually mapped to two columns in the data source. A statistical technique named simple linear regression is used to create a line of best fit and plot the line on a chart. The chart represents one variable on the X-axis (horizontal) and the other variable on the Y-axis (vertical).

### Scatter diagram tab

The screenshot shows the 'CHARTrunner - Line chart 03 (mfg)' dialog box with the 'Scatter diagram' tab selected. The dialog has a blue title bar and a tabbed interface with tabs for 'Step 1: Chart name/type', 'Step 2: Data source', 'Step 3: Data definition', 'Scatter diagram', 'Titles', and 'Misc.'. The 'Scatter diagram' tab is active, showing a list of options to be checked or unchecked, and input fields for custom scaling.

Scatter diagram:

- ☒ Draw line of best fit
- ☒ Show line of best fit equation and R value
- ☒ Vertical grid lines
- ☒ Horizontal grid lines

Decimal places for statistics:

☒ Custom Y-axis scaling

Max value:   
Min value:   
Increment:

☒ Custom X-axis scaling

Max value:   
Min value:   
Increment:

- Draw line of best fit – Enable this option to have the line of best fit displayed on the chart. Without this line, you will only see the data point markers.
- Show line of best fit equation and R value – Enable this option to display the line of best fit equation and the relevant statistics as titles above the plot area of the chart.
- Vertical grid lines – Enable this item to display vertical grid lines on the chart.
- Horizontal grid lines – Enable this item to display horizontal grid lines on the chart.
- Decimal places for statistics – Set the number of decimals to display in the optional statistics which may appear above the chart.
- Custom Y-axis scaling – Enable this option if you want to set your own values for Y-axis scaling – the vertical scale. If you do not enable this option, the software will automatically select an appropriate scale.
  - Max value – Enter the maximum Y-axis value to display
  - Min value – Enter the minimum Y-axis value to display
  - Increment – Enter an increment for Y-axis tick marks
- Custom X-axis scaling –
  - Max value – Enter the maximum X-axis value to display
  - Min value – Enter the minimum X-axis value to display
  - Increment – Enter an increment for X-axis tick mark

## Titles tab - applies to all charts

For every chart type, you have the same options for placing titles on the chart. You may place up to 10 rows of titles above the chart and up to 10 rows of titles below the chart. You may enter a left, center, and right title for each row. Additionally, a left title and a right title may be entered; these will appear as vertical text on either side of the chart.

**CHARTrunner - Measurement control chart 01 (mfg)**

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Limits/specs | Control chart | **Titles** | Misc.

Titles at top of chart:

Line	Left title	Center title	Right title
1		CHARTrunner Lets You Add Annotations To Your Charts	
2		~	
3		Annotations allow you to put text on the chart where you want it.	
4		You can position an annotation at a fixed location on the chart.	
5		Or, you can attach an annotation to a data point on the chart.	
6		When the data point moves, the annotation follows the data p...	

Titles at bottom of chart:

Clear all titles

Line	Left title	Center title	Right title
1		@DT	
2	@image(crlogo.wmf)	www.charrunner.com 800-777-3020	@image(pqlogo.wmf)
3			
4			
5			
6			
7			

Left title (vertical text on left side of chart):

Right title (vertical text on right side of chart):

☒ Chart type as a title ☐ Title grid lines

☒ Control limits as a title

☐ Multiple control limit titles

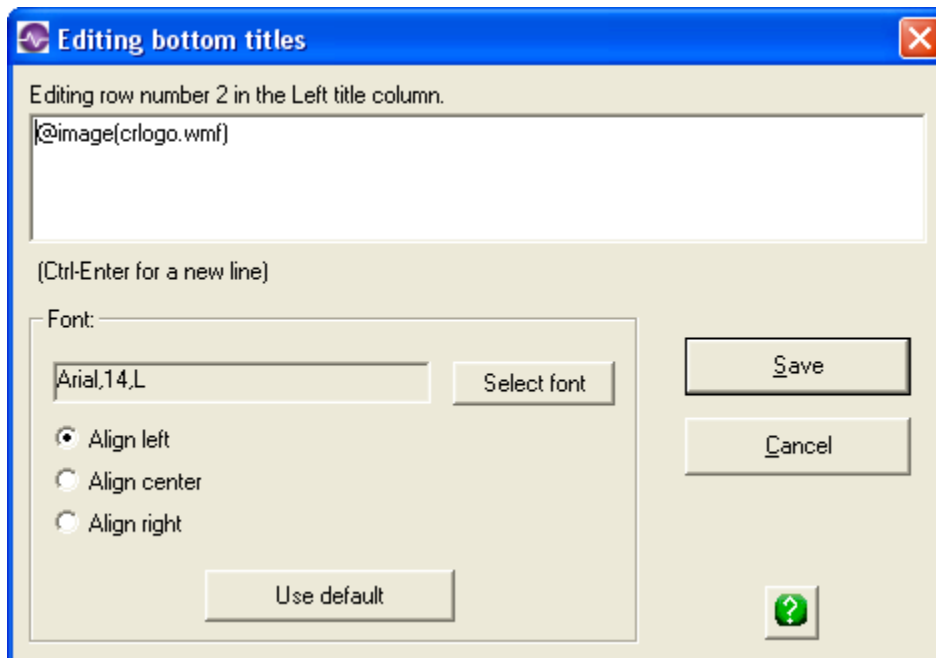
View data Save as default [User Icon] [Help Icon] OK Cancel



To enter a title in any position, double click in that position either in the *Titles at the top of the chart grid* or in the *Titles at bottom of the chart grid*. This will display a pop-up dialog box where you may type in the text and select font options for the title. Use this same double-click gesture to modify an existing title.

- Left title (vertical text on left side of chart) – Enter text for a title that will appear vertically to the left of the plot area.
- Right title (vertical text on right side of chart) – Enter text for a title that will appear vertically to the right of the plot area.
- Chart type as a title – Enable this option to display a title above the plot area which describes the type of chart.
- Control limits as a title – On any control chart, enable this option to have the control limits displayed as a title above the plot area.
- Multiple control limit titles – On control charts that display multiple sets of control limits, enable this option if you want each set of control limits displayed as titles above the plot area.
- Title grid lines – Enable this option if you want the titles both above and below the chart to be displayed with grid lines separating the rows and columns.

When you double-click to enter or edit any chart title, the following form will be displayed:

The image shows a Windows-style dialog box titled "Editing bottom titles" with a blue header bar and a red close button. The main area has a light beige background. At the top, it says "Editing row number 2 in the Left title column." Below this is a text input field containing the code "@image(crlogo.wmf)". Underneath the text field is the instruction "(Ctrl-Enter for a new line)". To the left, there is a "Font:" section with a text box showing "Arial,14,L" and a "Select font" button. Below the font section are three radio buttons for "Align left" (which is selected), "Align center", and "Align right". At the bottom left of the font section is a "Use default" button. On the right side of the dialog, there are two buttons: "Save" and "Cancel". At the bottom right, there is a green question mark icon in a square box.

Enter the text of your title, select your font options, and then click on the Save button.

Enter the tilde character (~) by itself in a title to create a blank title at that position.

You may use any of the applicable chart title codes in the text of a title. For example, the title shown above uses the @IMAGE title code. See the topic **Chart title codes - titles tab** (on page 192) for more information

## Chart title codes - titles tab

You may insert various title codes into all chart titles. These codes allow the software to substitute an appropriate value whenever the chart is rendered. The simplest example is the @D title code. If you place this in a chart title, when the chart is generated, today's date will replace the @D. So a chart title that is entered like this:

Chart generated on @D

Will be displayed on the chart as:

Chart generated on 07/05/2007

Title codes can be used to save time while defining charts. For example, if you want the chart name to appear as a chart title, you could manually type in the chart name as a title. However, if you make a copy of the chart or change the name of the chart, the chart title will have to be manually edited. If you use the @CTN title code – then the chart can be copied and renamed and will always display the appropriate chart name.

The @IMAGE(FilePath,PctWidth) title code displays the image file specified by 'FilePath'. The desired width of the displayed image is specified as a percentage of the chart width by 'PctWidth'. The aspect ratio of the image will be maintained as it is resized in order to fit within the specified width of the chart. If the image file specified by 'FilePath' cannot be found using the specified path, then CHARTrunner will try to find the image file in the current chart folder, and if that fails it looks in the SysData folder. The following image file types are supported: BMP, JPG, JPEG, PNG, WMF and EMF. In general the best results are obtained with WMF or EMF since this type of image file can be resized without loss of quality, although it can be challenging to properly create WMF or EMF image files.

### List of chart title codes

@AIS	Actual percent within specifications
@AOOS	Actual percent out of specifications
@CBAR	Count mean or c-bar
@CONAME	Company name
@CNM	Column names treated as Measurement
@CP	Cp
@CPK	Cpk
@CPL	Cpl
@CPM	Cpm
@CPU	Cpu
@CR	Cr
@CTD, @CHART_DESC	Chart description
@CTF, @CHART_FILE	Filename for chart
@CTN, @CHART_NAME	Chart name
@CTR, @CHART_REFRESH	Chart refresh interval
@CVAR	Coefficient of variation statistic

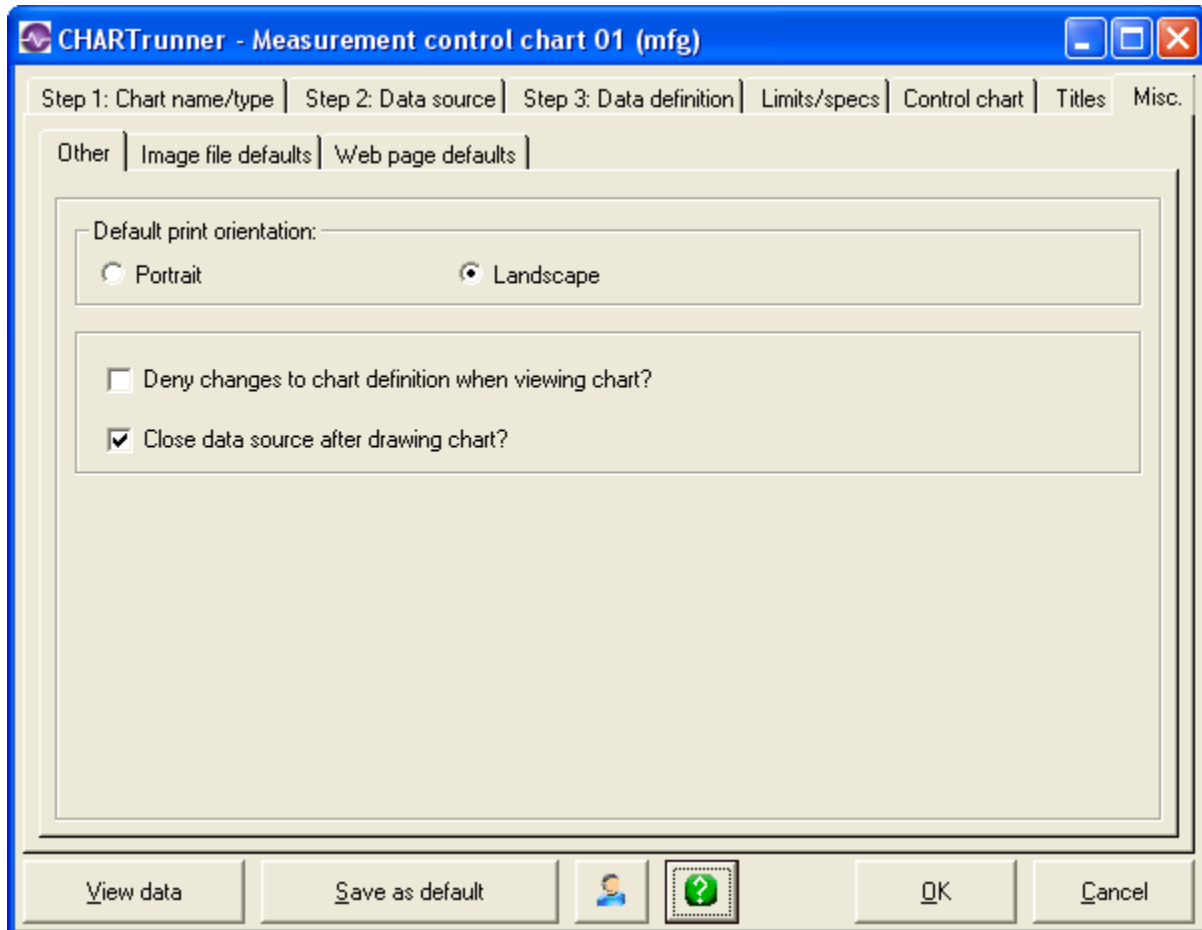
@CVAR	Coefficient of variation
@D, @DATE	Current date
@DPM	Defects per million
@DSC, @DATA_CONNECT	ADO or ODBC connection string
@DSF, @DATA_FILE	Filename for file-based data source (full path)
@DSN, @DATA_NAME	ADO or ODBC data source name
@DSO, @DATA_ORDER	Column name by which data is ordered
@DST, @DATA_TABLE	Data table name
@DT, @DATETIME	Current date and time
@ESIGMAR	Estimated sigma based on range
@ESIGMAS	Estimated sigma based on sigma
@FN	Filename for file-based data source (filename and extension only)
@IMAGE(FilePath,PctWidth)	Display image file
@IMEAN	Mean of number inspected
@KURT	Kurtosis value of the data
@LSL	Lower specification value
@MAX	Maximum
@MEAN	Mean of the data
@MEANRANGE	Mean range
@MEDIAN	Median of the data
@MIN	Minimum
@MOV	Number of subgroups in moving average/range
@NDP	Number of data points
@NPBAR	Proportion mean or Np-bar
@NUMBARS	Number of bars (Pareto)
@NUMENTRIES	Number of entries (Pareto)
@OOC	List of out-of-control test rules
@PBAR	Percent mean or p-bar
@PP	Pp
@PPK	Ppk
@PR	Pr
@{{QUERYPARAMETERNAME}}	The value of the query parameter whose name is "QueryParameterName"
@!SGF, @!FILTER	Current filter – even if not currently enabled
@SGF, @FILTER	Current filter – only if it is enabled
@SGS, @SCOPE	What records are being used? All, First n, Last n

@SIGMA	Sigma of the data
@SKEW	Skewness of the data
@SOURCEFILEDATE	Date on the source data file (if using a file-based data source)
@SQL	SQL Select statement used to retrieve the data
@T, @TIME	Current time
@TIS	Theoretical percent within specifications
@TOOS	Theoretical percent out of specifications
@TOTALCOUNT	Total count of data points on a Pareto chart. If multiple Pareto charts are displayed it will be the total count of all the charts.
@TSL, @TS	Target (or Nominal) value
@UBAR	Ratio mean or U-bar
@USL	Upper specification value
@WHERE	Where clause of SQL select statement
@ZLOW	Z-lower
@ZTARG	Z-target
@ZUP	Z-upper

NOTE: Not all statistical title substitutions will have meaning for all chart types. For example, let's say that you put @CPK in a title of a Pareto chart. Since there is no context for calculating Cpk in a Pareto chart, the @CPK will be rendered in the title as nothing (i.e., zero length text), rather than as the computed Cpk statistic. This holds true for all title codes that are inappropriate for the current chart context.

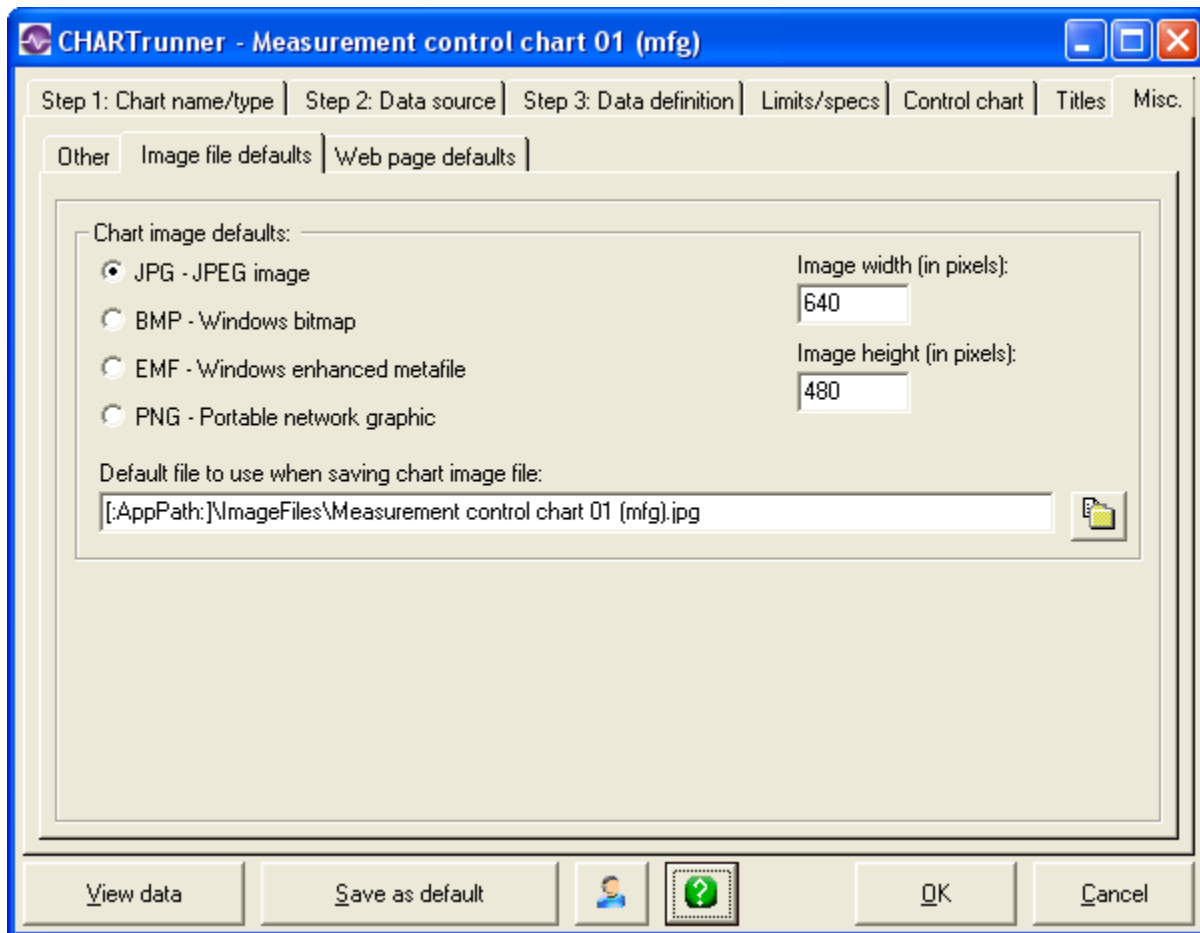
## Misc. tab - applies to all charts


### Other sub-tab - misc. tab - applies to all charts



- Default print orientation: Portrait – Enable this option so that charts default to being printed in portrait orientation. Note this can be overridden at chart print time.
- Default print orientation: Landscape – Enable this option to have charts default to being printed in landscape orientation. Note this can be overridden at chart print time.
- Deny changes to chart definition when viewing chart? – Enable this option if you do not want viewers of the chart to have the *Edit/Chart definition* option from the chart display form.
- Close data source after drawing chart? – Enable this option to ensure that after the chart is displayed, the software closes the connection to the underlying data source. It is recommended that this option be enabled in order to avoid problems with charts consuming scarce database connections or holding a data source open and thus causing problems with other users who are using the data source.

## Image file defaults sub-tab - misc. tab - applies to all charts



- Chart image defaults
  - Select one of the following as the default image file format:
    - JPG-JPEG image – The ubiquitous JPEG image format is very popular. The quality of the JPEG image is determined by the *JPG image quality* setting under the Setup > Preferences > General pull-down menu on the CHARTrunner main form.
    - BMP-Windows bitmap – This results in large image files. Use this only when you have a specific need to do so.
    - EMF-Windows enhanced metafile – This is a good choice when the image will be inserted into another application, such as Word or PowerPoint, and then resized to fit the available space.
    - PNG-Portable network graphic – This is a good choice since it does not result in loss of image quality as JPEG does, and is typically smaller than a JPEG image.
  - Default file to use when saving chart image file – Enter a file name for the default location where the chart image will be saved when you *Save chart as image*. Click the  button to open the file selection dialog. You can use {{CHART\_NAME}} as part of the chart image file name, such as C:\ChartImages\{{CHART\_NAME}}.png. When the chart image file is created, the current chart definition name will be substituted in place of {{CHART\_NAME}}.
  - Image width (in pixels) – Enter a number for the default width in pixels of the chart image.
  - Image height (in pixels) – Enter a number for the default height in pixels of the chart image.



## Web page defaults sub-tab - misc. tab - applies to all charts

Any chart may be saved as a Web page. Use this tab to select settings which affect saving the chart as a Web page.

When saving a chart as a Web page, an image file and an HTML Web page file will be created in the output folder. The format of the Web page is determined by the Web page template file that you specify. If you do not specify a template file, then CHARTrunner will use the Default-WebTemplate.htm file that is located in the SysData folder. Feel free to customize the supplied DefaultWebTemplate.htm (after you save a backup copy of the file – just in case you need it), or use it as a starting point to create your own customized template file(s).

You can customize DefaultWebTemplate.htm or any other template file using the HTML editor (or text editor) of your choice.

The following macro substitutions are performed each time the template file is processed into the chart's Web page:

- `{{CHART_IMAGEFILE}}` – This is replaced by the Web page's image filename, such as "Sample 01.png." This typically is used in an image tag, such as `<IMG SRC="{{CHART_IMAGEFILE}}" ALT="Chart Image">`.
- `<!--CHART_IMG_TAG-->` – This is replaced by a completed `<IMG>` tag that will place the chart image at that point in the HTML of the template file. If you embed spaces in this macro, it will not be recognized.
- `<!--DATA_TABLE-->` – The Web page's chart data table will be rendered wherever `<!--DATA_TABLE-->` appears in the HTML of the template file. Multiple chart data tables will be created for a Multi-chart containing multiple child charts. If you embed spaces in this macro, it will not be recognized.
- Title Codes – Any title code in the template will be expanded in the output. For example, DefaultWebTemplate.htm uses the `@CHART_NAME` title code to display the chart's name. See **Chart title codes - titles tab** (on page 192) for a complete list of available title codes.



CHARTrunner - Measurement control chart 01 (mfg)

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Limits/specs | Control chart | Titles | Misc.

Other | Image file defaults | Web page defaults

Image type:

- ☐ JPG - JPEG image
- ☒ PNG - Portable network graphic

Image size (in pixels, zero=use default):

Width: 800 Height: 600

Options:

- ☒ Show failed tests in the data table (as appropriate)




Maximum Identifier Length: Data Table Width:

Web page HTML output file or folder:

Web page template file:

View data Save as default ? OK Cancel

- Image type
  - Select the type of image file to create for the Web page.
    - JPG-JPEG image – Enable this to generate the image as a .jpg file.
    - PNG-Portable network graphic – Enable this to generate the image as a .png file. Since PNG files compress the image with no loss of detail, you might prefer this setting.
- Image size (in pixels, zero=use default)
  - Width – Enter a number for the width in pixels of the Web page's chart image. If zero is entered, the image width specified on the *Image file defaults* sub-tab will be used.
  - Height – Enter a number for the height in pixels of the Web page's chart image. If zero is entered, the image height specified on the *Image file defaults* sub-tab will be used.
- Options
  - Show failed tests in the data table (as appropriate) – Enable this option to have each out-of-control condition shown in the Web page's data table.
  - Maximum identifier length – If you are including a data table as part of the Web page, enter a value here for the maximum identifier length. This will truncate identifiers to this maximum length, which can make the table more readable when long identifiers are present.

- **Data table width** – If the chart template includes a data table in the output Web page, this setting affects how wide the table will be. Leave this blank to allow the Web browser to set the table width. Enter a number to specify the table width in pixels. Or, enter a percentage to specify that the table should be some percentage of the Web page's width. For example, if you enter 75%, the data table will consume 75% of the width of your browser window. If you enter 500, the data table will be 500 pixels wide.
- **Web page HTML output file or folder** – If you specify only a folder, then the output Web page HTML file will be created in the specified folder and will use the chart name as the basis for the output Web page file name. Any embedded spaces in the chart name will be replaced by the underscore character. Or, you can specify the full path to the HTML Web page file to be created. Click the  button to open the folder selection dialog, or the  button to open the file selection dialog.
- **Web page template file** – The format of the output Web page is determined by the Web page template file that you specify here. If you do not specify a template file, then CHARTrunner will use the DefaultWebTemplate.htm file that is located in the SysData folder. Click the  button to open the file selection dialog.

## Advanced row selection

The following chart types support Advanced Row Selection:

1. **Measurement control charts and run charts** - Both "Sample rows" and "Group rows" can be useful for these types of charts
2. **Measurement histograms** - You can use "Sample rows" to look at a subset of the available data. There is no benefit from using "Group rows" since all observations from all subgroups are considered "in total" for a histogram.
3. **Box and whisker charts** - You typically use "Group rows" to create the "subgroup" that is evaluated for each box on the chart.

## How it works

CHARTrunner sees your data source as rows of data, where the columns that make up these rows are determined by how you "Treat as" the data source columns on the Step 3: Data definition tab. If you do not enable Advanced Row Selection, then the data values from each row of the data source are used to create each subgroup. In other words, you get one subgroup per row. For all charts other than a histogram, each subgroup is used to generate one data point on the chart. When Advanced Row Selection is enabled, you have more flexibility in how data source rows are selected and processed into subgroups for the chart. There are two modes of operation using this feature:

1. **Sample rows** – Instead of using every row (or record) returned by the data source, you can "sample" the rows so that the chart uses a subset of the available rows. For example, the chart might use every 15th row of data, or it might use the first 5 rows out of every 100 rows of data.
2. **Group rows** – This method "groups together" contiguous rows and uses all the data points in the group to form a single subgroup. You can use a date/time column from your data source to form a subgroup for each unit of time such as day, week, or month. For example, if you group by week, then 500 rows of data that covers a 10 week period will result in 10 subgroups where each subgroup represents a week of data.

One use of "Group rows" is to form subgroups based on one column of data. When you have individuals data in one column, but want to look at the data as subgroups containing more than one observation per subgroup (such as a sample size of 3), you can do that by using "Group rows" mode.

## Advanced row selection steps

Here are the steps that Advanced Row Selection takes to create the subgroups that are processed when creating a chart:

1. CHARTrunner forms a “set of contiguous rows” from the data source. It seems natural to refer to this as a group of rows, but in order to avoid confusion with the “Group rows” mode of operation, these rows will be referred to as a rowset. Since contiguous rows will be “clumped together” into rowsets, the data order (how the data is sorted) is important. For more information on how the data order column is determined see ***Understanding the data order concept***.
2. When Look at every N rows of data, where N= is selected, each rowset is composed of the next specified N number of contiguous rows. The last rowset will be composed of fewer than N rows if the data source does not contain a multiple of N rows.
3. When Look at every row of data until column Y data changes is selected, each rowset is composed of the next set of contiguous rows having the same value for the specified “Column Y.” This is explained in more detail below.
4. The rows contained in each rowset are filtered to determine which ones are passed along for subsequent processing. The options are to Use all the rows, Use the first X rows, or Use the last X rows in the rowset.
5. When Group rows is the operating mode, all of the data values contained in each filtered rowset are used to form a subgroup for the chart. In other words, there will be one subgroup per rowset.
6. When Sample rows is the operating mode, each row in the filtered rowset is used to form a subgroup for the chart. In other words, there will be one subgroup per row from the filtered rowset..

Click the Advanced>> button on the Step 3: Data definition tab of the chart definition form to open the Advanced Row Selection dialog box shown below.

**Advanced Row Selection**

How to handle rows:

Mode:

☒ Group rows ☐ Sample rows

☐ Look at every N rows of data, where N =

☒ Look at every row of data until column Y data changes

Where column Y =

Choose rows based upon:

And use these rows:

Where X =

? OK Cancel

- Mode
  - Group rows – Select this option when you want to “group together” the data from multiple rows in your data source to form a single subgroup. In this case, all of the data values from each rowset will be “grouped together” to form a single subgroup.
  - Sample rows – Select this option when you want to use a subset of the available rows from the data source. The “sampled rows” will always create one subgroup per “sampled row.” In other words, while you might not use every row from the data source, each row that you do use will result in one subgroup for the chart.

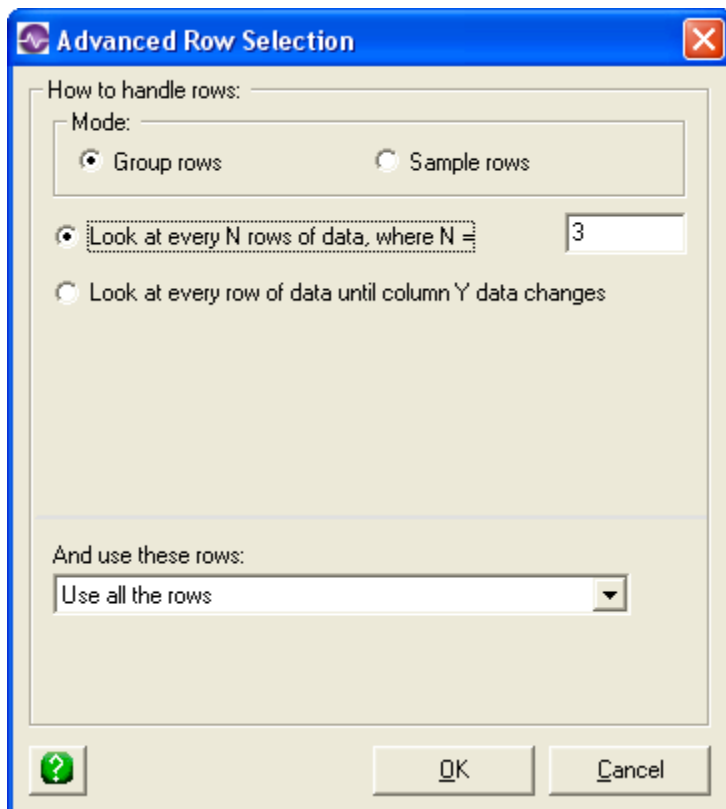
The next two options determine how CHARTrunner selects the contiguous rows that are placed into a rowset.

- Look at every N rows of data, where N= - Select this option to enter the number N of contiguous rows that will be placed into each rowset.
- Look at every row of data until column Y data changes – Select this option when you want to use the contents of the Where column Y = column (we refer to this as the ColumnY column) in your data source to establish how each rowset is formed. In this case the data source must be ordered (or sorted) by the ColumnY column. Whenever the value of the ColumnY column changes, a new rowset will be formed. If the ColumnY column is a date/time column, then you can form rowsets by units of time such as Day, Week, or Month as specified by the Choose rows based upon field.
  - Where column Y = – Enter the name of the data source column (we refer to this as the ColumnY column) that will be watched in order to form rowsets. Whenever the value of this column changes, a new rowset will be formed.
  - Choose rows based upon – When ColumnY is a date/time column, you can select the units of time over which the rowsets are formed. Select one of these options:
    - Blank – Choose the blank option to form a new rowset whenever the value of the ColumnY column changes.
    - Minute – Form a new rowset whenever the value of the ColumnY column changes by a minute.
    - Hour – Form a new rowset whenever the value of the ColumnY column changes by an hour.
    - Day – Form a new rowset whenever the value of the ColumnY column changes by a day.
    - Week – Form a new rowset whenever the value of the ColumnY column changes by a week.
    - Month – Form a new rowset whenever the value of the ColumnY column changes by a month.
    - Quarter – Form a new rowset whenever the value of the ColumnY column changes by a quarter.
    - Year – Form a new rowset whenever the value of the ColumnY column changes by a year.
- And use these rows: – The rows contained in each rowset are filtered to determine which ones are passed along for subsequent processing. The filtering options are:
  - Use the first X rows – Select this to use the first X rows from each rowset. Enter the value for X in the Where X = field.
  - Use the last X rows – Select this to use the last X rows from each rowset. Enter the value for X in the Where X = field.
  - Use all the rows – Select this to use all the rows from each rowset.

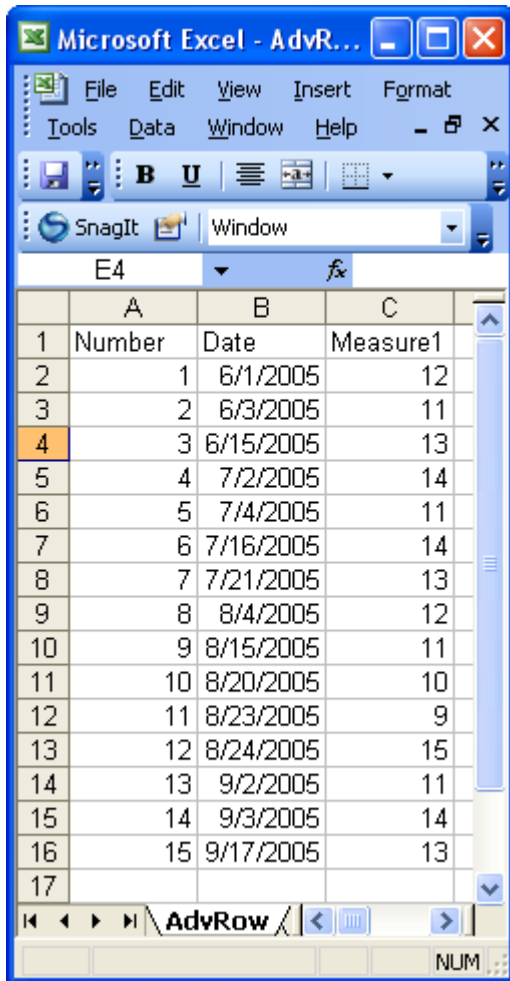
The rows from each rowset that remain based upon the And use these rows choice will either be “grouped together” to form a subgroup when Group rows is chosen, or each row will be used to form a subgroup when Sample rows is chosen.

## Advanced row selection example 1

In this example the Advanced Row Selection settings are set up as follows.

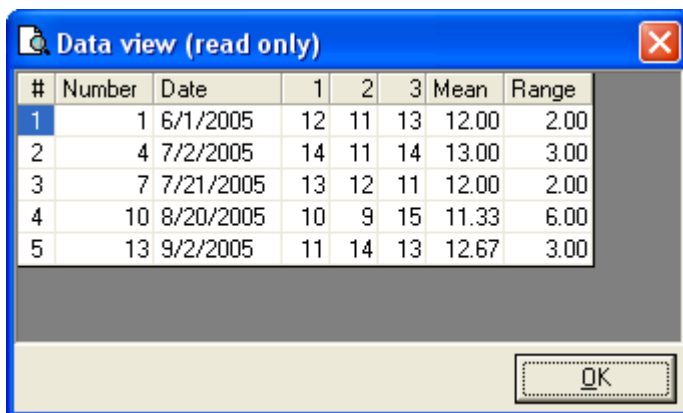


- Raw data – The raw data from the data source is shown below. Notice that there is a single column of observations in the Measure1 column.



	A	B	C
1	Number	Date	Measure1
2	1	6/1/2005	12
3	2	6/3/2005	11
4	3	6/15/2005	13
5	4	7/2/2005	14
6	5	7/4/2005	11
7	6	7/16/2005	14
8	7	7/21/2005	13
9	8	8/4/2005	12
10	9	8/15/2005	11
11	10	8/20/2005	10
12	11	8/23/2005	9
13	12	8/24/2005	15
14	13	9/2/2005	11
15	14	9/3/2005	14
16	15	9/17/2005	13
17			

- Data that gets charted – Shown below is the “View chart data” for the resulting chart.

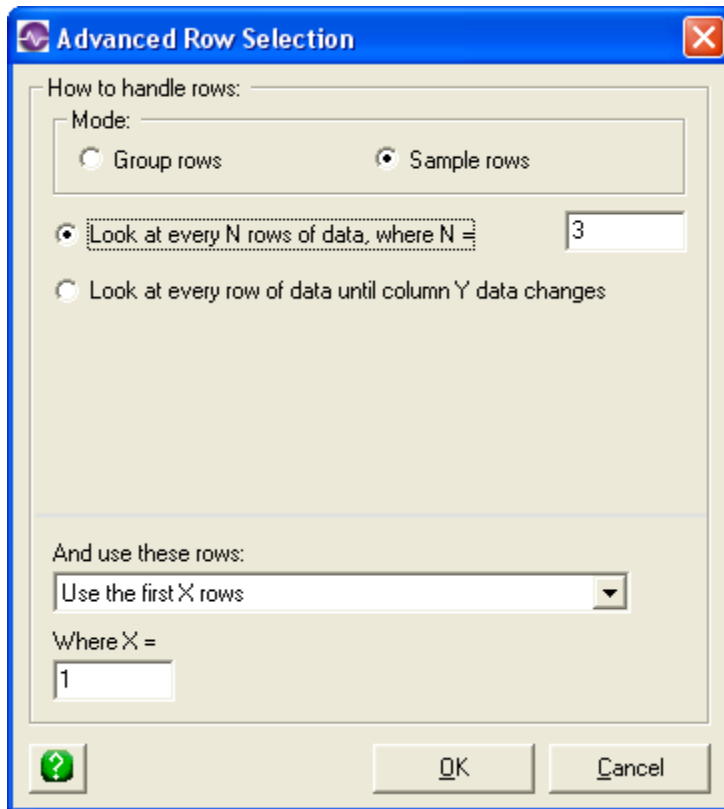


#	Number	Date	1	2	3	Mean	Range
1	1	6/1/2005	12	11	13	12.00	2.00
2	4	7/2/2005	14	11	14	13.00	3.00
3	7	7/21/2005	13	12	11	12.00	2.00
4	10	8/20/2005	10	9	15	11.33	6.00
5	13	9/2/2005	11	14	13	12.67	3.00

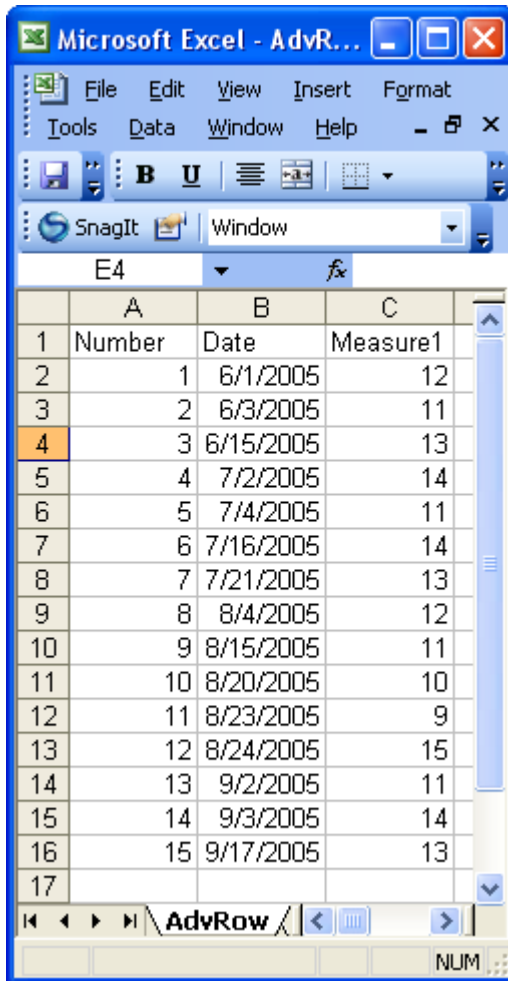
In this example, each three rows of raw data are “grouped together” to form one subgroup. Each subgroup will create one data point on the chart. The resulting X-bar chart will have 5 data points where each data point is the Mean of the three observations.

## Advanced row selection example 2

In this example, the Advanced Row Selection settings are set up as follows.

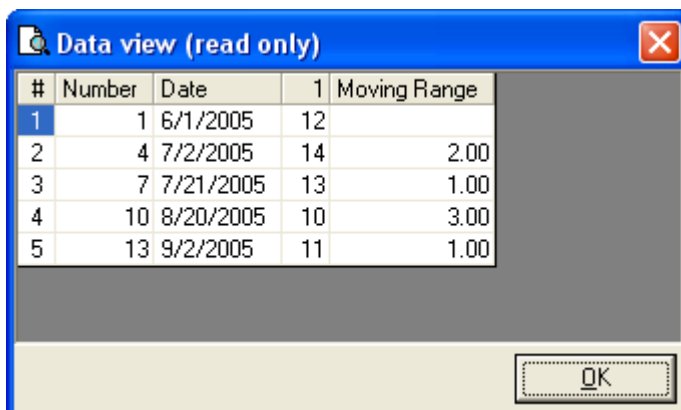


- Raw data – The raw data from the data source is shown below. Notice that there is a single column of observations in the Measure1 column.



	A	B	C
1	Number	Date	Measure1
2	1	6/1/2005	12
3	2	6/3/2005	11
4	3	6/15/2005	13
5	4	7/2/2005	14
6	5	7/4/2005	11
7	6	7/16/2005	14
8	7	7/21/2005	13
9	8	8/4/2005	12
10	9	8/15/2005	11
11	10	8/20/2005	10
12	11	8/23/2005	9
13	12	8/24/2005	15
14	13	9/2/2005	11
15	14	9/3/2005	14
16	15	9/17/2005	13
17			

- Data that gets charted – Shown below is the “View chart data” for the resulting chart.



#	Number	Date	1	Moving Range
1	1	6/1/2005	12	
2	4	7/2/2005	14	2.00
3	7	7/21/2005	13	1.00
4	10	8/20/2005	10	3.00
5	13	9/2/2005	11	1.00

In this example we are sampling by plotting data only from every third row of the raw data. The individuals chart will contain 5 data points. When you have a large data table, sampling may give you a less cluttered chart. Just be aware that you are looking at a sample and not all of the data.



## Advanced row selection example 3

In this example, the Advanced Row Selection settings are set up as follows.

**Advanced Row Selection**

How to handle rows:

Mode:

☒ Group rows ☐ Sample rows

☐ Look at every N rows of data, where N =

☒ Look at every row of data until column Y data changes

Where column Y =

Choose rows based upon:

And use these rows:

? OK Cancel

- Raw data – The raw data from the data source is shown below. Notice that there is a single column of observations in the Measure1 column.

	A	B	C
1	Number	Date	Measure1
2	1	6/1/2005	12
3	2	6/3/2005	11
4	3	6/15/2005	13
5	4	7/2/2005	14
6	5	7/4/2005	11
7	6	7/16/2005	14
8	7	7/21/2005	13
9	8	8/4/2005	12
10	9	8/15/2005	11
11	10	8/20/2005	10
12	11	8/23/2005	9
13	12	8/24/2005	15
14	13	9/2/2005	11
15	14	9/3/2005	14
16	15	9/17/2005	13
17			

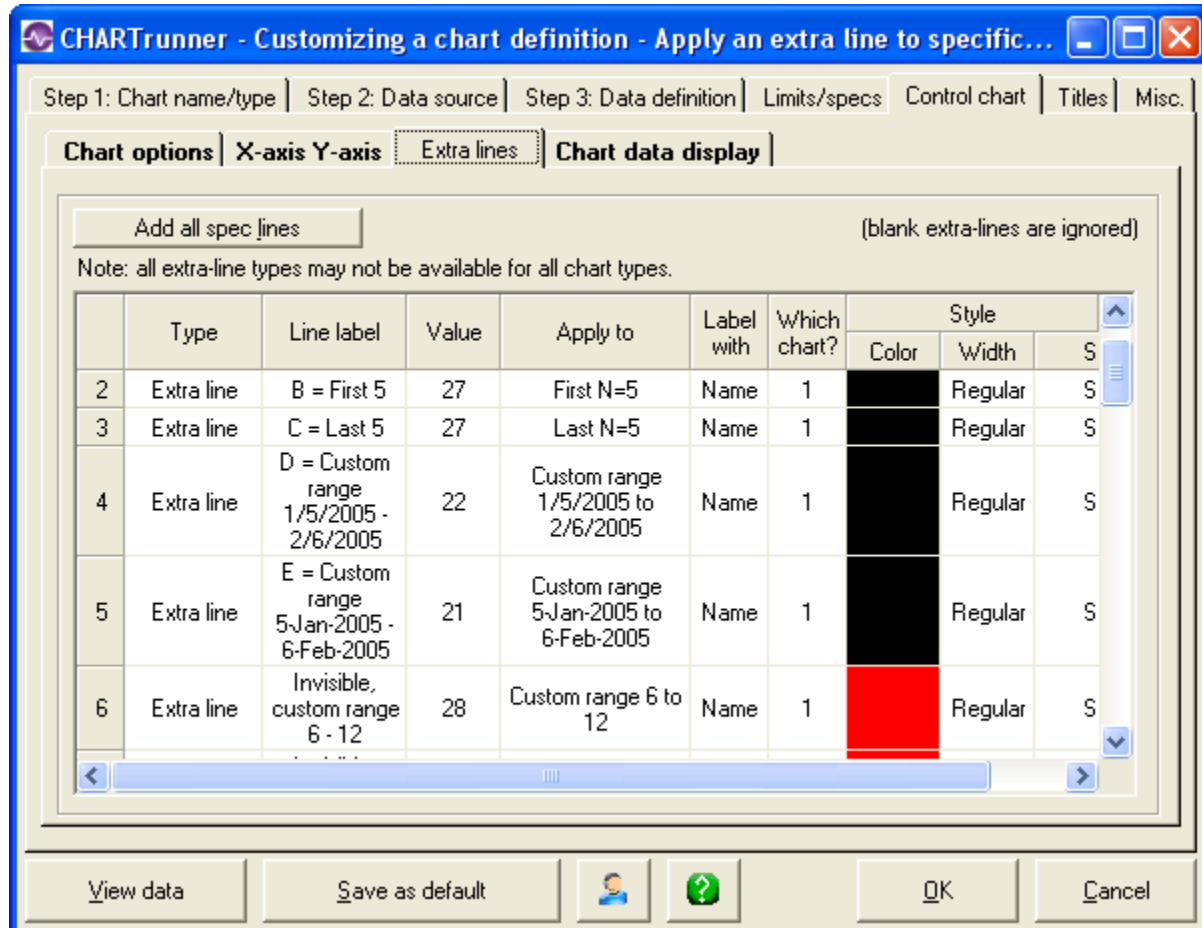
- Data that gets charted – Shown below is the “View chart data” for the resulting chart.

#	Number	Date	1	2	3	4	5	Mean	Range
1	1	6/1/2005	12	11	13			12.00	2.00
2	4	7/2/2005	14	11	14	13		13.00	3.00
3	8	8/4/2005	12	11	10	9	15	11.40	6.00
4	13	9/2/2005	11	14	13			12.67	3.00

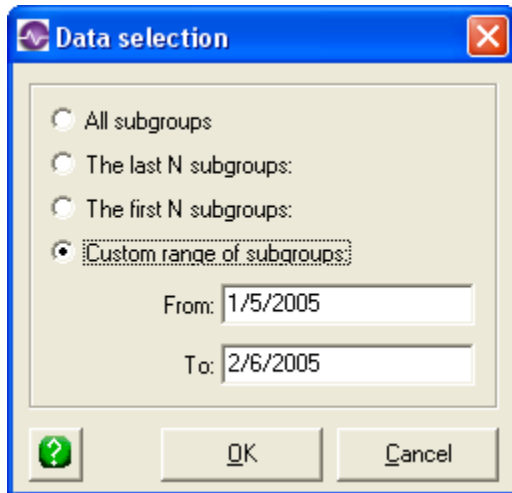
In this example we are grouping the rows of individuals data to form subgroups based on the contents of the Date column. Notice that each row in the results table can have a different number of observations based on how many raw data rows fell into a particular month. Since the subgroup size is potentially different for each month, the control limits on the X-bar chart will be adjusted accordingly.

## Applying an extra line to specific subgroups

Many types of charts allow you to add extra lines to the chart. The extra line is defined on the Extra lines tab, as shown below.



When you click in the Apply to column of an extra line, you can choose from the options shown below to determine what subgroups (or data points) the extra line will be applied to.



- All subgroups – The extra line will be applied to all of the subgroups on the chart.
- The last N subgroups – The extra line will be applied to the last N subgroups on the chart.
- The first N subgroups – The extra line will be applied to the first N subgroups on the chart.
- Custom range of subgroups – The extra line will be applied “from” and “to” the subgroups on the chart whose “data order” column value is between the specified From and To values (inclusive). If no “data order” column is available, the From and To values are assumed to specify the relative subgroup number, where the first subgroup on the left side of the chart is relative subgroup number 1, the next subgroup is 2, and so on. For more information on how the data order column is determined see ***Understanding the data order concept.***
  - From – Specify the “From” value in terms of the “data order” for the chart. If the specified “From” value is not compatible with the “data order” column’s values, the extra line will not be displayed on the chart.
  - To – Specify the “To” value in terms of the “data order” for the chart. If the specified “To” value is not compatible with the “data order” column’s values, the extra line will not be displayed on the chart.

Any extra line having a From or To value that is not compatible with the “data order” column type will not be displayed on the chart.

1. If the “data order” column is of type Date / Time and contains date values, then the From and To values need to specify a date, such as “1/5/2005” or “5-Jan-2005”.
2. If the “data order” column is of type Date / Time and contains date and time values, then the From and To values need to specify a date and time, such as “1/5/2005 08:00:00”.
3. If the “data order” column is of type Numeric, then the From and To values need to specify an appropriate number.
4. If the “data order” column is of type Text, then the From and To values need to specify an appropriate text value. It can be challenging to get the desired results in this case.

Example: On the Extra lines tab of the chart definition shown above the “data order” column has a data type of Date / Time, thus the extra lines defined on lines 4 and 5 will be displayed on the chart and the extra line defined on line 6 will not be displayed. This is because CHARTrunner interprets “1/5/2005” and “5-Jan-2005” as values that are compatible with a Date / Time, but “6” is not interpreted as a date.

## Understanding the data order concept

When CHARTrunner applies a control limit or an extra line to a specific range of subgroups the concept of the “data order” becomes important. The “from” and “to” subgroups for the limit or extra line are specified in terms of the value of the “data order” column.

The “data order” column is determined as follows:

- For a Table data source the "data order" column is the column specified by Column to use for Order By on the Step 3: Data definition tab.
- For a non-Table data source (i.e. Query or View, Stored procedure or Custom query) the "data order" column is assumed to be the column marked as the Unique Identifier on the Step 3: Data definition tab.

Each control limit saves the “data order” column name that was in effect when that limit was calculated. When the chart is drawn only those control limits whose “data order” column name matches the current “data order” will be considered.



## CHAPTER 9

# Using charts

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## Displaying charts

Different methods to display an existing chart:

- **Toolbar** – When a chart is selected in the CHARTrunner definitions list, click on the Display the chart button in the toolbar to display the chart.
- **Double-click** – Double-click on a chart in the CHARTrunner definitions list, and the chart will be displayed (or edited). Note that under Setup > Preferences, you may configure CHARTrunner so that double-click will either edit the chart or display the chart.
- **Pull-down menu** – When a chart is highlighted in the CHARTrunner definitions list, select the Chart > Display pull-down menu to display the chart.
- **Right-click menu** – You may right-click on a chart in the CHARTrunner definitions list to bring up a context menu (sometimes called a right-click menu). Select Display from the context menu to display the chart.
- **Command line arguments** – Any chart may be displayed by passing command line arguments into CHARTrunner when the program is started. This can be done by creating a shortcut that starts CHARTrunner with the desired command line arguments when the shortcut is opened. CHARTrunner command line arguments are documented in the appendix.
- **Chart review** – This allows you to easily navigate and to display other charts in the current working folder or workspace. For a workspace, you must select Chart Review from the right-click or pull-down menu in order to start reviewing the first chart in the workspace. While you are viewing a chart, use the following keys to display the other charts in the folder or workspace:
  - **PgDn** – Display the next chart in the folder or workspace.

- PgUp – Display the previous chart in the folder or workspace.
- Ctrl-Home – Display the first chart in the folder or workspace.
- Ctrl-End – Display the last chart in the folder or workspace.
- Chart slideshow – This is similar to Chart review, but CHARTrunner will automatically cycle to the next chart after a specified number of seconds. When the end of the chart list is reached, the slideshow restarts at the top of the chart list and continues until the slideshow is canceled or the chart window is closed. To start a slideshow, first display a chart from the current working folder. For a workspace, select Chart Review from the right-click or pull-down menu in order to display the first chart in the workspace. Next, select Review > Slideshow from the pull-down menu (or press F6) and specify how many seconds each chart should be displayed before cycling to the next chart. To stop the slideshow, press Esc (which closes the chart display window) or select the Review > Slideshow pull-down menu and click Cancel.

## Controlling the chart display window

While viewing any chart, you have the following options for closing the chart window:

- File > Close – Select File > Close from the pull-down menu to close the current chart display window.
- File > Close all charts – When multiple chart windows are displayed, select this menu option to close all displayed chart windows.
- Windows Close button – You can close a chart window by clicking on the Windows close button. This is the X icon in the upper right corner of the window – in Windows XP this icon is red.

While viewing any chart, you have the following options for resizing the chart window:

- Minimize – Use the Windows minimize button to minimize a chart into your Windows toolbar area. This button appears in the upper right corner of the window.
- Maximize – Use the Windows maximize button to make the chart window expand to fill your entire display area. This button appears in the upper right corner of the window.
- Restore down – When a chart is maximized, use the Windows restore down button to restore the chart to the previous non-maximized window size. This button appears in the upper right corner of the window when the chart display is already maximized.
- Resize or reposition – As you resize a chart window or move it into different positions on the screen, this information is retained in the chart definition. The next time you display the chart, it will be positioned and sized as it was when it was last displayed. If you do not have sufficient rights to make changes to the chart definition file, then CHARTrunner will be unable to update the size and position information for the chart.

The chart display may be refreshed – to reflect new data – in the following ways:

- Manual refresh – While viewing any chart, use the pull-down menu for Edit > Refresh chart (or press F5) to redisplay the chart. This will display the chart with new data that may have been saved since the chart was originally displayed.
- Automatic refresh – On the chart definition form for all charts, there is a setting for Refresh interval. If this is blank, the chart will not refresh automatically. You may set this to the desired number of seconds, so that whenever the chart is displayed, it will automatically refresh at this interval.
- Displaying subgroup data via mouse hover – Select View > Enable mouse hover information menu on the chart display window to enable mouse hover information. When this option is selected and you let the mouse cursor hover near a data point on the chart, a popup window appears with summary information about that data point. Press the F9 key to toggle mouse hover information on or off.



## Charts that scroll

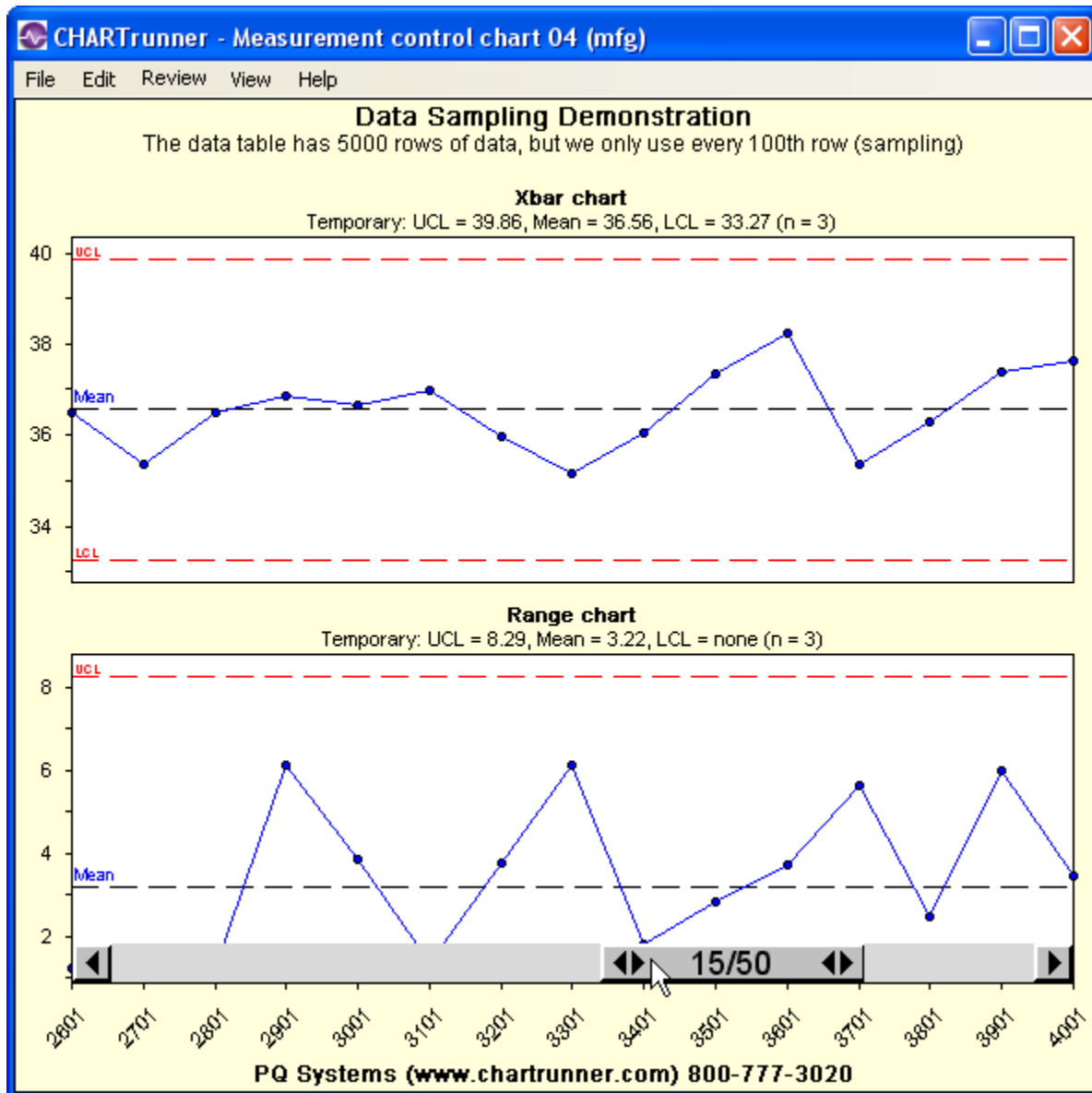
In some cases, your chart may contain too many data points to easily view and interpret all at once. For example, on many control charts, once you have more than about 100 data points on the chart, detecting small shifts and unusual patterns becomes more difficult. In this situation, a scrolling chart may be used. The following chart types support scrolling: measurement control charts, count control charts, short-run SPC charts, run charts, and multi-line charts.

The following settings, which are found on the X-axis Y-axis sub-tab of the chart definition form, affect horizontal scrolling:

- **Enable horizontal X-axis scrolling** – Select this option to allow the scroll bar to appear when the mouse hovers over the horizontal (X-axis) line at the bottom of the plot area.
- **Chart width in subgroups** – Set this to the initial number of subgroups that you want the chart to display, i.e., the slice width. For example, if your data source results in 100 subgroups, you could set this to 25 so that you will view a slice of the 100 subgroups that is 25 subgroups wide. The next option determines whether to initially display the first (leftmost) or last (rightmost) slice of subgroups.
- **Start at left or Start at right** – Select whether to initially display the first (leftmost) or last (rightmost) slice of subgroups. For example, assume your data source provides 100 subgroups and have your *Chart width in subgroups* set to 25. If you select **Start at right**, when the chart is first displayed, it will show subgroups 75 to 100.

**Scrolling a chart with the scroll bar** – While the chart is displayed, use the scroll bar to move the chart slice to the left or right, or change the current width of the chart slice. To minimize visual clutter on the chart, the scroll bar is visible only when the mouse pointer hovers over the horizontal axis line at the bottom of the plot area. If you move the mouse pointer away from this area, the scroll bar will disappear after a slight pause. While the scroll bar is visible, you can scroll the displayed slice back and forth across the chart's data. Additionally, you can use the scroll bar to dynamically change the slice width of the scrolling window. Click on the arrows at the left and right edge of the X-axis to scroll the chart to the left or right by one subgroup per click. Position the mouse pointer on the scroll bar and use left-click to drag the bar, which results in scrolling the chart by larger increments. Click on the slice size buttons at each end of the scroll bar to increase or decrease the current slice size of the chart.

Below is an example of a chart with the scroll bar activated. In this case the chart slice width is displaying 20 subgroups out of the 100 possible subgroups that resulted from the chart's data source:



## Other chart display menus

- View > Chart always on top – Use this menu option to ensure that the chart window will always be displayed in front of other windows on the screen. This option toggles on and off each time you make the selection.
- View > Test rules – Any control chart may be set up to use out-of-control testing rules. These rules determine which points are marked as out-of-control on the chart. CHARTrunner allows you to define custom rules or use standard rules on each chart. Select this menu option to display a list of the rules that are defined in the chart definition for the current chart.

NOTE: The out-of-control testing rules that you view here – i.e., the ones defined in the chart definition – may not actually be the rules that are used when the chart is drawn. In Setup > Out-of-control tests, you can choose to apply a single “active” set of test rules to all control charts, regardless of the test rules that may be defined in each chart definition.

- **Right-click chart context menus** - While viewing any chart, you have the option of right-clicking with the mouse to display a context menu. The choices in this menu will vary based on the type of chart you are viewing and where you click on the chart. For example, when viewing a control chart, this menu will contain options for computing control limits; and when viewing a Pareto chart, the control limit options will not be available. If you right-click on or near an annotation, you will have options to delete or edit the annotation. If you right-click where there is no annotation, these options will not be available.
- **Context Menus related to annotations** - See the topic ***Using annotations on charts*** for more detailed information about using annotations.
  - **Add annotation** – Select this option to add an annotation to your chart. This will display the annotation form, which allows you to add text and line annotations to the chart. The initial position of the annotation will be near the right-click point on the chart.
  - **Edit annotation** – When you right-click near an existing annotation, this option will display the annotation form and allow you to make changes to the existing annotation.
  - **Delete annotation** – When you right-click near an existing annotation, this option allows you to delete the annotation.
  - **Annotation list** – When you right-click in the plot area while viewing a chart that has annotations, this option will display a listing of all of the annotations that have been saved in the chart definition.
- **Context menus related to chart data**
  - **View chart data** – Select this option to display a grid showing the data being used by the current chart. This data has been processed for the chart and contains information beyond the raw data. For example, the subgroup observations, means (averages), and ranges will be shown when the current chart is an X-bar and Range chart. If *Advanced row selection* is enabled, the displayed subgroup observations will reflect that processing. For a Pareto chart, you will see the categories and counts behind the chart.
  - **View data source records** – Select this option to display a grid showing the unprocessed data records that come from your data source. Note the data shown on this grid is based upon how you specified Treat as for the data source columns on the *Step 3: Data definition* tab of the chart definition form. This option is available only when Close data source after drawing chart is not selected on the Misc > Other sub-tab of the chart definition
- **Other context menus on the chart form**
  - **Clear selected subgroups** – On control charts you may select a subgroup by clicking on the data point. You may select multiple subgroups by clicking-and-dragging a rectangle through the plot area. When you do this, one or more subgroups will be highlighted visually with a vertical band. Select this option to clear the highlight from the chart.
  - **View highlighted subgroup information** – When a subgroup (one data point) is selected, it will be highlighted with a vertical band. Use this option to display information about the selected subgroup. The raw data, calculated statistics, and information about out-of-control conditions will be displayed.
  - **Compute limits** – This option is available only on control charts. You must select a range of subgroups on the chart before this option will be available. To select subgroups, use your mouse to click-and-drag a rectangle through the plot area. The rectangle should include the subgroups you want to use for computing the control limits. See the ***Control limits*** (on page 224) topic for further information.

- **Disable (hide) limits** – This option is available only when you right-click near a control limit line or control limit title for a set of control limits which you have previously computed. Control limits have names, and the menu choice will include the control limit name. For example, the menu choice might be Disable (hide) limits: Set 1. In this case the name of the control limit is Set 1. Select this option to hide the specified set of limits from the current chart display. Note that the limits will not be deleted from the chart definition; rather, they will be marked so as not to be used by the chart.
- **Delete limits** – Select this option to delete a set of control limits both from the current chart display and from the chart definition. This option is available only when you right-click near a control limit line or control limit title for a set of limits you have previously computed and saved.

## Editing and copying chart definitions

Once you create and save a chart, you may occasionally need to change something about the chart. To do this, you will use the same chart definition form that you used to create the chart. Make your changes and click the OK button to save the updated chart definition.

### Different methods to edit a chart definition

- **Toolbar** – When a chart is highlighted on the CHARTrunner definitions list, click on the Edit button in the toolbar to edit the chart.
- **Pull-down menu** – When a chart is highlighted in the CHARTrunner definitions list, select the Chart > Edit pull-down menu to edit the chart.
- **Right-click menu** – You may right-click on a chart in the CHARTrunner definitions list to bring up a context menu (sometimes called a right-click menu). Select Edit from the context menu to edit the chart.
- **Double-click** – Double-click on a chart in the CHARTrunner definitions list, and the chart will be edited (or displayed). Note that under Setup > Preferences you may configure CHARTrunner so that double-click will either edit the chart or display the chart.
- **From the chart display form** – While viewing any chart, you can open the chart definition form using one of these three methods: (1) right-click on the chart and select Edit chart definition, (2) use the Edit > Edit chart definition pull-down menu, or (3) press Ctrl-D. Make your changes and click the OK button to apply the changes and redisplay the chart. Note that these changes will be saved to the disk only if you elect to save them when you close the chart window. This allows you to experiment visually with changes before you save the changes to the chart definition file on the disk.

## Copying a chart definition

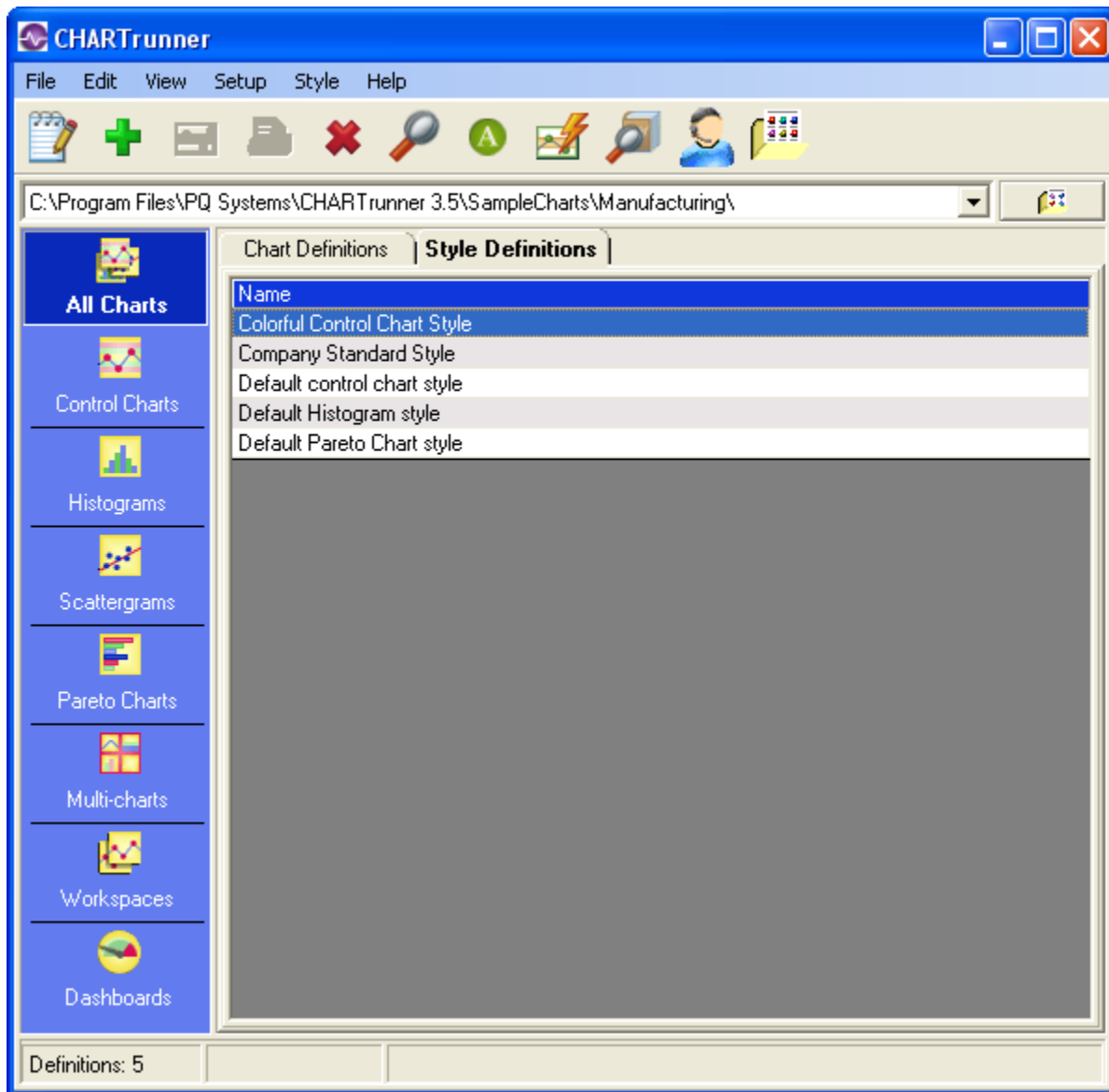
You may need to create several charts that are similar. Perhaps each chart uses a different data column in the same spreadsheet. Perhaps each chart uses the same data but looks at a different range of dates. To help with this, create your first chart. Be sure to save this chart with all settings and titles that will be the same on subsequent charts. For additional charts, use the copy command. This allows the first chart to act as a template for all the charts that follow.

- To copy a chart – Create and save the chart that you wish to copy from. In the CHARTrunner definitions list, use the mouse to right-click on the chart you wish to copy from and select Copy from the context menu. The chart definition form will open, and it will contain a copy of the original chart, but with a new name. Change the chart name (if desired) and make any other changes; then click the OK button to save the copied chart.
- Copying a chart and @ title substitutions – There are several title substitution options that you may use in the titles for a chart. For example, entering @CTN in a chart title will cause the chart name to be displayed in that position. Using these titles substitutions can save time when you are copying a chart definition. If you manually type in the chart name as a chart title, then when you copy the chart you will have to manually update the “chart name” title. However, using the @CTN option will eliminate this step.
- Copy to experiment – If you want to experiment with changing a chart but you do not want to damage the original chart definition, make a copy of the chart and do your experimenting with the copy.

## Editing and copying chart styles

All CHARTrunner charts have a setting for Chart Style. A chart style is a named collection of settings that affect the appearance of a chart. A style contains information like chart background color, line colors, line styles, and fonts to use when rendering the chart. On the *Step 1: Chart name/type* tab of the chart definition form, you may select the chart style you wish to use on the chart.

As shown below, the available chart styles are listed on the Style Definitions tab. In the CHARTrunner definitions list, the available chart styles are definitions list. There are three types of chart styles: Control chart, Histogram chart, and Pareto chart. When CHARTrunner is installed, a default style of each type is available. These default styles may not be deleted. You may create as many new styles as you need.



## Different methods to edit a chart style

Note that when you change something in a chart style, this change will be visible in every chart that uses this named style definition. Many different charts can and often do use the same chart style. See the topic **Chart style form** (on page 23) for more details.

- **Toolbar** – When a chart style is highlighted in the CHARTrunner definitions list, click on the Edit button in the toolbar to edit the chart style.
- **Pull-down menu** – When a chart style is highlighted in the CHARTrunner definitions list, select the Style > Edit pull-down menu to edit the style.
- **Right-click menu** – You may right-click on a chart style in the CHARTrunner definitions list to bring up a context menu (sometimes called a right-click menu). Select Edit from the context menu to edit the chart style.
- **From the chart display form** – While viewing any chart, right-click on the chart and select Edit chart style, or use the Edit > Edit chart style pull-down menu. The chart style editor will open. Make your changes and click the OK button – the displayed chart will be refreshed to use the edited style definition. You will be asked to confirm whether to save the style definition change to the disk because other charts (not currently visible) could be affected by your style changes.

## Copy a chart style

If you want a new chart style that is similar to one you already have, use the option to copy an existing chart style.

- **To copy a chart style** – In the CHARTrunner definitions list, right-click on the chart style you wish to copy and select the Copy command. The chart style editor will open with a copy of the existing style. Enter a new name for the style, make your style changes, and then click the OK button to save the new style. The newly created chart style name will now be available in the drop-down list for chart style on the chart definition form.

## Deleting charts and chart styles

If you no longer need a chart definition or a chart style, use one of the following options to delete it:

- **Delete to the recycle bin** – Click once to select a chart or style definition in the CHARTrunner definitions list. Press the Delete key on your keyboard or click the X button in the toolbar. You will be asked to confirm the deletion. If you answer Yes, the definition will be deleted to the recycle bin. The recycle bin allows you to restore the chart or style definition file at a later date.
- **Permanently delete** – Click once to select a chart or style definition in the CHARTrunner definitions list. Hold down the Shift key. Press the Delete key on your keyboard or click the X button in the toolbar. You will be asked to confirm the deletion. If you answer Yes, the definition will be permanently deleted.

## Using annotations on charts

One way to add meaning to a chart is with annotations. Annotations may be placed on the plot area of most chart types. The simplest annotation is text used to explain some aspect of the chart. Lines, arrows, and boxes may also be used to enhance the annotation.

## Add an annotation to a chart

While viewing any chart, use your mouse to right-click in the plot area near the spot where you want the annotation placed. When the context menu is displayed, select Add annotation. The annotation editor will be displayed as shown below.

The screenshot shows the 'Annotation Editor' dialog box. At the top, there is a text field labeled 'Annotation text:' containing the text 'Process Shift?'. Below this, the dialog is divided into three main sections: 'Line', 'Text', and 'Box'. Each section has a set of options with checkboxes and color/orientation pickers. The 'Line' section includes options for 'Draw Line' (checked), 'Line Color' (red), 'Orientation' (down arrow), 'Connect point' (top), 'Arrows' (down arrow), 'Arrow size' (greater than), and 'Extend across'. The 'Text' section includes 'Draw Text' (checked), 'Text Color' (red), 'Orientation' (blue 'A'), 'Connect point' (bottom), 'Font' (blue 'A'), and 'Extra space around text'. The 'Box' section includes 'Draw box' (checked) and 'Fill Color' (cyan). To the right of these sections are buttons for 'OK', 'Cancel', and 'Undo'. Below the main sections, there is an 'Annotation Position:' section with checkboxes for 'Connect X to the data value' and 'Connect Y to' (with a text input field containing '.730' and an 'Apply' button). Below this is a button labeled 'Annotation position details'. To the right of the 'Annotation Position' section is a 'Move:' section with a directional pad and a 'Shorter line' button. To the right of the 'Move' section is an 'Increment size:' section with radio buttons for 'Miniscule', 'Tiny', 'Small' (selected), 'Medium', and 'Large', and a 'Longer line' button.

The annotation editor allows you to customize the three pieces of an annotation: (1) a line, (2) the text, and (3) a box that may be drawn around the text. It also allows you to position the annotation and optionally connect it to your data in various ways.



## Line options

- Draw Line – Enable this check box if you want your annotation to include a line.
- Line Color – Use this to select a color for your line.
- Orientation - Use this to decide if your line will be horizontal or vertical. If your line contains the optional arrows, use this setting to set which way they point.
- Connect point – Use this to select the point along the line where the annotation is connected to the line.
- Arrows – Use this to select which arrows, if any, will be placed on the line. You may have no arrows, one on either end, or one on both ends of the line.
- Extend across – Use this option to extend the line for this annotation across the plot area. This allows you to place either a vertical or horizontal line across the plot area at a specific location. This setting is affected by the Orientation property of the line.

## Text options

- Draw Text – Enable this checkbox if you want the text of your annotation to appear on the chart. In some cases you may want only the line to show.
- Text Color – Use this to select the color for your annotation text.
- Orientation – Use this to select vertical or horizontal text and also the direction in which the text will flow.
- Connect point – Use this to select the position, with respect to the text, where the line will be connected to the text.
- Font – Use this to select font settings for the annotation text.
- Extra space around text – Use this to increase (right arrow) or decrease (left arrow) the amount of space between the annotation text and the optional box that may surround the text.

## Box options

- Draw box – Enable this check box if you want the text of your annotation to be surrounded by an outline.
- Fill color – If you are using a box around your annotation text, use this option to set the background color inside the box.

## Moving and sizing an annotation

Use the options under Move to adjust where your annotation is placed in the plot area and the length of the annotation line. Click the arrow buttons to move the annotation. The size of the move for each click is determined by the Increment size option you have selected. Use the Longer line and Shorter line buttons to change the length of your annotation line. The Increment size option also affects the line length buttons.

Annotation Position – You can connect the annotation to the data, or position the annotation at a fixed location on the chart.

- Connect X to the data – Select this option if you want to connect the annotation to the *Unique identifier* value for the data point. This option is available only when a data source column is treated as the *Unique identifier*. When this option is not selected, the annotation is connected at a fixed percentage relative to the plot area width.
- Connect Y to the data – Select this option if you want to connect the vertical position of the annotation to the specified Y-axis value. When this option is not selected, the annotation is connected at a fixed percentage relative to the plot area height.
- Annotation position details – Click this button for more details on how the annotation is positioned and “Connected to the data” on the chart.

## Deleting annotations

To delete an annotation from a chart, first right-click on the annotation to display the context menu. Select Delete annotation from the menu. If you do not see the Delete annotation option, it might be because you did not right-click on or near the annotation. The menu option is available only if there is an annotation near where you right-click.

## The annotation list

If a chart has annotations, you view all the annotations in a list. This can be helpful if you are trying to delete an annotation that is near several other annotations. Using the list, you can be sure to delete the correct annotation. Sometimes an annotation will no longer be displayed on the chart because it was attached to data that is no longer shown on the chart. You can use the list to delete these orphaned annotations.

- To display the annotation list – Right-click in the plot area while viewing a chart. Select the Annotation list option. This will display a listing of all of the annotations that have been saved in the chart definition. Select an annotation and click Remove to delete that annotation.

## Control limits

Control limits are used on several chart types. Measurement, count, and short-run SPC control charts all use control limits. Control limit formulas vary by chart type. However, the general concept of control limits is the same for all. The following topics discuss how to use control limits in CHARTrunner. The information applies equally to all control chart types supported in CHARTrunner.

## What are control limits?

Control limits are sometimes called the voice of the process because they are computed based on data from some process. A set of control limits consists of three numbers calculated from data: (1) an upper control limit, (2) a lower control limit, and (3) a mean or centerline. You might think of control limits as a model of your process. The model tells you where the process is centered (the mean) and how much the process typically varies (upper limit and lower limit). Limits are displayed on a control chart as three horizontal lines (upper, center, lower) and act as a visual comparison for the main data line of the chart.

## What are temporary control limits?

When you first display a new control chart, it will have temporary control limits. You will see the word temporary in the control limits title above the chart. Temporary limits are computed and displayed automatically. They are based on all of the data for the chart, even if you are viewing only a slice of the subgroups available for the chart due to setting the Chart width in subgroups property of the chart definition. They are called temporary because they re-calculate each time the chart is rendered. If new data has arrived since the last time the chart was rendered, the limit values may change because different data is used. Temporary limits are helpful on new charts but should not be used for the long term.

## Editing existing control limits

If you want to change an existing set of control limits, follow these steps:

1. Display the chart.
2. Right-click on a control limit line or on a control limit title.
3. Select Edit limits from the context menu.
4. The control limit dialog will be displayed.
5. Make your changes and click the OK button to apply the changes to the chart.

## Disable (hide) control limits

Follow these steps to remove a set of control limits from the chart display:

1. Right-click on a control limit line or a control limit title.
2. Select Disable (Hide) limits from the context menu.
3. The chart will be re-displayed without that set of control limits. Note that this does not remove the limits from the chart definition file – it just hides the limit from being displayed on the chart.

## Delete control limits - from the chart display

Follow these steps to delete a set of control limits while viewing a chart:

1. Right-click on a control limit line or a control limit title.
2. Select Delete limits from file from the context menu.

3. The chart will be re-displayed without these limits, and they will be deleted from the chart definition file.

## **Delete control limits - from the chart definition form**

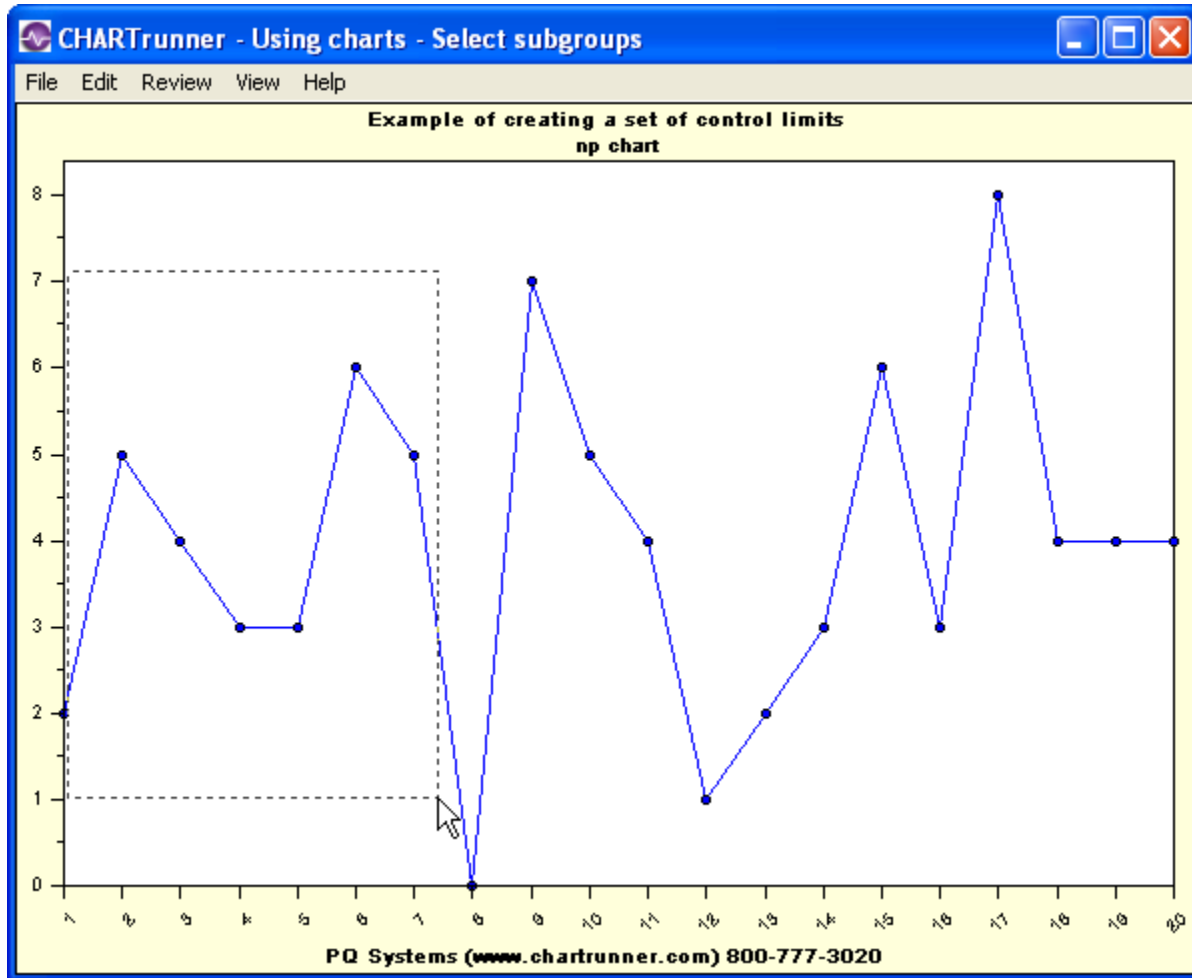
Follow these steps to delete a set of limits while viewing the chart definition form:

1. Click on the Limits/specs tab of the chart definition form.
2. In the control limits grid, click once to select a row containing control limits.
3. Press the Delete key on your keyboard.
4. Click on Yes to confirm the control limit deletion.
5. Click the OK button to save the chart definition.

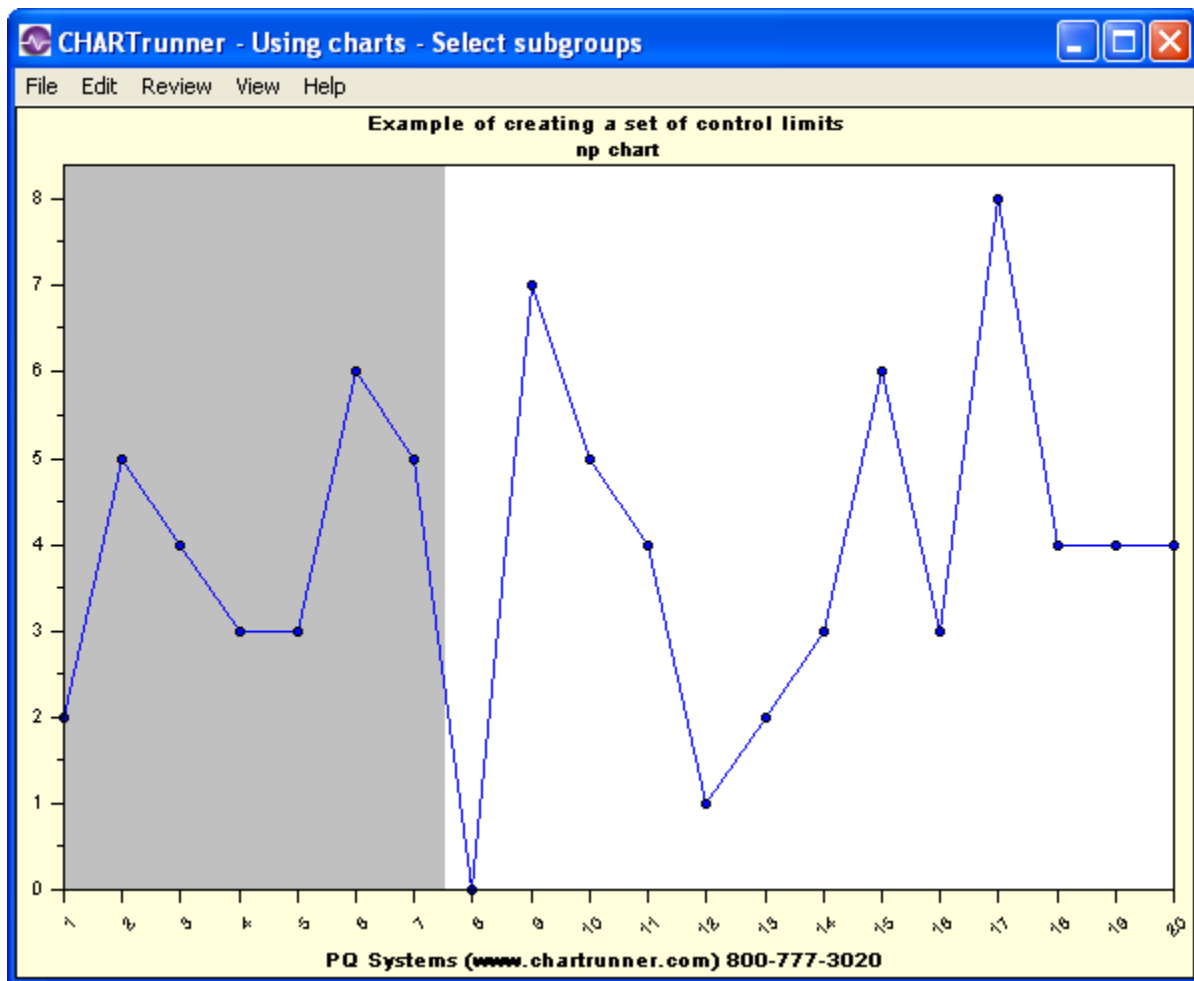
## To compute a new set of saved control limits

To compute a new set of saved control limits, the first step is to display the control chart. Next, select the subgroups (the data points) that you want to use to compute the limits. These subgroups represent the voice of the process that will be compared against to determine if the process model changes. You can select all of the data on the chart or a subset of the data. To select data points, left-click-and-drag a rectangle through the plot area of the chart using the mouse.

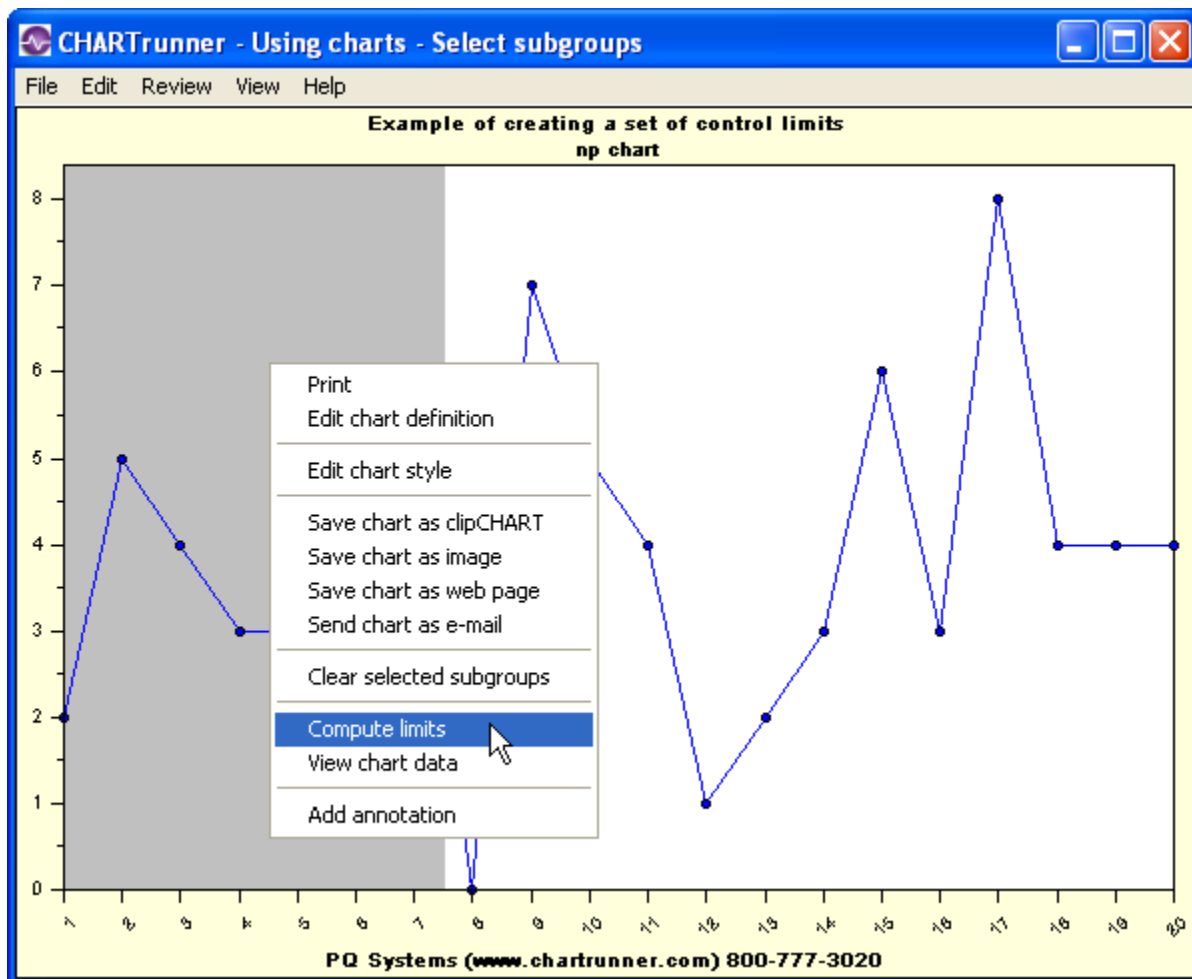
In the example below, subgroups 1 to 7 are in the process of being selected:



When you release the mouse button, the selected subgroups will be highlighted as shown below:



Next, right-click on the chart to display the context menu. Select Compute limits from the context menu. If this is not an option on your menu, it might be that you have not selected subgroups or the current chart is not a control chart.



The Compute limits choice will display the control limits dialog box shown below:

## The control limits dialog

- Name for this set of limits – Each saved set of control limits has a name. If you use a chart over a period of time, you may end up with several sets of control limits. Use the default names provided (Set 1, Set 2, etc.) or enter a meaningful name like January 2004.
- How to compute limits – You have the following options for how control limits will be computed. If you have any doubt about which option to use, always select the Standard option.
  - Standard (based on estimated sigma - recommended) – Enable this option to compute limits using the most standard formula. This will use the mean plus or minus 3 sigma. For a measurement chart, sigma is estimated based on the range.
  - Based on n sigma, where n= [Attributes chart] – Most control limits are computed based on the mean plus or minus 3 sigma. If you want to use a value other than 3, enable this option.
  - Based on n sigma (ind) where n= [Measurement chart] – Most control limits are computed based on the mean plus or minus 3 estimated sigma. If you need to use actual sigma or you want to use a value other than 3, enable this option.



- Based on n sigma (est) where  $n =$  [Measurement chart] – Most control limits are computed based on the mean plus or minus 3 estimated sigma. If you want to use a value other than 3, but still want to use estimated sigma, enable this option.
- User entered – In some cases you may already know the proper control limit values and want to use these values. Enable this option to enter your own control limit information. Depending on the chart type, the limit information you must enter will vary.
- Subgroups included – In this section the First subgroup and the Last subgroup, which you selected back on the chart, are shown. You may adjust these values so the limits will be based on a different range of subgroups. For a Table data source, the first and last subgroups are specified in terms of the Order By column; if no Order By column is specified, these are specified in terms of relative subgroup number. For a non-Table data source (Query or view, Stored procedure, or Custom query), the first and last subgroups are specified in terms of the Unique identifier column; if no Unique identifier is specified, these are specified in terms of relative subgroup number.
- Extend the control limits – Check this box if you want this set of control limits extended beyond the subgroups used to compute them. For example, you might start a control chart where the first set of limits is computed on the first 25 subgroups. This set of limits is then extended across any new data that arrives. The line style used for the control limit lines will distinguish extended limits.
- Control limit values – Control limit values are shown here. Depending on the chart type, you will see different labels. For chart types that show two charts, like an X-bar and Range chart, there will be a set of control limit values for each type of chart.

If you make changes on the control limit dialog box, use the Compute button to compute new limits values based on your changes.

Click the OK button to have your control limits applied to the chart. When you close the chart, you will be asked if you want to save your changes. If you answer Yes, your control limits will be saved in the chart definition and displayed the next time you view the chart.

## Using control charts and control limits

When using control charts and control limits, you are faced with many decisions. When should I compute limits? What data should I use to compute limits? When should I adjust the limits? How many sets of control limits should I use? These questions become easier to answer when you keep in mind the purpose of using control charts:

Why use control charts? Control charts are designed to minimize two common errors:

1. Adjusting a process when it would be better to leave it alone.
2. Not adjusting the process when it might be improved by intervention.

Control charts minimize these errors by helping you distinguish between two types of variation:

1. Normal or natural variation inherent in all processes.
2. Exceptional or assignable cause variation.

On a control chart, assignable cause variation shows up as out-of-control conditions. In CHARTrunner, these typically are square, red data markers. Points outside the control limits, trends, runs, and unusual patterns will cause out-of-control conditions.

A control chart that has no out-of-control conditions represents a process that is said to be in control. The process is predictable. It will continue to produce the same mean and variation around the mean unless something causes a change to the process model.

A control chart that does have out-of-control conditions represents a process that is said to be out-of-control, unstable, or not predictable. There is assignable cause variation present. If you study the process, you can probably find reasons or causes for the out-of-control conditions.

#### One recipe for using control charts

Create and display the initial control chart. It will be displayed with temporary control limits. Ideally, you will have at least 25 points on the chart, but this is not an absolute requirement. There is no need to look at thousands of data points at this early stage.

If there are out-of-control conditions on the chart, study each one, looking for the reason or the assignable cause. For any assignable cause you discover, do your best to remove it from the process – ensure that it will not happen again. Once assignable causes have been removed, display the same control chart using newer data. Repeat the process of looking for out-of-control conditions and removing assignable causes until you get a control chart with no out-of-control conditions.

Once you have removed assignable causes, calculate a set of control limits using the most recent 25 to 100 subgroups (just a guideline). Check the option to extend these control limits. Set up the control chart to always display the last 25 to 50 subgroups. At this point you can use the control chart for ongoing monitoring of the process. When you see an out-of-control condition, it means that some assignable cause is present. This should be investigated and understood. Steps should be taken to ensure it does not happen again.

Once your process is in control, it is also predictable. You can assume that the output of the process will remain consistent unless some significant change occurs. If the output of the process is in control, but not meeting customer needs in some area of quality, then the system must be changed in some way. Better equipment, better training, improved inputs, improved procedures: something will have to be changed because the control chart is telling you that the process is stable.

#### The control chart mindset

Control charts are designed to look at data over time. They answer questions like the following: Is the process getting better over time? Is the process getting worse over time? Is the process stable? They are part of a continuous improvement approach. A control chart is not something you do at the end of the year to summarize performance – rather it is a tool to help you keep thinking about the process, and how to make it better, all the time.

#### Key Measures

All organizations produce data. There are numerous opportunities to make control charts from this mountain of data. Control charts should be used on important measures; measures that have a perceptible and useful impact on some aspect of quality or performance.

## Lloyd Nelson limits option

CHARTrunner offers a feature known as the Lloyd Nelson limits option, designed to render individuals control charts more effective in identifying special causes by using common cause variation ONLY to estimate sigma for the individual limits. Any moving range values that lie above this Upper Control Limit for the Moving Range are removed from the calculation thus using only common cause variation to estimate sigma for limits on the X chart. The MR range chart is typically not displayed since the sample-to-sample variation is already graphically displayed in the X chart.

This procedure was suggested by Lloyd Nelson in the Technical Aids section of the Journal of Quality Technology (Vol. 14, No. 3, Pg. 172, July 1982). Nelson points out that a moving range that is out of control because of a sudden increase in what is being measured leads to an increase in the value of the moving range ( $\overline{MR}$ ), which would then include variation from both special and common cause variation. This, in turn, inflates control limits:

$$UCL_x = \bar{X} + \overline{MRE}_2$$

$$LCL_x = \bar{X} - \overline{MRE}_2$$

As a result, control limits would be wider than they would otherwise be, making it more difficult to identify assignable causes for individual values.

The feature was added to the software program as a result of a suggestion by Lloyd Provost and his colleagues at Associates in Process Improvement (API), who supported the development of the Lloyd Nelson limits option. Lloyd Provost, Cliff Norman and Jane Norman worked with Gordon Constable of PQ Systems to implement this option. In addition, Byron Murray and Sandy Murray of CT Concepts utilize this methodology in their practice.

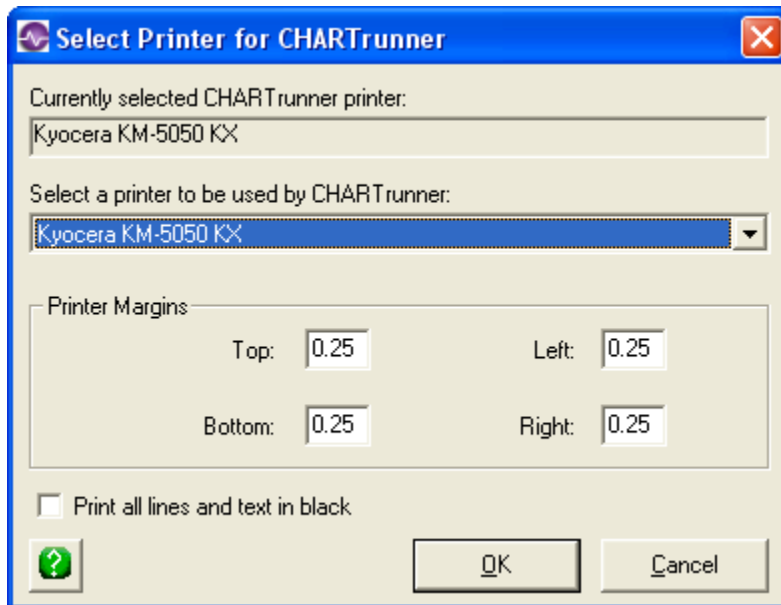
The Lloyd Nelson limits option is specified on the Limits/specs tab of the measurement control chart definition.

## Printing charts

CHARTrunner allows you to select a printer that will be used by default whenever you print a chart. You always have the option to select a different printer from the Windows printer dialog when you print, but the CHARTrunner printer will be selected by default.

To select the CHARTrunner printer

On the main form of CHARTrunner, select the File > CHARTrunner printer pull-down menu. The following dialog will be displayed:



Select the printer you will use most often and then click the OK button to save your settings.

Print a chart from the charrunner chart list

To print a chart from the CHARTrunner chart list, follow these steps:

1. Right-click on the chart in the list and select Print.
2. The Windows printer dialog box will be displayed. Make any needed changes.
3. Click the OK button to send the chart to the printer.

Print a chart from the chart display

To print any chart that you are currently viewing, follow these steps:

1. Select File > Print from the pull-down menu, or
2. Right-click on the chart and select Print.
3. The Windows printer dialog box will be displayed. Make any needed changes.
4. Click the OK button to send your chart to the printer.

### Printer properties

Whenever you print a chart, you will have the option to click on the Properties button of the Windows printer dialog. This allows you to change properties specific to your printer. A common example is that you may select either Portrait or Landscape page orientation.

## Chart definition settings that affect printing

On the Misc. tab of the chart definition form for every chart, there is a setting for Default print orientation. When you select either Portrait or Landscape for a chart, this will be used later when you print the chart as the default page orientation. You always have the option to override this default at the time you print the chart.

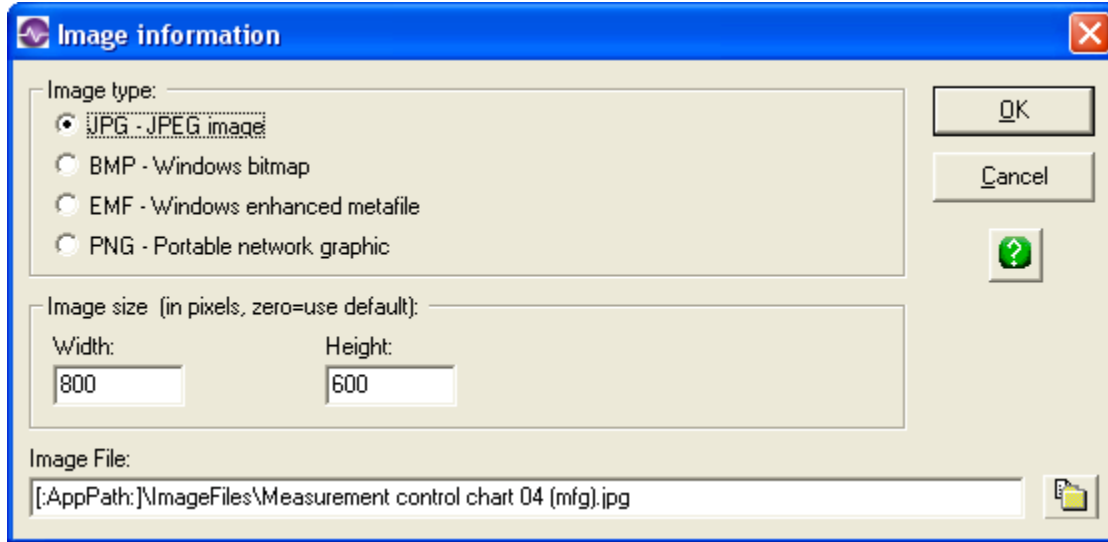
## Saving charts and sharing them with others


A useful feature of CHARTrunner is the ability to define a chart once and then use it often. Each time you generate the chart, it reflects current data from the data source. The chart represents a snapshot of the underlying process. You may want to make these snapshots available to other people. CHARTrunner provides several methods which allow you to share charts with others.

- **Copy chart to the clipboard** – While viewing any chart, you may copy the chart image to the Windows clipboard and then paste it into another application such as Microsoft Word or Microsoft PowerPoint. On the chart display form, select Edit > Copy chart to clipboard from the pull-down menu. You may copy the chart to the clipboard either as a bitmap or a metafile. Use the metafile for best image quality when you might need to resize the image in the target program. Once the chart has been copied to the clipboard, switch to the other application and use the Edit > Paste pull-down menu to paste the chart image. Remember that you have copied and pasted a snapshot of the chart as it looks right now; if new chart data becomes available in the future, the pasted chart image will not update to reflect the new data.
- **Save chart as image** – You may save any chart as an image file by using the Save chart as image right-click menu on the CHARTrunner definitions list or the File > Save chart as image pull-down menu on the chart display form. The following image formats are supported: JPG (JPEG), EMF (Windows Enhanced Metafile), BMP (Bitmap), and PNG (Portable Network Graphics). On the chart definition form under Misc > Image file defaults, you may select the default image type you want to use when saving the chart as an image file. The default image type can be overridden when the image file is created. For more details, see the **Save chart as image dialog** topic.
- **Save chart as Web page** – You may save any chart as an HTML Web page which contains an image of the chart and optionally a table of the chart's data. Use either the Save chart as Web page right-click menu on the CHARTrunner definitions list, or the File > Save chart as Web page pull-down menu on the chart display form. A dialog box will be displayed where you can make selections to create the Web page. For more details, see the **Save chart as Web page dialog** topic.
- **Send chart as e-mail** – You may send any chart as an attachment in an e-mail message. This can be done using either the Send chart as e-mail right-click menu on the CHARTrunner definitions list or the File > Send chart as e-mail pull-down menu on the chart display form. A dialog box is displayed where you make selections to send the e-mail. For more details, see the **Send chart as e-mail dialog** topic.
- **Save chart as clipCHART** – A clipCHART is a special type of CHARTrunner file (with a .CCF file extension) that contains both a snapshot of the current chart data and a chart definition. To save a chart as a clipCHART, use either the Save chart as clipCHART right-click menu on the CHARTrunner definitions list or the File > Save chart as clipCHART pull-down menu on the chart display form. CHARTrunner must be installed in order to view a clipCHART. Viewing a clipCHART allows another user to change chart settings and ask various what if questions with your chart. To open a clipCHART, run the clipCHART viewer program that is installed with CHARTrunner, or double-click the clipCHART file.

## Save chart as image dialog

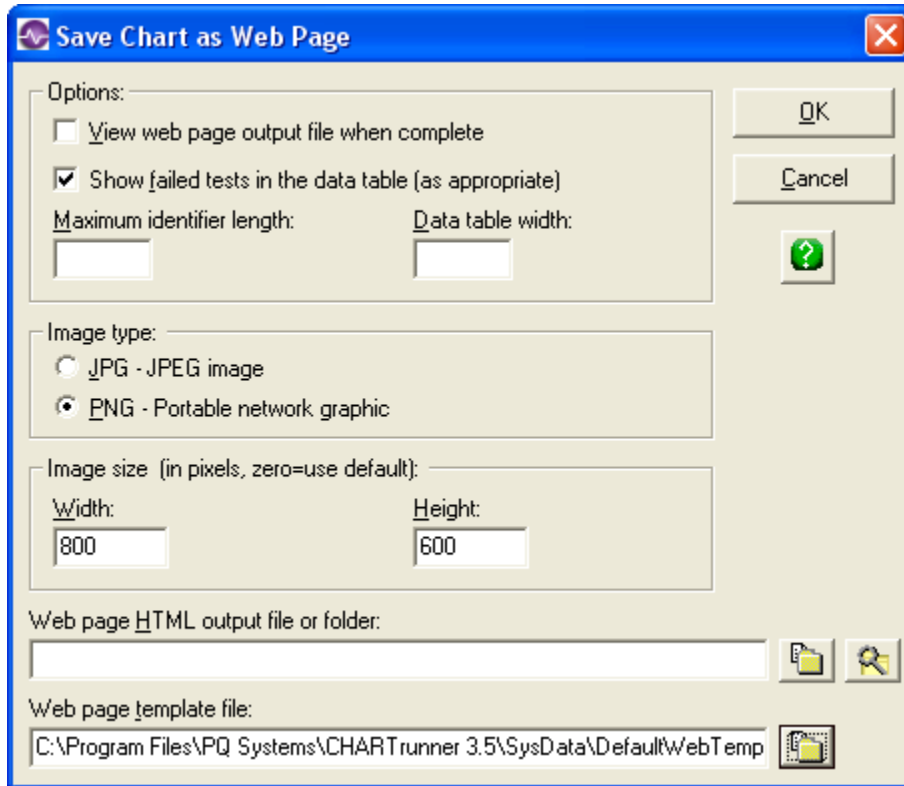
When you select the option to Save chart as image, the following dialog will be displayed. Select the desired options and click the OK button to create the chart image file.



- Image type – Select one of the following image file formats:
  - JPG-JPEG image – The ubiquitous JPEG image format is very popular. The quality of the JPEG image is determined by the JPG image quality setting under the Setup > Preferences > General pull-down menu on the CHARTrunner main form.
  - BMP-Windows bitmap – This results in large image files. Use this only when you have a specific need to do so.
  - EMF-Windows enhanced metafile – This is a good choice when the image will be inserted into another application, such as Word or PowerPoint, and then resized to fit the available space.
  - PNG-Portable network graphic – This is a good choice since it does not result in loss of image quality as JPEG does, and is typically smaller than a JPEG image.
- Image size (in pixels, zero=use default)
  - Width – Enter a number for the width in pixels of the chart image. If zero is entered, the default image width specified by the chart definition is used.
  - Height – Enter a number for the height in pixels of the chart image. If zero is entered, the default image width specified by the chart definition is used.
- Image file – Enter the location where the chart image will be saved. Click the .

## Save chart as web page dialog

When you select the option to Save chart as Web page, the following dialog will be displayed. Select the desired options and click the OK button to create the Web page.



The dialog box is titled "Save Chart as Web Page" and features a standard Windows-style title bar with a close button. It is divided into several sections for configuration. The "Options" section contains three checkboxes: "View web page output file when complete" (unchecked), "Show failed tests in the data table (as appropriate)" (checked), and two input fields for "Maximum identifier length" and "Data table width". The "Image type" section offers two radio button options: "JPG - JPEG image" and "PNG - Portable network graphic", with "PNG" selected. The "Image size" section includes input fields for "Width" (set to 800) and "Height" (set to 600). At the bottom, there are two text input fields: "Web page HTML output file or folder:" and "Web page template file:", each followed by a file selection icon. On the right side of the dialog, there are "OK" and "Cancel" buttons, along with a green question mark icon.

**Save Chart as Web Page**

Options:

- ☐ View web page output file when complete
- ☒ Show failed tests in the data table (as appropriate)
- Maximum identifier length:
- Data table width:

Image type:

- ☐ JPG - JPEG image
- ☒ PNG - Portable network graphic

Image size (in pixels, zero=use default):




Width:  Height:

Web page HTML output file or folder:

Web page template file:

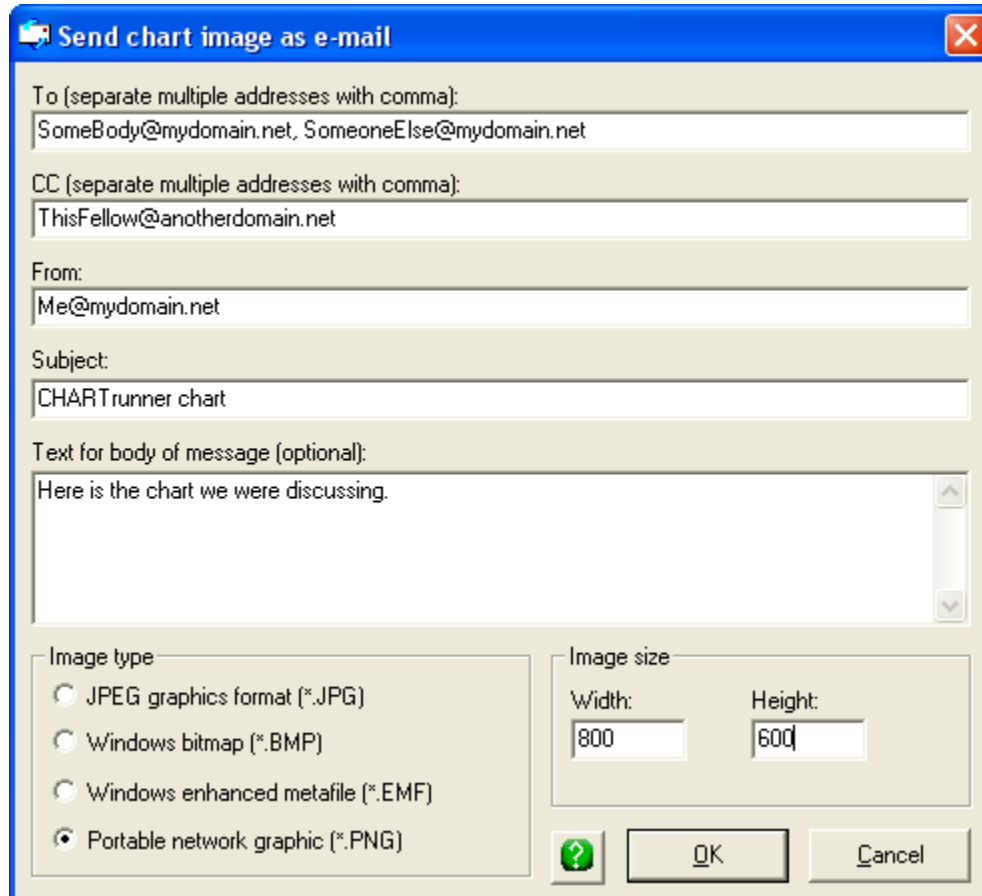
Buttons: OK, Cancel, ?



- View Web page output file when complete – Enable this box if you would like to view the Web page, using your Web browser, after it has been generated.
- Show failed tests in the data table – Enable this option to have each out-of-control condition shown in the Web page's data table.
- Maximum identifier length – If you are including a data table as part of the Web page, enter a value here for the maximum identifier length. This will truncate identifiers to this maximum length, which can make the table more readable when long identifiers are present.
- Data table width – If you include a data table in the Web page, this setting affects how wide the table will be. Leave this blank to allow the Web browser to set the table width. Enter a number to specify the table width in pixels. Alternatively, enter a percentage to specify that the table should be some percentage of the Web page's width. For example, if you enter 75%, the data table will consume 75% of the width of your browser window. If you enter 500, the data table will be 500 pixels wide.
- Image type – Select either JPG or PNG for the type of image to use for the chart that will be displayed as part of the Web page. PNG usually gives better image quality.
- Image size, width and height – Enter values here to determine the size of the chart image (in pixels) within the Web page. Enter zeros if you want to use the image size properties saved with the chart definition.
- Web page HTML output file or folder – If you specify only a folder, then the output Web page HTML file will be created in the specified folder and will use the chart name as the basis for the Web page file name. Any embedded spaces in the chart name will be replaced by the underscore character. Or, you can specify the full path to the HTML Web page file to be created. Click the  button to open the folder selection dialog, or the  button to open the file selection dialog.
- Web page template file – The format of the output Web page is determined by the Web page template file that you specify here. If you do not specify a template file, then CHARTrunner will use the DefaultWebTemplate.htm file that is located in the SysData folder. Click the  button to open the file selection dialog.

## Send chart as e-mail dialog

When you select the option to Send chart as e-mail, the following dialog will be displayed. Select the desired options and click the OK button to send the e-mail.



The dialog box is titled "Send chart image as e-mail" and contains the following fields and options:

- To (separate multiple addresses with comma):** SomeBody@mydomain.net, SomeoneElse@mydomain.net
- CC (separate multiple addresses with comma):** ThisFellow@anotherdomain.net
- From:** Me@mydomain.net
- Subject:** CHARTrunner chart
- Text for body of message (optional):** Here is the chart we were discussing.
- Image type:**
  - ☐ JPEG graphics format (\*.JPG)
  - ☐ Windows bitmap (\*.BMP)
  - ☐ Windows enhanced metafile (\*.EMF)
  - ☒ Portable network graphic (\*.PNG)
- Image size:**
  - Width:** 800
  - Height:** 600

At the bottom, there is a green question mark icon, an **OK** button, and a **Cancel** button.

- **To** – Enter the destination e-mail address. If you are sending to multiple recipients, separate each address with a comma. For example: Somebody@mydomain.net, SomeoneElse@mydomain.net.
- **CC** – If you want to carbon-copy other users, enter their e-mail addresses here. If you are sending to multiple recipients, separate each address with a comma.
- **From** – Enter your e-mail address here. This will appear to the recipient as the sender's e-mail address.
- **Subject** – Enter a subject line for this e-mail.
- **Text** – Enter the (optional) text you wish to appear in the body of the e-mail message.
- **Image type** – Select the type of graphic image file you want to create and attach to the e-mail. PNG usually gives better image quality.
- **Image size** – Enter the width and height (in pixels) of the chart image file that will be attached to the e-mail.

When you click the OK button, the chart is generated as an image file and the image file is added as an attachment to the e-mail message. The e-mail message will be sent to the addresses you specified in the To: or CC: fields.

If you get an error when you select Send chart as e-mail, or if the e-mail is not sent, you may have to configure CHARTrunner for your e-mail system. This is done on the main form by selecting the Setup > Preferences > E-mail setup pull-down menu.

## Linking to chart or dashboard images using Microsoft PowerPoint or Word

You may want to always use the most recently created version of your CHARTrunner chart or dashboard images in your PowerPoint presentation or Word document. If you use the Copy-to-clipboard and Paste-into-document method of getting the image into PowerPoint or Word, the image in the document will not update when the image file on disk is updated. However, if you follow these instructions and link the image, your PowerPoint presentation or Word document will always show the most recently created CHARTrunner chart and dashboard images.

Start the process by saving the required dashboard indicators or charts as images. You may save any chart as an image file by using the right-click menu on the CHARTrunner definitions list or the File > Save chart as image pull-down menu on the chart display form. The following image formats are supported: JPG (JPEG), EMF (Windows Enhanced Metafile), BMP (Bitmap), and PNG (Portable Network Graphics). On the chart definition form under the Misc > Image file defaults sub-tab, you may select the default image type you want to use when saving the chart as an image file. The default image type can be overridden when the image file is created. For more details, see Save chart as image dialog.

The key is to link each image into your document rather than to insert the image. Select the Insert > Picture > From File pull-down menu in PowerPoint or Word, navigate to the folder containing the image, such as C:\Charts\Presentation1, select the appropriate image file, such as MyChart1.emf, and finally select Link to File from the selection button at the lower right of the Insert Picture window.

NOTE: You must select the Down-Arrow next to Insert and then select Link to File.

### Updating dashboard images in a folder

You can easily update many dashboard images for a presentation using this technique.

Right-click on the dashboard definition in the CHARTrunner definitions list that contains images for your presentation and select Update all indicator images in specified folder.

Specify the folder that contains the presentation document and the image files used by that document, such as:

C:\Charts\Presentation1

CHARTrunner will update all images files found in the specified folder if the image file name corresponds to an indicator name in the dashboard, and the image type is EMF or PNG. The width and height of the image will be maintained.

### Using a workspace to update many chart images

You can easily update many chart images for a presentation using this technique.

Create a CHARTrunner chart workspace that contains all of the charts that are to be displayed in your presentation. Give the workspace the same name as your presentation to aid in keeping track of which workspace goes with which presentation.

Whenever you want to generate new images (that reflect the most recent data) for your presentation, right-click on the appropriate workspace in CHARTrunner and select Save all charts as image to specified folder. Save the images to the folder that contains the presentation document and the image files used by that document, such as:

### C:\Charts\Presentation1

While you can use any of CHARTrunner's image types in PowerPoint or Word, it is suggested that you use EMF (Windows Enhanced Metafile) images. This type of image resizes well to fit the space allocated to it in the presentation. An image size of 800 x 600 is a good default size for your EMF images.

### PowerPoint linking tips

When you link to an image file, PowerPoint stores the full path to the image file, such as C:\Charts\Presentation1\Chart1.emf. If you attempt to use the PowerPoint slideshow on a computer where C:\Charts\Presentation1\Chart1.emf does not exist, PowerPoint will be unable to display the linked image. The solution is to store a relative path to the image file, such as Chart1.emf, and keep the images and PowerPoint PPT file in the same folder. Unfortunately, PowerPoint does not have a built-in means of converting these full image paths to relative paths. Fortunately, the free demo of PPTools FixLinks utility will do this for you. Get this helpful utility at <http://www.rdpslides.com/pptools/fixlinks/index.html>.

If you want to send your PowerPoint presentation to someone else, for example as an e-mail attachment, how might you do that? You can try using one of the following methods:

- Zip the contents of the folder containing the image files and the PowerPoint PPT file into a zip archive file. Tell the recipient to unzip the archive into an empty folder and open the PowerPoint PPT file. If you used relative paths (via FixLinks) then it does not matter what folder the recipient unzips into. Otherwise, the recipient must unzip to the exact same drive and folder path as was used on the sending computer.
- In PowerPoint use File > Save As to save the presentation as a file type that is easily transported to another computer. You can save as a "Single File Web Page" that creates a single .MHT file that can be displayed in Internet Explorer. Or you can save each slide as an image and send the slide image files.
- If you have the ability to create a PDF, such as via Adobe Acrobat, then create a PDF version of the presentation and send that.

## Publishing charts

In some situations, you may want to make chart images available to a wider audience. The previous section discussed the mechanics of creating chart images and saving charts as Web pages. The following topics address options for making these images available to other users on the network.

## Using a local share as a chart image repository

Many organizations have shared disk drives that are available to network users. Each workstation on the network can be set up with access to various network shares. One way to make your charts visible to others is to save chart images into shared folders. You may need to check with your local information technology staff to arrange for a common place to put chart images so that those who need to view them have the appropriate access.

For example, you might designate Q:\CrCharts\ as a standard place where CHARTrunner images are generated. When you select Save chart as image, you would select Q:\CrCharts\ as the destination folder for your chart image. Anyone who wants to view your chart images may browse to and display them by double-clicking on the file in Windows Explorer. Note that these are snapshots. The chart owner would occasionally need to generate new images to keep the images in the folder current.

The same approach will work for charts that are saved as Web pages. The user would double-click on the desired Web page file, and the Web page would be displayed in their Web browser.

Note that generating chart images and chart Web pages can be automated using command line parameters. When combined with a scheduled task, these images might be generated automatically every morning at 3:00 am.

## Publishing charts on the Internet

If you want people outside of your immediate local area network to see your CHARTrunner charts, you can publish chart images or Web pages on a Web server using a public (visible on the Internet) or a private (intranet) company Web site. The principles are the same as above. First, a network folder that is being published on your Web site must be designated. Next, CHARTrunner is used to generate chart images or chart Web pages into that network folder. Finally, any user with a browser and access to the appropriate Web site will be able to browse to and view your chart images.

If you want a turnkey solution to publishing your charts on a Web site, consider using CHARTrunner-e. For more information on CHARTrunner-e, please visit <http://www.charrunner.com/cre>. (<http://www.charrunner.com/cre>)

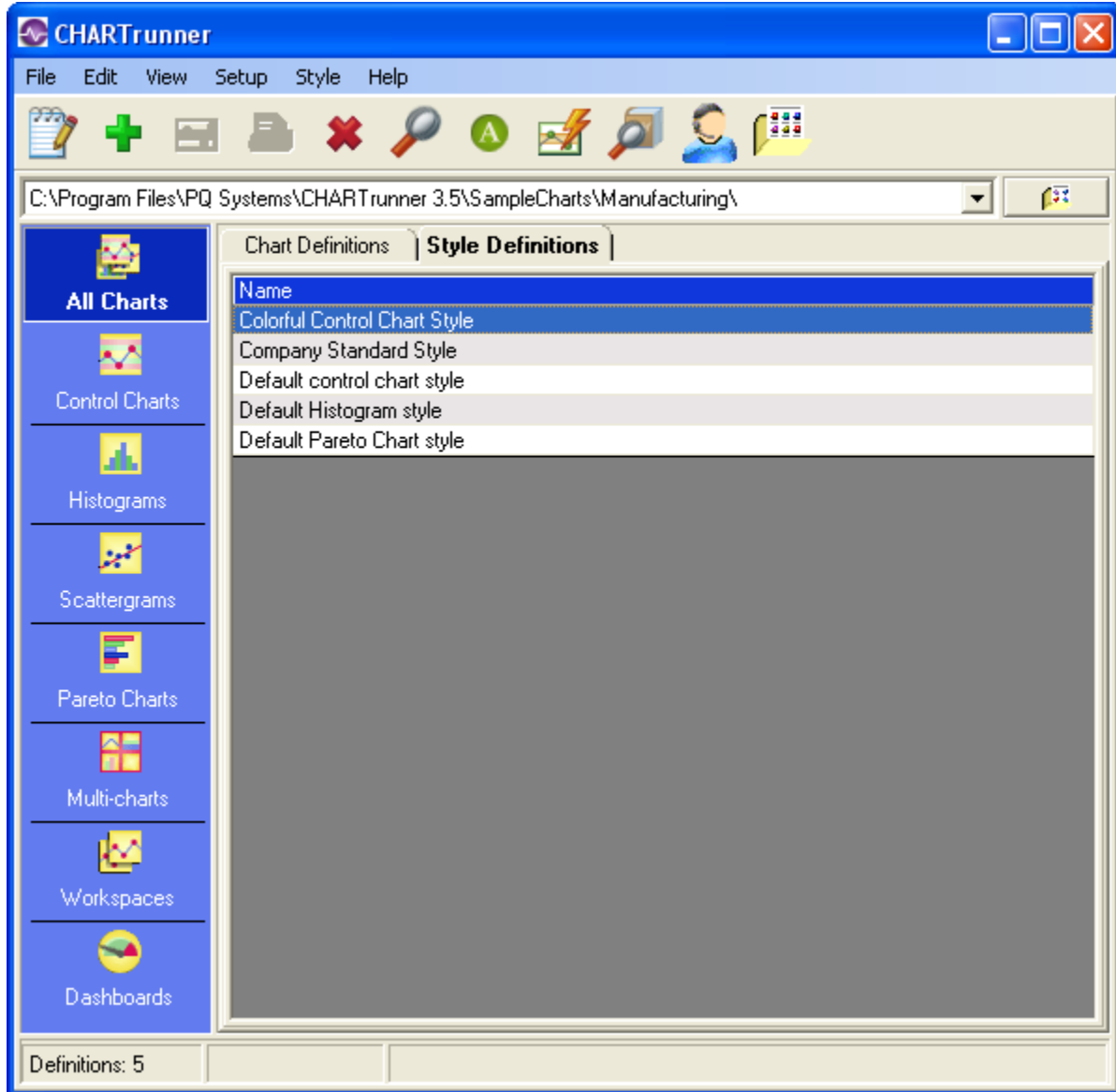
## The CHARTrunner software development kit

Many CHARTrunner functions can be controlled programmatically via the Software Development Kit (SDK). For more information, visit <http://www.charrunner.com/sdk> (<http://www.charrunner.com/sdk>).

# Using styles to control the look of your charts

## What is a chart style?

All regular (i.e., not a Multi-chart or a Workspace) charts have a setting for Chart style. A chart style is a named collection of settings that affect the visual appearance of a chart, such as chart background color, line colors, line styles, and fonts.



In the CHARTrunner definitions list, the chart styles appear under the Style Definitions tab, as shown in the figure above. There are three types of chart styles: Control chart styles, Histogram chart styles, and Pareto chart styles. CHARTrunner provides a default style for each of these three categories of charts. The default styles may not be deleted, although you can modify the settings of a default style. You can create as many new styles as you need.

## Selecting a style for a chart

The chart style name is selected from the Chart style drop-down list on the *Step 1: Chart name/type* tab of the chart definition form, as shown below:

The screenshot shows the CHARTrunner - Attributes control chart 04 (health) dialog box. The 'Step 1: Chart name/type' tab is active. The 'Chart name' field contains 'Attributes control chart 04 (health)' and the 'Description' field contains 'Proportion of medical bills with mistakes'. The 'Chart style' drop-down list is open, showing options: 'Default control chart style' (selected), 'Colorful Control Chart Style', 'Company Standard Style', and 'Docs control chart style'. Below the list are two columns of radio buttons for 'Chart categories' and 'Chart types'. The 'Chart types' column has 'p-chart' selected. A preview window shows a p-chart with a blue line and red dashed control limits. At the bottom, there are fields for 'Inspected count name' (Bills checked) and 'Special count name' (Number with errors), and buttons for 'View data', 'Save as default', 'OK', and 'Cancel'.

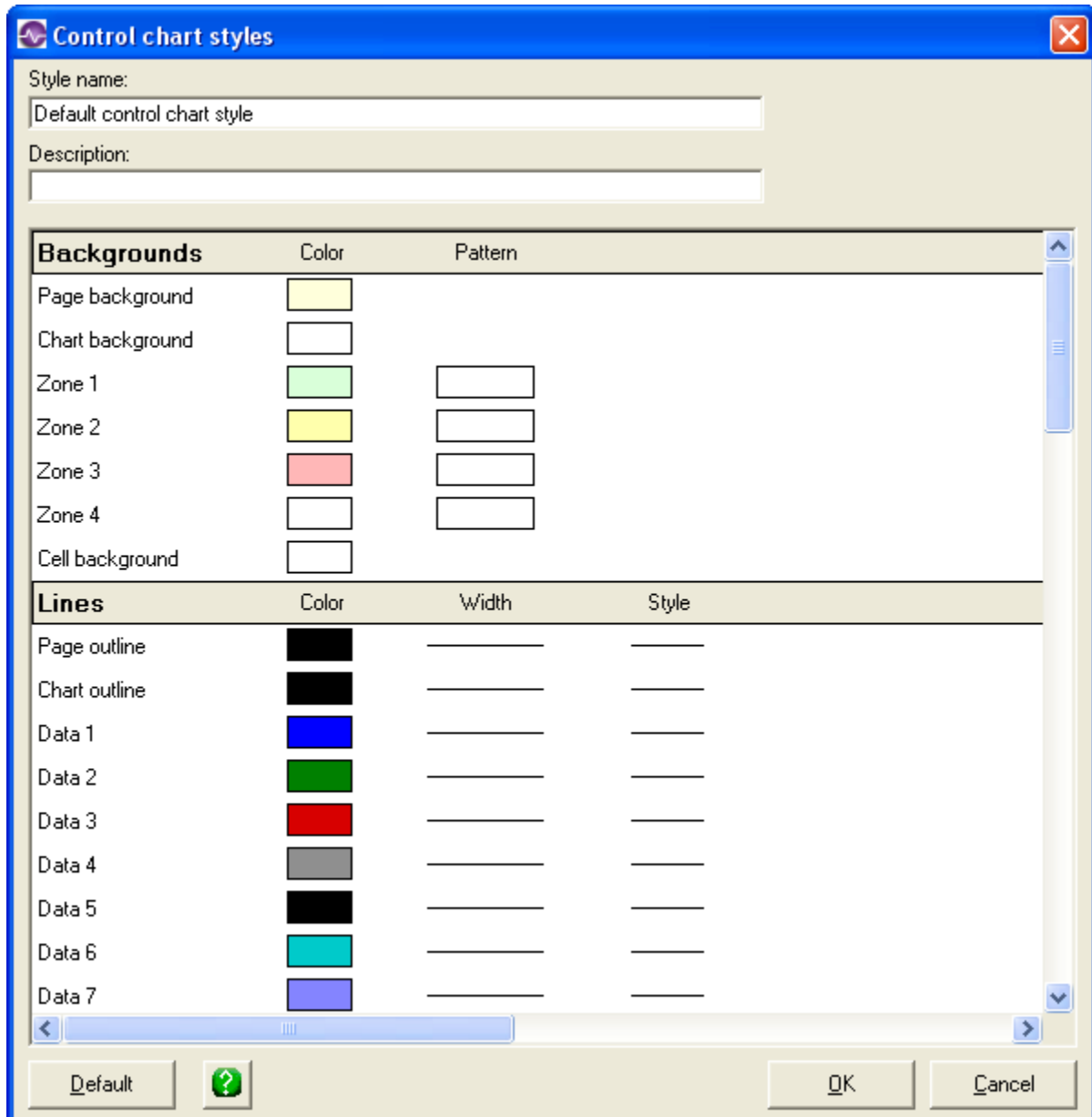
Chart categories	Chart types
<input type="radio"/> Measurement control charts	<input checked="" type="radio"/> p-chart
<input checked="" type="radio"/> Count (attribute) control charts	<input type="radio"/> np-chart
<input type="radio"/> Pareto charts - category data	<input type="radio"/> c-chart
<input type="radio"/> Distribution and capability analysis	<input type="radio"/> u-chart
<input type="radio"/> Line charts	
<input type="radio"/> Advanced charts	
<input type="radio"/> Short run control charts	
<input type="radio"/> Rare event control charts	

The style names in the Chart style drop-down list are based on the chart style definitions that are found in the CHARTrunner Styles folder on your computer, plus any style definitions that are found in the current working chart folder. When a chart is rendered, if the named chart style cannot be found, then the default chart style for that type of chart will be used instead.



## The chart style editor

You may edit a chart style by right-clicking on it in the CHARTrunner definitions list and selecting Edit. Also, while you are viewing a chart, you may right-click on the chart and select Edit chart style, or select the Edit > Edit chart style pull-down menu, or press Ctrl-T. In any case, the chart style editor will open to allow you to modify the settings of the chart style. The contents of the style editor will vary based on which type of chart style you are editing (i.e., Control chart style, Histogram chart style, or Pareto chart style). An example of the style editor for a control chart style is shown below:



There are many style settings that you can change. Notice the scroll bar; you may have to scroll vertically to find the specific style setting you want to change. The style settings are organized into the following categories:

- Background colors

- Lines
  - Fonts
  - Markers.
- To change a style setting. Click on any style setting you wish to change. Additional dialogs will prompt you for a selection such as a color, font, line style, or marker size. Once you have made your changes, click the OK button to save the chart style. Any charts that use that chart style will reflect your changes the next time they are rendered.
  - Experimenting with style setting changes. In order to become familiar with what effect a particular style setting change has on the appearance of a chart, it is helpful to connect a test chart to a test style, and experiment by making changes to the test style in order to see the resulting visual effect on the chart. The following steps can be used:
    1. If you do not have a test style to use, then create one, or make a copy of an existing style. Let's assume the test style is named "Test Chart Style."
    2. If you do not have a test style to use, then create one, or make a copy of an existing style. Let's assume the test style is named "Test Chart Style."
    3. If you do not have a test chart you want to use, then create one, or make a copy of an existing chart. Edit the test chart definition and set the Chart style drop-down list to "Test Chart Style."
    4. Display the test chart.
    5. While the chart is displayed, open the style editor by pressing Ctrl-T (or by using the various menu choices to open the style editor).
    6. Change a style setting, then click the OK button to close the style editor. You will be asked whether to "Save the style definition so that the changes will be applied to any charts that use this style in the future?" Your answer determines whether the style setting change you just made is saved to the style definition file on the disk (if you select Yes), or just retained in memory for use with the currently displayed chart (if you select No). Since you are using a test style definition, select the Yes button. However, if the chart had been using the default chart style, and you changed the Chart background setting to hot pink (just to see what it would look like), you would probably want to select the No button.
    7. Notice how the visual appearance of the chart changed as a result of the style setting change you made.
    8. Repeat the process by going back to Step 4 and making additional style changes.
  - Local style definitions versus per-chart-folder style definitions. Style definitions are normally stored on your computer in the CHARTrunner Styles folder (typically C:\Program Files\PQ Systems\CHARTrunner 3.5\Styles). If you keep chart definitions in a network folder so that they are accessible by multiple users, you may run into the situation where a chart has a different visual style when it is displayed on different computers because the style definition that is used by the chart is different on each of the computers. You could ensure that each computer where CHARTrunner is installed has the same style definitions (but that could be difficult to maintain). Alternatively, you can copy (using Windows Explorer) any style definition files needed by the charts directly into the chart folder. CHARTrunner will use the style definition that is found in the chart folder before it will use a style definition by the same name in the local computer's CHARTrunner Styles folder. When a style name is preceded by ">" in the definitions list, that indicates the style definition file is located in the chart folder, rather than in the CHARTrunner Styles folder.

## Out-of-control tests

Out-of-control (OOC) tests are criteria used to interpret a control chart for process stability. For example, tests might look for points out of control, consecutive points above or below the centerline, or two of three points beyond two sigma.

Each control chart specifies in the chart definition the out-of-control tests that will be used by that chart. However, you can specify in Setup > Preferences to use one master set of out-of-control tests for all your charts.

Refer to Appendix E: Out-of-control Tests And Codes for information on the out-of-control test definitions that are provided with CHARTrunner.

## Test rule syntax

The out-of-control test rules follow the syntax shown below.

Test rule keywords are shown in CAPITAL LETTERS below, but CHARTrunner is not sensitive to case, so you may use either upper or lower case.

Optional parameters are shown in lower case.

m	ALTERNATING		a	r
m	INCREASING (See Note 1 below)	o	a	r
m	DECREASING (See Note 2 below)	o	a	r
m	BEYOND LIMITS	i	a	r
m	BEYOND SPECS	i	a	r
m	BEYOND n SIGMA	i	a	r
m	WITHIN LIMITS	i	a	r
m	WITHIN SPECS	i	a	r
m	WITHIN n SIGMA	i	a	r
m	BELOW LOWER LIMIT	i	a	r
m	BELOW LOWER SPEC	i	a	r
m	BELOW CENTER LINE	i	a	r
m	BELOW TARGET	i	a	r
m	BELOW MEDIAN	i	a	r
m	BELOW n SIGMA	i	a	r
m	BELOW n	i	a	r
m	ABOVE UPPER SPEC	i	a	r
m	ABOVE UPPER LIMIT	i	a	r
m	ABOVE CENTER LINE	i	a	r

m	ABOVE TARGET	i	a	r
m	ABOVE MEDIAN	i	a	r
m	ABOVE n SIGMA	i	a	r
m	ABOVE n	i	a	r
	SWED EISENHART TOO LITTLE VARIATION			b
	SWED EISENHART TOO MUCH VARIATION			b
	SWED EISENHART RUN			
	SWED EISENHART TREND			

NOTE 1: ASCENDING can be used in place of INCREASING.

NOTE 2: DESCENDING can be used in place of DECREASING.

Where the optional parameters are:

m represents "how many points"

(the numeric constants shown below are representative; you can specify any number):

Nothing

1

1 POINT

2

2 POINTS

2 of 3

2 of 3 POINTS

2 out of 3

2 out of 3 POINTS

a represents an expression in parentheses of these forms:

(N < constant)

(N > constant)

(N <= constant)

(N >= constant)

N represents "the number of subgroups of data." Other letters have no meaning, but are not critiqued.

r represents which chart type the test applies to:

Nothing (applies to all chart types)

Any combination of:

[XBAR]

[INDIVIDUALS]

[MEDIAN]

[RANGE]

[SIGMA]

[ATTRIBUTES]

[RUN]

[DIFFERENCE]

[DIFFERENCERANGE]

[ZED]

[ZED\*]

[ZEDWEIGHT]

[ZED\*WEIGHT]

[XBARASINDIVIDUALS]

[RANGE OF X BARS] [NO USE] (This allows specifying a Test, but not using it)

o represents:

Nothing

ONLY

i represents:

Nothing

INCLUSIVE

n represents:

Nothing

Numeric constant like 4

b represents:

Nothing (defaults to 1% risk)

(1% risk)

(5% risk)

- Custom test rules – You can specify a custom test if you need one that is not provided in CHARTrunner's list of predefined tests. In general, you can change the numeric part of a rule, as long as the rule still makes sense. For instance, you could customize the predefined rule “4 of 10 below 2 sigma” so that it becomes “6 of 11 below 2 sigma.” But if you specify “6 of 5 below 2 sigma,” that would not be accepted because it does not make sense.
- The “(N operator constant)” test qualifier – The optional parameter shown above allows you to append an expression like (N >= 20) to a test rule. For example, in the test “7 ascending only (n>=20),” the constant value of 20 refers to the number of subgroups that are “available for consideration” by the chart, so that the test will be applied to the chart only if the number of subgroups “available for consideration” by the chart is greater than or equal to 20 subgroups. What determines the number of subgroups that are “available for consideration” by the chart? Consider the following example. Assume that the data source returns 100 rows of data, and since you are not using *Advanced Row Selection*, the 100 rows of data will result in 100 subgroups that potentially can be charted. On the *Step 3: Data definition* tab of the chart definition, if the Result records to include field specifies “Last N = 30” or “First N = 30,” then only 30 subgroups out of the 100 subgroups are “available for consideration” by the chart. However, if the Result records to include field specifies “All” subgroups, then all 100 subgroups are “available for consideration” by the chart. While the chart is displayed, you can use the slider bar to adjust the number of subgroups currently displayed by the chart, or you can edit the chart definition and on the X-axis Y-axis sub-tab select Enable horizontal x-axis scrolling and specify the chart width. But neither of these has any effect on the number of subgroups that are “available for consideration” by the chart.
- The “only” test qualifier – When testing for a trend such as “7 ascending” or “7 descending,” two identical data values “in the middle” of the trend will be counted as “ascending.” If you do not want this behavior, then use the only qualifier in the test. If you specify the test as “7 ascending only” or “7 descending only,” then two identical values in the middle of a trend will not be counted as part of a trend - in other words, they will break the trend. When testing data for a run such as “7 above the mean,” the run may not start with two identical data values. However, if two identical data values appear “in the middle” of a run, they will be counted as part of the run.

## The Swed Eisenhart run test rules

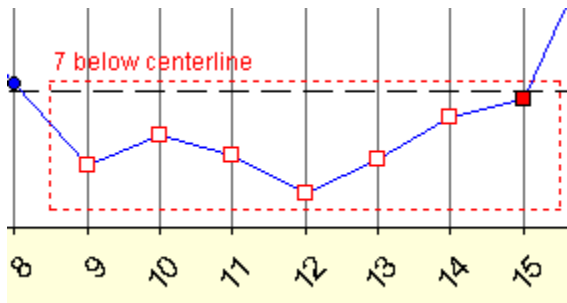
The Swed Eisenhart rules are used only on run charts. To determine if a point violates one of the rules, a lookup table is used. The lookup table is based on the number of data points on the chart and the number of runs present. When a data point violates a rule, it is displayed using the “OOC data” marker style that is defined by the style definition used by the chart.

The tests that are named too much variation and too little variation use two different lookup tables. These tables are calculated differently, based on the risk of failing the run test for random patterns of data. One table is based on a 1% risk, and one table is based on a 5% risk. This is why CHARTrunner offers both a 1% and a 5% version of the Swed Eisenhart tests.

If you have any doubt about which set to use, select the 1% tests. Different practitioners have different preferences for how sensitive they want these tests to be. For example, Bob Lloyd prefers the tests based on 1% risk where Lloyd Provost recommends the tests based on 5% risk.

## Out-of-control data markers

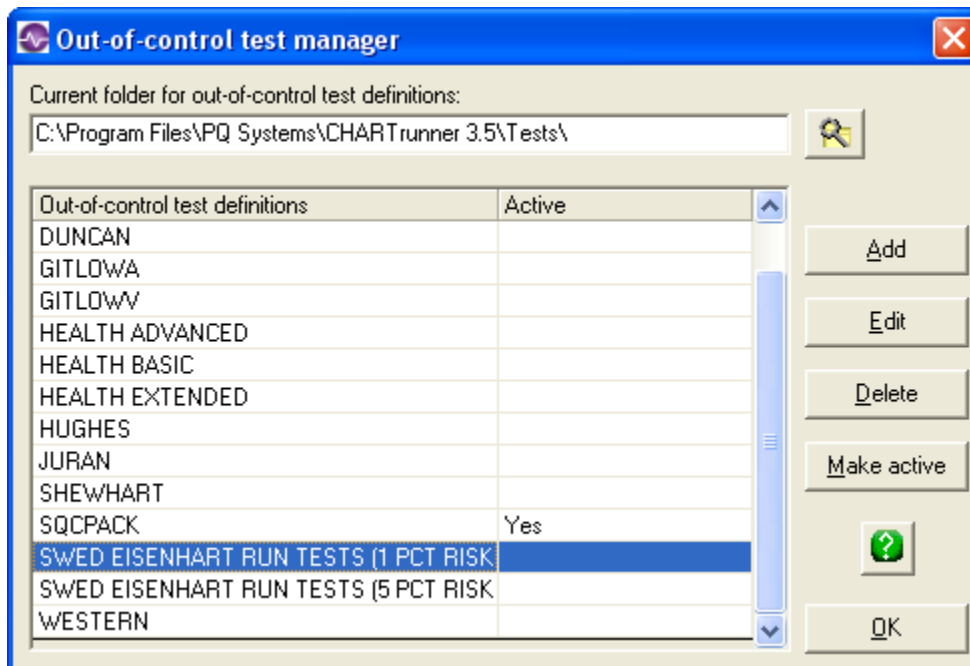
CHARTrunner flags data points that fail the out-of-control test conditions by using the “OOC data” marker style that is defined by the style definition used by each chart. In the figure shown below, the square data marker is used as the “OOC data” marker.



As shown in the figure above, points that contribute to a test failure, but are not actually failed points, are displayed using a hollow “OOC data” marker. Points that actually fail a test are displayed using a solid “OOC data” marker.

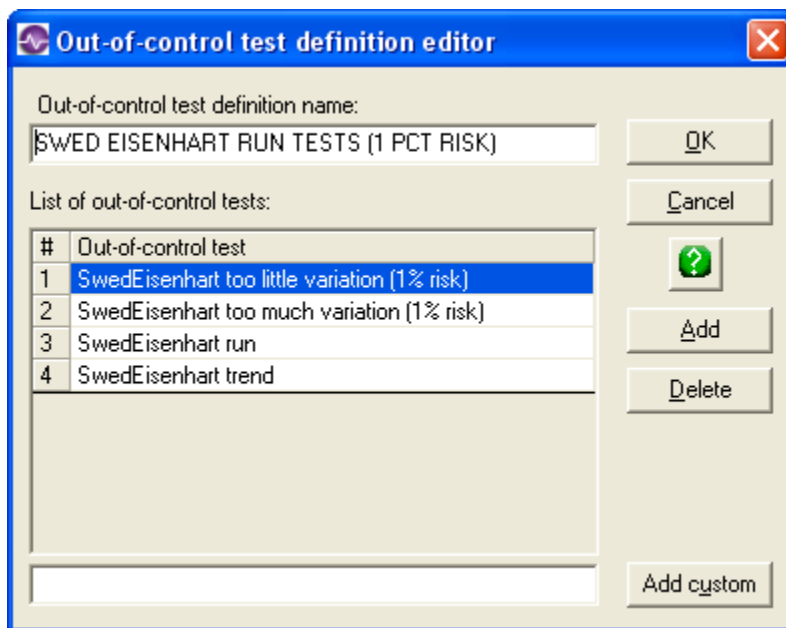
## To specify out-of-control tests

Use the Setup > Out-of-control tests menu on the main CHARTrunner window. The *Out-of-control test manager* form will open, as shown below, and display the out-of-control test definitions found in the specified folder.



- Set folder – This allows you to specify the location of the folder where the Out-of-control test definition files is located. By default this points to CHARTrunner's SysData folder. You might choose to keep a common set of Out-of-control test definition files on a network share instead.
- Add – This allows you to add a new out-of-control test definition. The *Out-of-control test definition* editor window shown below will open.
- Edit – This allows you to edit the currently highlighted out-of-control test definition. The Out-of-control test definition editor window shown below will open.
- Delete – This allows you to delete the currently highlighted out-of-control test definition.
- Make active – This allows you to specify the currently highlighted out-of-control test definition as the active one. In Setup > Preferences, if you specify to Use the same out-of-control tests for all charts, then the active out-of-control test definition will be used on all control charts (the tests defined in the chart definition will not be used). If Use the same out-of-control tests for all charts is not specified, the active set of out-of-control tests will be used as the default for any new chart definitions, as well as for older chart definitions that did not contain “per-chart” out-of-control tests.

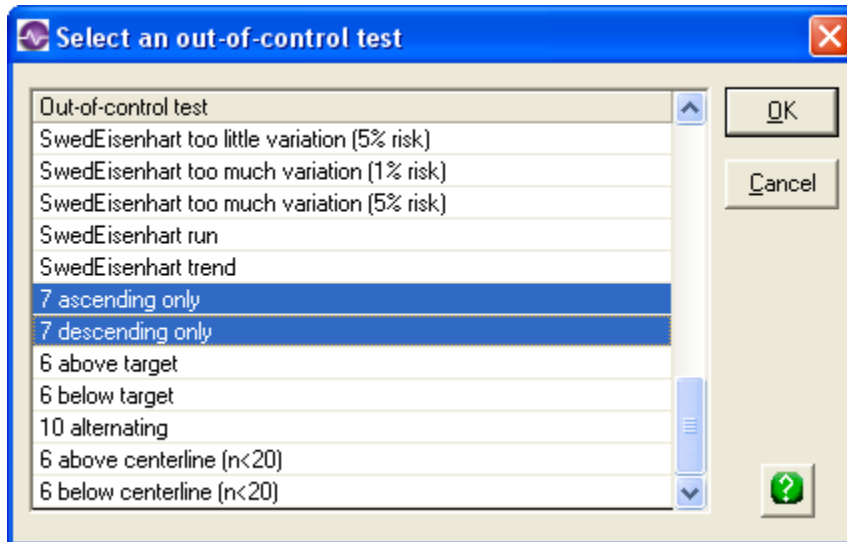
When the Add or Edit button is clicked, the following “Out-of-control tests editor” opens:





Out-of-control test definition name – Enter the name to identify this out-of-control test definition.

Add – Click this button to add a predefined test rule. The Select an out-of-control test window (shown below) opens to display the predefined test rules you may select from. Highlight the test rule or rules you desire to use (select multiple rules with Ctrl-Click) and click the OK button. Added rules are placed below the currently selected row in the list. Arrange the order of the test rules by clicking and dragging the rule number with the mouse.



- Delete – Highlight a test rule in the list and click the Delete button to remove the test from the list.
- Add custom – Click this button to add the custom test you entered in the field to the left of the Add custom button into the list of test.



## CHAPTER 10

# Dashboards

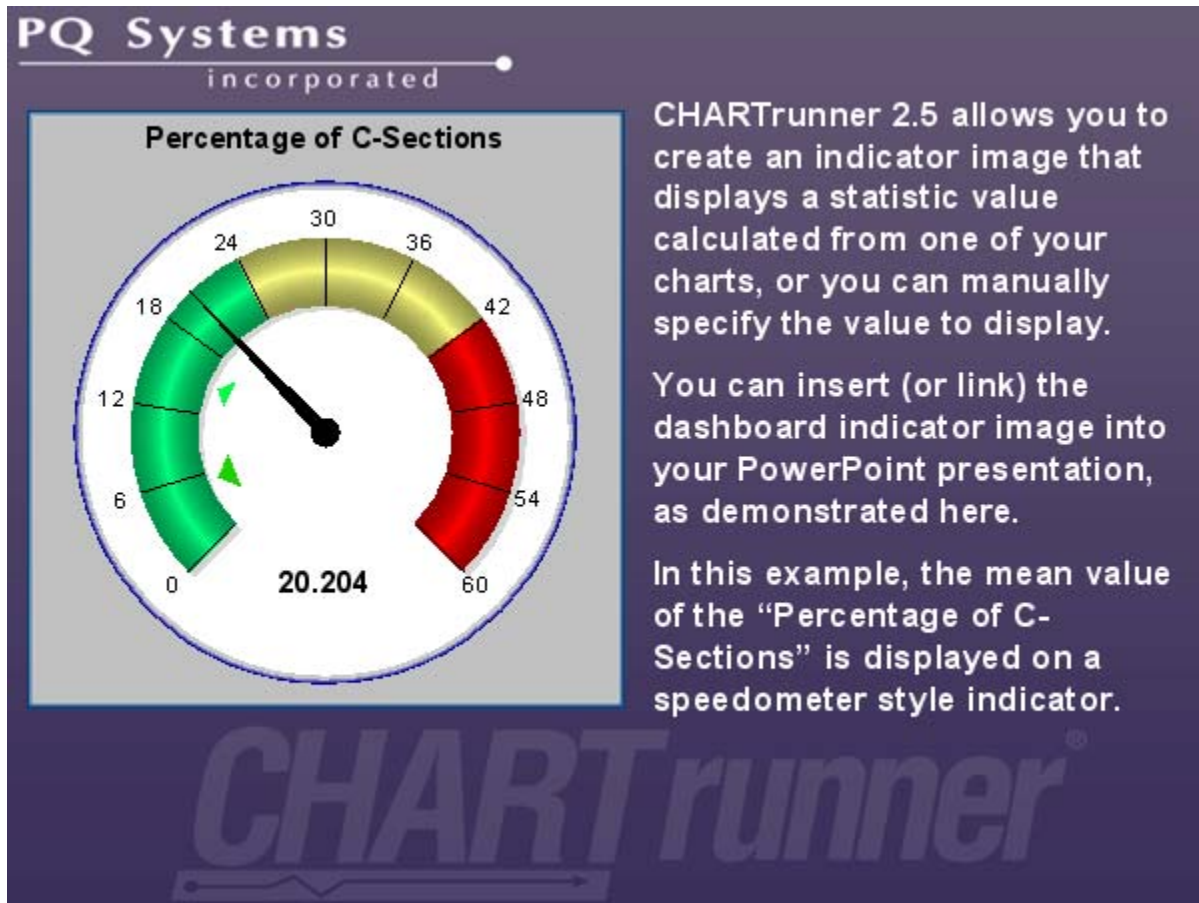
## In This Chapter

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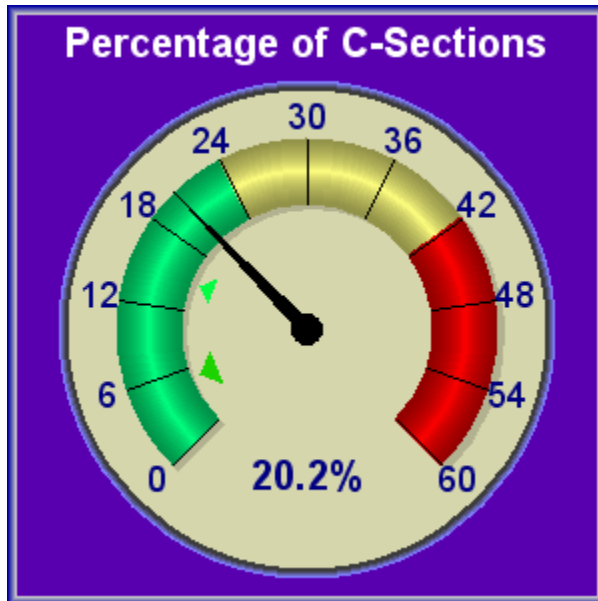
## Introduction to dashboards

CHARTrunner users sometimes need to present statistical information about their business processes to an audience that may not be familiar or comfortable with interpreting statistical process control charts. Charts present a lot of meaningful information about a process. In the best case scenario persons who are involved in understanding and improving processes within the company would use charts. But there can be times when a less complex presentation of key process metrics is useful.

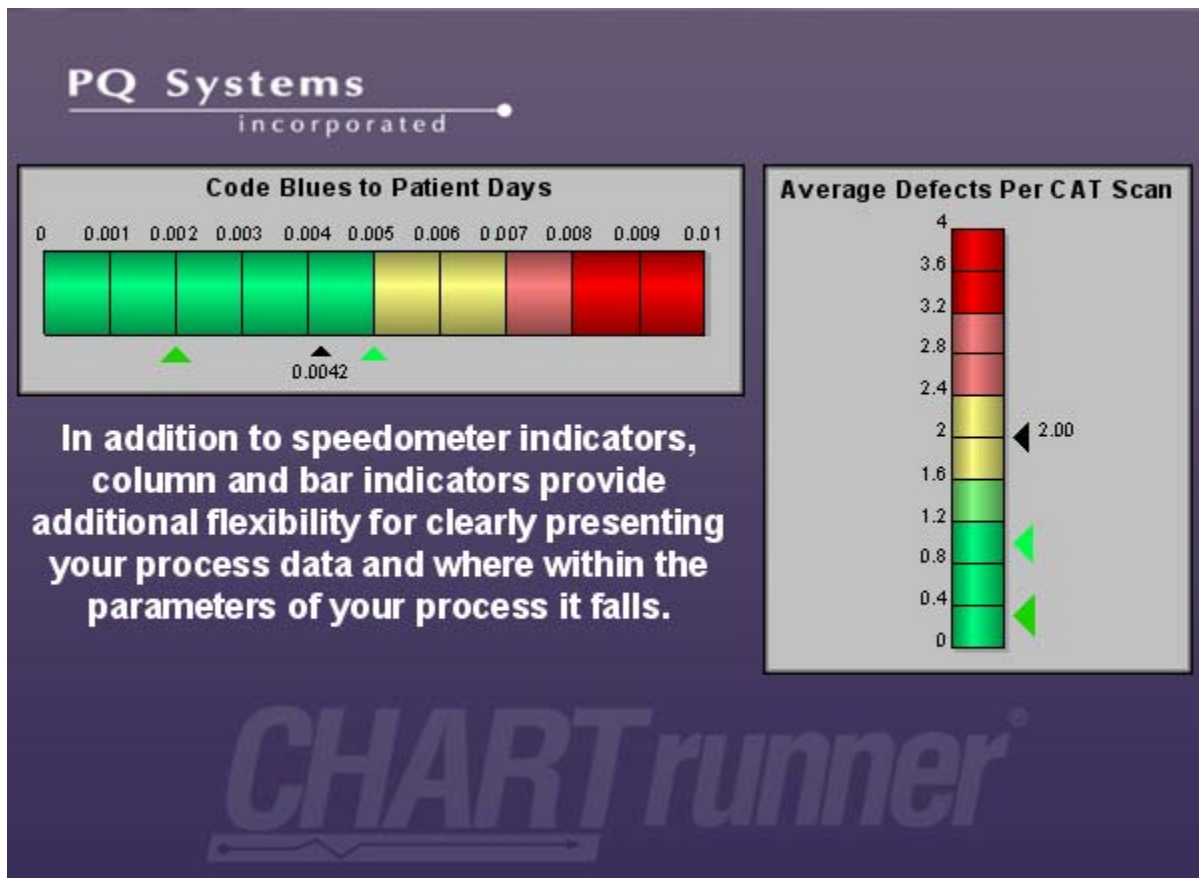
One way of presenting this process information is via a dashboard presentation, such as is illustrated by the following slide from one of the sample PowerPoint presentations that come with CHARTrunner.



CHARTrunner allows you to create dashboard indicators in the style of a speedometer (as shown above). In this example, the “Percentage of C-Sections” mean value is currently 20.204 percent. The goal of 15 percent is shown by the light green pointer, and the stretch goal of 5 percent is shown by the larger dark green pointer.



You can customize the size, colors, borders, fonts and title of each indicator. The speedometer indicator shown above has been customized to have a more colorful appearance than it did in the preceding sample PowerPoint slide.



In addition to speedometer indicators, CHARTrunner allows you to create indicators in the style of a vertical or horizontal bar graph (as shown above). You choose the indicator style that best presents information about your process.

Your indicators will be saved as image files. You use these indicator images to create visually appealing dashboard presentations using PowerPoint, Word, web pages, or any other presentation medium that allows you to insert or link your indicator images into the presentation.





# The basic steps of creating and using dashboards

Here are the basic steps you will follow to create and use CHARTrunner dashboards:

- Define your dashboard - Create your dashboard definition in CHARTrunner. Each named dashboard definition contains one or more indicator definitions. Each indicator definition describes the properties of a single dashboard indicator (speedometer, vertical bar or horizontal bar). Typically you will group similar indicators together into one dashboard definition. For example, you might put the fifteen indicators used in your monthly presentation to the board of directors in a dashboard definition called "Monthly Board Presentation."
- Update indicator values - Prior to creating or updating the indicator images for your presentation, you should ensure that the process value displayed by each indicator, and the goal pointer(s) on each indicator, accurately reflect the current state and goals of each process. Each indicator definition can be associated with a CHARTrunner chart definition, and the indicator value can be calculated from a statistic associated with the chart. It is very easy to update the calculated statistic value for each indicator in the dashboard. Just right-click on the dashboard in the CHARTrunner definition list and select Update indicator values from chart statistic. CHARTrunner will open the associated chart definition for each indicator, calculate the requested statistic value, and update the display value for the indicator.
- Generate new indicator images – You can easily generate a set of indicator images to use in your presentation. Just right-click on the dashboard in the CHARTrunner definition list and save the new indicator images into the folder that you specify.
- Use the new indicator images in your dashboard presentation – This can be a very easy step if you are using a presentation tool such as Word or PowerPoint that allows you to link rather than insert your indicator images into the presentation. Linked images are not physically stored in the presentation document. Thus whenever you update the images, the presentation uses the new images without any further work on your part. For more information on using linked images with PowerPoint, see ***Linking to Chart or Dashboard Images Using Microsoft PowerPoint or Word*** (on page 242).

## Working with dashboard definitions

You may use these means of working with a dashboard definition:

- Toolbar – When a dashboard is selected in the CHARTrunner definitions list, you may perform the following operations using the toolbar:
  - Click on the Edit the selected definition button  in the toolbar to edit the dashboard definition.
  - Click on the New definition button  in the toolbar to create a new dashboard definition.
  - Click on the Display the selected definition button  in the toolbar to display each indicator defined by the dashboard.
  - Click on the Delete the selected definition button  in the toolbar to delete the dashboard definition.

- **Double-click** – Double-click on a dashboard definition in the CHARTrunner definitions list, and the dashboard will either be displayed or opened for editing. Under Setup > Preferences you tell CHARTrunner which action to take when a definition is double-clicked.
- **Right-click menu** – You may right-click on a dashboard in the CHARTrunner definitions list to bring up a context menu (sometimes called a right-click menu) with these menu choices:
  - **Display** – Display each indicator defined by the selected dashboard. You may cycle through the available indicator images by using the arrow keys or by clicking on the navigation buttons at the bottom of the display window.
  - **Edit** – Edit the selected dashboard definition.
  - **Copy** – Make a copy of the selected dashboard definition and then edit the copied definition.
  - **Delete** – Delete the selected dashboard definition.
  - **Save all indicators as images to specified folder** – Create an image file for each indicator defined by the dashboard definition. CHARTrunner will ask you to specify the folder into which to save the indicator images. You must also specify what type of image to create (EMF or PNG). You have the option to create each image using the size in pixels defined by each indicator definition, or you can override that and generate all the indicator images using the height and width that you specify.
  - **Update all indicator images in specified folder** – Update an existing image file for each indicator defined by the selected dashboard definition. CHARTrunner will ask you to specify the folder that contains the indicator images to be updated. You do not specify the type of image file or the image size, because CHARTrunner gets that information from the image files that are already in the folder. In order for an image to be updated, it must be an EMF or PNG image, and the image filename must match the indicator name.
  - **Update indicator values from chart statistic** – CHARTrunner will open the associated chart definition for each indicator in the selected dashboard definition, calculate the specified statistic value, and update the display value for the indicator. Indicator definitions that have the Only permit manual update of the statistic value from chart option selected will not be updated.
  - **New dashboard** – Create a new dashboard definition.
- **Pull-down menu** – When a dashboard is highlighted in the CHARTrunner definitions list you may select options from the Dashboard menu. The available options are identical to those described above for the right-click menu.

## What type of image file should I use?

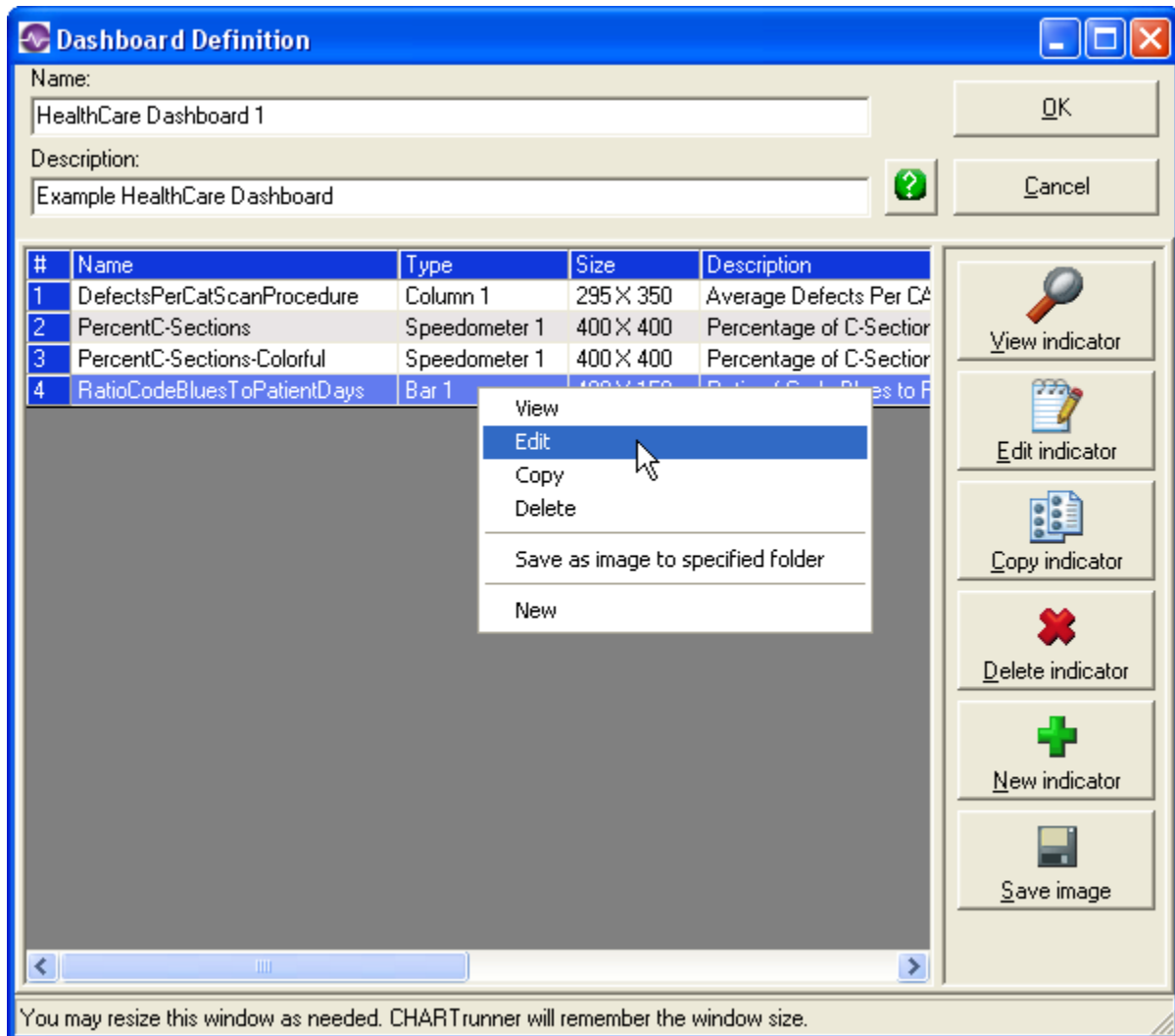
You have the option of creating an indicator image file as either an EMF or PNG image. Select an image type based upon the following criteria:

- a** **EMF (Enhanced MetaFile)** – EMF images resize in your presentation tool much better than PNG images do. Therefore, unless your target presentation is a web page, we recommend that you use EMF images.
- b** **PNG (Portable Network Graphics)** – Web browsers such as Internet Explorer or Firefox do not work well with EMF images, so use PNG images for your browser-based presentations.



## Dashboard definition

The following form is used to view and change the properties of a dashboard definition.



**Dashboard Definition**

Name: HealthCare Dashboard 1

Description: Example HealthCare Dashboard

#	Name	Type	Size	Description
1	DefectsPerCatScanProcedure	Column 1	295 X 350	Average Defects Per CA
2	PercentC-Sections	Speedometer 1	400 X 400	Percentage of C-Section
3	PercentC-Sections-Colorful	Speedometer 1	400 X 400	Percentage of C-Section
4	RatioCodeBluesToPatientDays	Bar 1	400 X 150	Ratio of Code Blues to P

View indicator  
Edit indicator  
Copy indicator  
Delete indicator  
New indicator  
Save image

You may resize this window as needed. CHARTrunner will remember the window size.

- Name – Enter the name that identifies the dashboard definition. This is the name that is displayed in the CHARTrunner definitions list.
- Description – Enter a description for this dashboard definition.
- Indicators Grid - The grid displays the name and other information about each indicator definition that is defined in this dashboard definition.
  - Name – The name of the indicator definition.
  - Type – The type or style of indicator: speedometer, vertical bar or horizontal bar.
  - Size – The default width and height of the indicator when it is saved as an image file.
  - Description – The description of the indicator.
  - Chart Definition – The full path to the associated chart definition for the indicator.

You may right-click on a row of the indicators grid, as shown in the figure above, and get a context menu with the following choices. The actions available via these context menu choices are also available using the buttons on the right side of the form.

- View – Display a sample of the selected indicator image.
- Edit – Edit the selected indicator definition.
- Copy – Make a copy of the selected indicator definition and then edit the copied definition.
- Delete – Delete the selected indicator definition.
- Save as image to specified folder – Create an image file for the selected indicator. CHARTrunner will ask you to specify the folder into which to save the indicator image. You must also specify what type of image to create (EMF or PNG). You have the option to create the image using the size in pixels defined by the indicator definition, or you can override that and generate the indicator image using the height and width that you specify.
- New – Create a new indicator definition.

## Indicator definition

The three tabs of the dashboard indicator definition form are used to view and change the properties of an indicator definition. A sample indicator image is displayed on the right side of the form. This image updates as the properties of the indicator are changed.

These fields are always visible no matter which tab is selected:

- Name – Enter the name that identifies the indicator. The name you specify here may only contain characters that are legal for a file name since this name determines the file name of the indicator graphic image file.
- Description – Enter a description for this indicator.
- Show indicator actual size – Select this option display the sample indicator image using the actual height and width in pixels. If this option is not selected the sample image will be scaled to fill as much of the form as is possible given the current size and aspect ratio of the form. You may resize the form using the standard Windows technique of dragging a corner of the window with the mouse.

## Indicator tab - indicator definition

**Dashboard Indicator Definition**

Name: DefectsPerCatScanProcedure

Description: Average Defects Per CAT Scan

**Indicator** | Scale | CHARTrunner Chart

Title: Average Defects Per CAT Scan

Indicator value: 2.00 Goal value: 1 Stretch goal value: 0.3

Indicator style: Column 1 ☒ Show goal markers

Decimal digits:

Title font: Arial, 15.75 pts, Bold

Scale font: Arial, 12 pts

☒ Show Outer Border ☒ Show Inner Border

Outer border: Outer background: Inner border: Inner background: Value marker: Goal marker: Stretch goal marker:

Indicator size (in pixels): 295 X 350

☐ Show indicator actual size

Average Defects Per CAT Scan

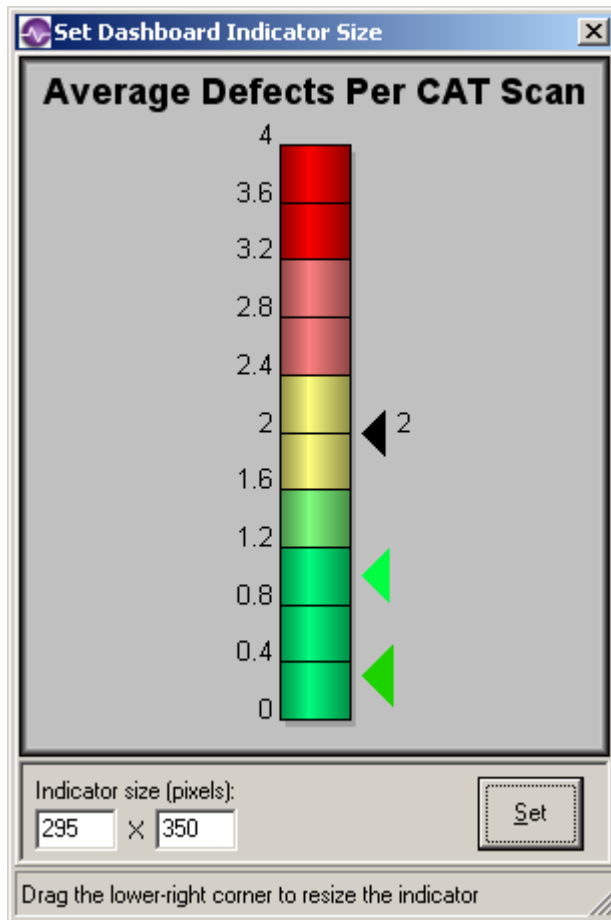
3.6  
3.2  
2.8  
2.4  
2  
1.6  
1.2  
0.8  
0.4  
0

2.00

You may resize this window as needed. CHARTrunner will remember the window size.

- Title – The optional title text to be displayed above the indicator.
- Indicator value – The numeric “indicator value” to be displayed by the indicator. If no value is entered the indicator will not display a value. This field and the Indicator statistic value field on the CHARTrunner Chart tab both display and allow you to change the “indicator value”.
- Goal value – The numeric value to be displayed by the goal marker. If no value is entered, or Show goal markers is not selected, the goal marker will not be shown on the indicator.
- Stretch goal value – The numeric value to be displayed by the stretch goal marker. If no value is entered, or Show goal markers is not selected, the stretch goal marker will not be shown on the indicator.
- Show goal markers – Select this option to enable displaying the goal and stretch goal markers on the indicator.
- Indicator style – Specifies the visual style of the indicator:
  - Bar 1
  - Column 1
  - Speedometer 1

- Decimal digits – Specify the number of decimal digits to display for the indicator value label. Leave this blank if you want the maximum available number of decimal digits to be displayed.
- Title font – Specify the font properties and color used for the title font. This font is also used for the label associated with the indicator value.
- Scale font – Specify the font properties and color used for labeling the scale values.
- Show Outer Border – Specify whether or not to draw the outer border.
- Show Inner Border – Specify whether or not to draw the inner border. The inner border is used only for the speedometer indicator.
- Outer border (color) – Specify the color of the outer border.
- Outer background (color) – Specify the color of the outer background area of the indicator.
- Inner border (color) – Specify the color of the inner border. The inner border is used only for the speedometer indicator.
- Inner background (color) – Specify the color of the inner background area of the indicator. The inner background is used only for the speedometer indicator.
- Value marker (color) – Specify the color of the marker used to indicate the current value of the indicator.
- Goal marker (color) – Specify the color of the goal marker.
- Stretch goal marker (color) – Specify the color of the stretch goal marker.
- Indicator size (in pixels) – The current width and height (in pixels) of the indicator is displayed. Click the Set Indicator Size button to change the size.
  - Set Indicator Size – Click this button to set the current height and width of the indicator. The following Set Dashboard Indicator Size window will open. Drag the lower-right corner of the window using the mouse to visually adjust the size of the indicator. Or, enter the size you want in the width and height fields at the lower-left. Click the Set button to apply the changed size to the indicator. Press the Esc key, or click the close button in the upper-right corner, to close the window without changing the indicator size.



## Scale tab - indicator definition

This tab allows you to specify the color and value assigned to each segment of the indicator. You can specify up to ten segments, but you can use fewer than ten segments if you so desire.

**Dashboard Indicator Definition**

Name: DefectsPerCatScanProcedure

Description: Average Defects Per CAT Scan

Indicator **Scale** CHARTrunner Chart

Scale option: Custom scale Value for 0: Value for 100 ☒ Show scale

Scale Value:	Color:
1 0	Green
2 0.4	Green
3 0.8	Green
4 1.2	Green
5 1.6	Yellow
6 2	Yellow
7 2.4	Red
8 2.8	Red
9 3.2	Red
10 3.6	Red
11 4	Red

Defaults Clear Auto Scale Remove Unused

☐ Show indicator actual size

Average Defects Per CAT Scan


3.6  
3.2  
2.8  
2.4  
2  
1.6  
1.2  
0.8  
0.4  
0

2.00

You may resize this window as needed. CHARTrunner will remember the window size.

- Scale option – Select from one of these scaling options:
  - Custom scale – The “indicator value” is used directly, without any transformation.
  - Percentage scale – The Indicator value, Goal value and Stretch goal value are transformed into a percentage between Value for 0 and Value for 100, and the calculated percentage value is displayed by the indicator. The percentage calculation formula is:  

$$\text{Percent} = 100 * ((\text{DataValue} - \text{ValueFor0}) / (\text{ValueFor100} - \text{ValueFor0}))$$
  - Value for 0 – Specify the data value that corresponds to zero percent.
  - Value for 100 – Specify the data value that corresponds to 100 percent.

- **Show scale** – Select this option to show the scale value for each segment of the indicator. The first and last scale values are always shown, regardless of whether this option is selected or not.
- **Scale Value** – Specify the scale value assigned to each segment of the indicator. You can specify up to ten segments, but you can use fewer than ten segments if you so desire.
- **Color** – Specify the color assigned to each segment of the indicator. Click  to open the color selection dialog. When the color rectangle has focus, press Ctrl-C to copy the current color to the clipboard. Afterwards, you may click on a different color rectangle and press Ctrl-V to paste the color from the clipboard. This technique allows you to quickly assign the same color to multiple color slots. You may press the Delete key to set the color to white.
- **Defaults** – Click to assign default scale and color values to the indicator segments.
- **Clear** – Click to clear all scale value fields, and assign white as the color for all segments.
- **Auto Scale** – Click to have CHARTrunner automatically assign scale values to empty slots that are bounded by a lower and upper value. The following examples illustrate how this works:

Before	0				10						
After	0	2.5	5.0	7.5	10						

Before	100					500					
After	100	180	260	340	420	500					

Before	0.0										1.0
After	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0

- **Remove Unused** – Click to remove the first empty scale value slot. Subsequent value and color slots are moved to fill in the removed slot. The following example shows what happens after this button is clicked twice.

Before	0.0	0.1	0.2			0.5	0.6	0.7	0.8	0.9	1.0
After	0.0	0.1	0.2	0.5	0.6	0.7	0.8	0.9	1.0		



## CHARTrunner chart tab - indicator definition

This tab allows you to specify the associated CHARTrunner chart for the indicator, and the statistic value to be calculated from the associated chart.

The screenshot shows the 'Dashboard Indicator Definition' dialog box with the 'CHARTrunner Chart' tab selected. The 'Name' field contains 'DefectsPerCatScanProcedure' and the 'Description' field contains 'Average Defects Per CAT Scan'. The 'CHARTrunner chart definition' field contains the path '[:AppPath:]\\SampleCharts\\Healthcare\\Attributes control chart 02 (health).crf'. The 'Indicator statistic value' is set to '2.00'. The 'Statistic from chart' dropdown is empty. The 'Update Statistic Value from Chart' button is visible. The 'Only permit manual update of the statistic value from chart' checkbox is unchecked. On the right, there is a preview of a vertical bar chart titled 'Average Defects Per CAT Scan' with a scale from 0 to 3.6. The current value of 2.00 is indicated by a yellow bar. A note 'Show indicator actual size' is present above the chart preview.

**Dashboard Indicator Definition**

Name: DefectsPerCatScanProcedure

Description: Average Defects Per CAT Scan

Indicator | Scale | **CHARTrunner Chart**

CHARTrunner chart definition: [:AppPath:]\\SampleCharts\\Healthcare\\Attributes control chart 02 (health).crf

Display Chart Edit Chart

Indicator statistic value: 2.00

Statistic from chart:

Update Statistic Value from Chart

☐ Only permit manual update of the statistic value from chart


☐ Show indicator actual size

Average Defects Per CAT Scan

3.6  
3.2  
2.8  
2.4  
2.0  
1.6  
1.2  
0.8  
0.4  
0

2.00

You may resize this window as needed. CHARTrunner will remember the window size.

- **CHARTrunner chart definition** – Specify the full or relative path to the associated chart definition file. Click the file selection button  to open the file selection dialog. In the example shown above the full path to the definition file is specified. And, the [[:AppPath:]] macro is used to specify the folder where CHARTrunner is installed. If only the relative path “Attributes control chart 02 (health).crf” were specified, then CHARTrunner would look in the current working folder for that chart definition.
- **Display Chart** – Click this button to display the associated chart in a new window.
- **Edit Chart** – Click this button to edit the associated chart definition.
- **Indicator statistic value** – The numeric “indicator value” to be displayed by the indicator. If no value is entered the indicator will not display a value. This field and the Indicator value field on the Indicator tab both display and allow you to change the “indicator value”.
- **Statistic from chart** – Specify the statistic value that you want to compute from the associated chart definition.
- **Update Statistic Value from Chart** – Click this button to have CHARTrunner open the associated chart definition, calculate the statistic value specified by Statistic from chart, and ask you whether or not to place the newly calculated statistic value in the Indicator statistic value field.
- **Only permit manual update of the statistic value from chart** – Select this option to prevent this indicator definition from having its statistic value calculated and updated when the user chooses Update indicator values from chart statistic on the dashboard definition form.

## CHAPTER 11

# Cpk Advisor Analysis

## In This Chapter

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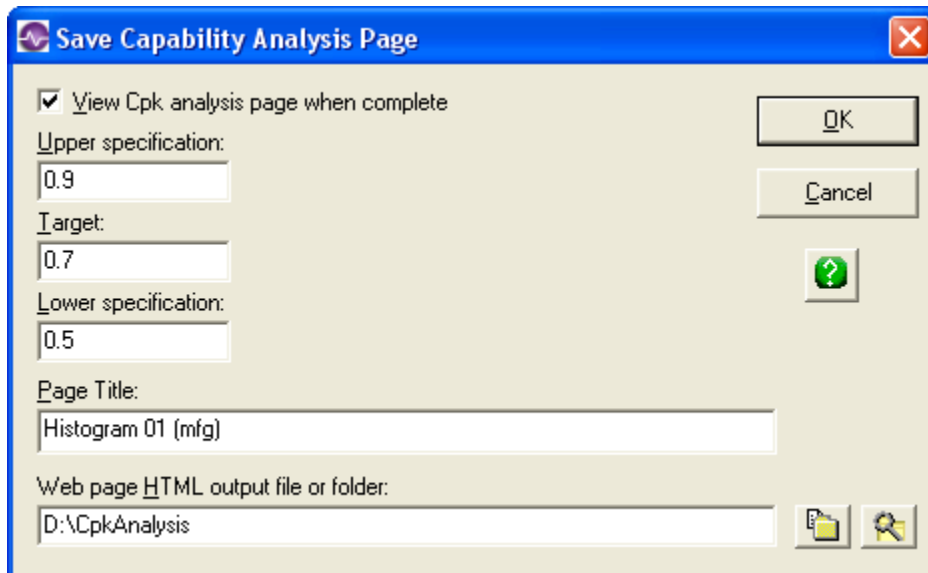
## Introduction to Cpk Advisor Analysis

For any histogram you create in CHARTrunner you may generate a Cpk Advisor Analysis. This analysis explains the capability statistics in an easy to read text form. Reading the analysis can help you interpret and understand the various and potentially confusing capability statistics.

## The basics steps to create a Cpk Advisor Analysis

There are two ways to begin when viewing the Cpk Advisor Analysis. The first is to display any histogram chart and then select File/Save Cpk Advisor Analysis from the pull-down menu. The second way is to right click on any histogram definition on the main form. When the right click menu is displayed, select Save Cpk Advisor Analysis.

When you make the menu selection, the following form will be displayed:



**Save Capability Analysis Page**

☒ View Cpk analysis page when complete

Upper specification: 0.9

Target: 0.7

Lower specification: 0.5

Page Title: Histogram 01 (mfg)

Web page HTML output file or folder: D:\CpkAnalysis

OK Cancel ? [File Explorer Icon] [Search Icon]

You may change settings on this form and then click OK to display the Cpk Advisor Analysis. Following is an overview of the settings:

- View Cpk analysis page when complete – The output from a Cpk analysis is an HTML file on the disk. Check this box if you want to launch your Internet browser and view the results. Leave the box unchecked if you only want to generate the file.
- Upper specification – Enter the upper specification for this analysis. If the chart definition already has an upper specification defined it will be displayed. However, you may override this to do what if analysis.
- Target – Enter the target specification for this analysis. If the chart definition already has a Target specification defined it will be displayed. However, you may override this to do what if analysis.
- Lower specification – Enter the upper specification for this analysis. If the chart definition already has a lower specification defined it will be displayed. However, you may override this to do what if analysis.  
To compute the capability statistics requires at least one of the upper or lower specifications, or both to be entered.
- Page Title – Enter text that you would like to appear at the top of the Cpk Advisor Analysis page.
- Web page HTML output file or folder – Use the buttons at the right to browse for either a folder or a specific file where you want the Cpk Advisor Analysis to be saved. If you specify only a folder, the chart definition's file name will be used as the file name; it will have .htm as a file extension.

## How the Cpk Advisor Analysis works

The output from a Cpk Advisor Analysis is a web page file (.htm file). When you click OK to view the analysis, your web browser will be launched. It will display the contents of the Cpk Advisor Analysis output file.

To create the output file, the software uses one of several template files. These templates are stored in the \SysData folder under the folder where you installed CHARTrunner. The main template is named CpkWebTemplate.htm and there are some template fragments that are also used. They have names like CpkDetails1.txt, CpkDetails2.txt, etc.

Depending on the statistics that get calculated, the output file will be based on the main template and one of the template fragments.

You may customize the main template. For example, you could put your company logo in the page. Be sure to make a backup copy of the original before you begin making changes.

Note that a Cpk Advisor Analysis can also be generated by a command line parameter.



## CHAPTER 12

# OOC Summary

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## Introduction to OOC Summary

OOC stands for out-of-control. The OOC Summary feature allows you to scan many different control charts, count the number of out-of-control conditions in each chart, and then view them in a ranked list. Double clicking on a chart in the list displays the underlying chart.

The benefit of using OOC Summary is that you look only at the control charts which actually need attention. Imagine that you have 50 important control charts. Most of the time, they are stable and in-control; occasionally, some of them show a few out-of-control conditions. Rather than look at them all to find the few that need attention, OOC Summary allows you to zero in on the problems and then get on with your work.

---

## Displaying the OOC Summary form

OOC Summary works on a chart workspace. A chart workspace is just a named collection of charts. If you do not already have a workspace you must create one. Give it a good name, include all the control charts you want to evaluate, and then save it.

On the main form, be sure the list of charts is set either to All charts or Workspaces. Use the buttons on the left to control what shows in the list.

Click once to select your workspace. Next, right click to display the context menu, then select Display out-of-control summary from the menu. The out-of-control summary form will be displayed:

Name	Description	Chart type	Number out of control
Attributes control chart 01 (mfg)	Horizontal grid lines	p-chart	?
Attributes control chart 02 (mfg)	Data above the chart	c-chart	?
Attributes control chart 03 (mfg)	Displays data values near each data point	u-chart	?
Attributes control chart 04 (mfg)	Temporary limits	np-chart	?



## OOC Summary form settings

When the form is first displayed, it shows your charts in the same order they are in the workspace. Under the column named Number out-of-control you will see question marks. Once the charts are evaluated, you will see numbers in place of the question marks. Note that you may resize each column displayed in this form. CHARTrunner will remember your preferences and show them with the new size from now on.

- **Refresh every** – The out-of-control summary form can be set to refresh the list of charts every so often. This is useful in situations where you have a regular flow of data into the data sources underlying the charts in your workspace. Enter a number here. For example to refresh every hour, enter a '1'.
- **Time units** – Select from the drop down list the time units for your refresh interval; minutes, hours, etc.
- **Analyze** - Select the Analyze option you prefer. If you want to look at the number of data rows as defined by the chart, select Analyze data rows defined by each chart. If you want each chart in the workspace to look back the same number of rows, then select Analyze Last N rows where N is and then be sure to enter a value for N.

NOTE: you may leave the Refresh every and Time units empty if you do not want to use the automatic refresh option.

- **Start** – Click this button to have the OOC Summary evaluate and rank your charts. If you are using a refresh interval, then the list will be evaluated and resorted at each interval until you close the window or click the Stop button.

Once OOC Summary has evaluated the charts in your workspace it will reorder them so the charts having the highest number of out-of-control conditions are the top of the list.

At any time you may view the actual chart by double clicking on it in the list or selecting Chart > Display from the menu. When you close the chart, the OOC Summary form will still be visible.



---

## CHAPTER 13

# System settings

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## Menu functions (for the main window) right-click context menus

Right-click on any item in the CHARTrunner definitions list to open a pop-up context menu listing menu choices appropriate for that item.

## File menu functions

The File menu functions are:

- **Edit definition** – This opens the definition editor for the currently selected definition in the CHARTrunner definitions list.
  - **New definition** – This creates a new chart, dashboard or style definition, depending on which section of the CHARTrunner definitions list is currently selected.
  - **CHARTrunner printer** – This allows you to specify the printer to be used by default for printing charts. You can also specify the printer margins used by CHARTrunner.
  - **Set folder containing charts** – This allows you to specify the folder you want to set as the current working folder. The chart and dashboard definitions displayed in the CHARTrunner definitions list are the ones that are found in the current working folder.
  - **Exit** – Select Exit to close CHARTrunner.
-

## Edit menu functions

The Edit menu functions are:

- Find – This allows you to search for a chart definition in the CHARTrunner definitions list. Enter a search word or phrase in the Find What field. Specify whether to search in the chart's Name and/or Description fields. To search for the complete word or phrase only, select Find Whole Word Only. To search for the word or phrase as typed, select Match Case. The shortcut for Find is Ctrl-F.
- Find Next – This allows you to repeat a search that was established using Find. The shortcut for Find Next is F3.
- ADO Data source templates – This allows you to manage your ADO Data source templates. See **ADO Data source templates** (see "If you select ADO as the type of data source" on page 85) topics for more information.

## View menu functions

The View menu functions are:

- Toolbar – Select this to toggle whether the toolbar is visible or not.
- Small icons – Select this to use small toolbar icons.
- Large icons – Select this to use large toolbar icons.
- Tool tips – This determines whether or not tool tip messages are displayed when the mouse pointer hovers over an area where a tool tip has been defined. You can turn on tool tip messages if you find them to be helpful, or turn them off if they distract you.
- Font – This allows you to specify the font and size used in the CHARTrunner definitions list.
- Refresh – This allows you to update the list of definitions shown in the CHARTrunner definitions list. The shortcut for Refresh is F5.
- Chart from clipboard – This allows you to chart data that is currently residing on the Windows clipboard. For more information see **Charting from data on the clipboard**.

## Setup menu functions

The Setup menu functions are:

- Out-of-control tests – This allows you to manage your out-of-control test definitions. See the **Out-of-control Tests** topic for more information.
- Language – This allows you to select a different language for CHARTrunner. Contact PQ Systems for more information about the availability of languages other than English.
- Preferences – This allows you to specify various preferences that affect the way CHARTrunner operates. See the **Preferences** topic for more information.
- Recent folder options – This allows you to specify the number of "recently used folders" that CHARTrunner remembers. You can also clear the list of recently used folders.

# Chart styles

Chart styles contain chart color, font, line, and data marker settings. CHARTrunner allows users to create an unlimited number of chart style definitions for each chart type, for example a different style for each customer or product line.

## Creating new styles

To create a new style:

1. On the System section of the CHARTrunner Tree, right-click on the type of chart for which you want to create a new style definition.
2. Select New Style from the pop-up menu. The Chart style definition editor will open.
3. Enter a style name (required) and Description (optional) for this style definition.

**Control chart styles**

Style name:  
My New control chart style

Description:

Backgrounds	Color	Pattern
Page background		
Chart background		
Zone 1		
Zone 2		
Zone 3		
Zone 4		
Cell background		

Lines	Color	Width	Style
Page outline			
Chart outline			
Data 1			
Data 2			

Default OK Cancel

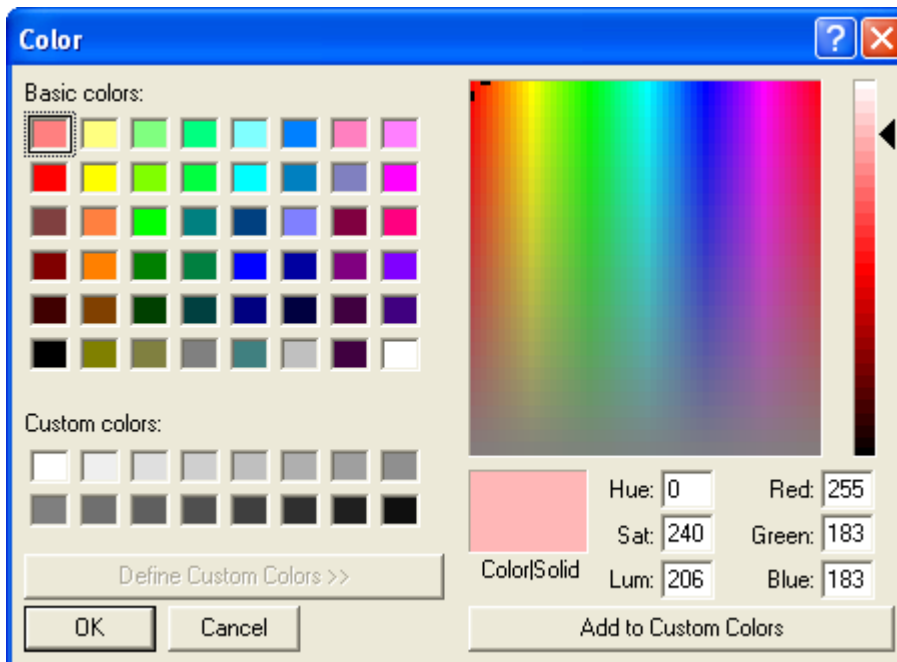
4. Make desired changes to the default settings. Instructions for each type of chart element will be described in the topics that follow.
5. Click the OK button to save your settings.

NOTE: Styles are normally saved in the Styles folder. However, if you use CHARTrunner-e, you may want to copy a style to the working folder. If a chart style in the working folder has the same name as a chart style in the Styles folder, the style in the working folder will be used. Also, if a style in the working folder has the same name as the chart definition (CRF) file, and the chart definition does not specify a chart style, CHARTrunner will use the style with the same name as the chart.

## Chart colors

You can set the color for the page and chart backgrounds, fonts, sigma zones, lines, and data markers. To select a color:

1. Click on the Color field. The Color form will open.



2. Click on the color that you want to use for this chart element and click the OK button.

## Patterns

You can select a pattern for the page and chart backgrounds, and sigma zones. To select a pattern:

1. Click on the Pattern field. The Pattern form will open.
2. Click on the pattern that you want to use for this chart element. The pop-up menu will close.

## Lines

In addition to line color, you can set line width and style.

To change line width:

1. In the Lines width column, click on the line that you want to edit. A pop-up menu will show the available line widths.
2. Click on the width that you want. The pop-up menu will close.

To change the line style:

1. In the Lines style column, click on the line that you want to edit. A pop-up menu will show the available line styles.
2. Click on the width that you want. The pop-up menu will close.

## Font options

In addition to font color, you can select a font face, size, and style. For some chart text, you can specify Alignment or angle.

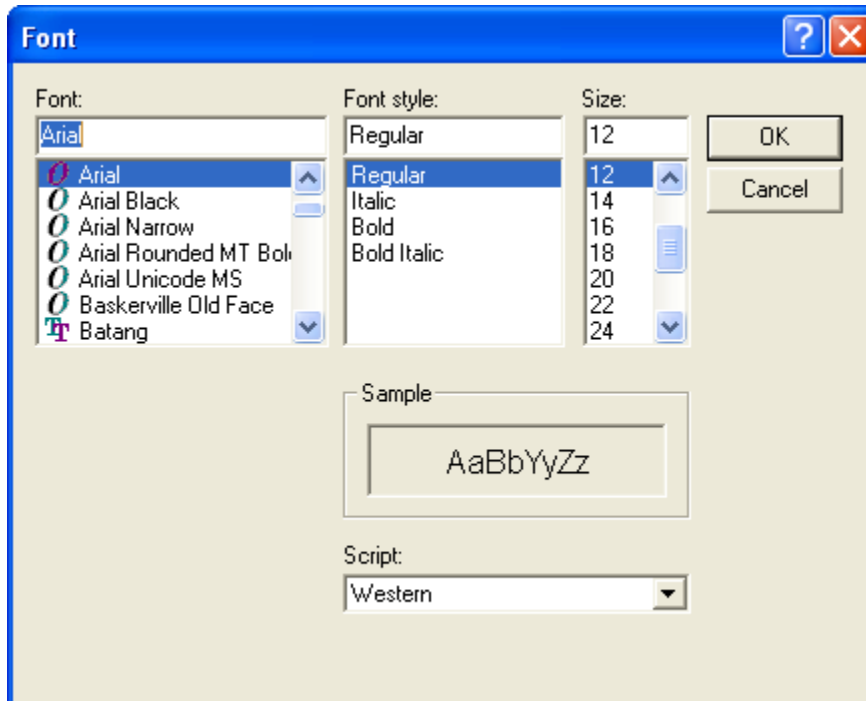
1. To change the font face or size, click in the Name or Size column for the title or label that you want to edit.
2. Select a font, font style, and font size for the selected chart property. Then, click the OK button to close the Font form.

To make a title or label bold:

- Click on the Bold font style.

To make a title or label italic:

- Click on the Italic font style.



## Angle

You can adjust the X-axis label's angle to prevent labels from overlapping on a crowded chart.

- Click on the Angle field and scroll up or down to find the desired angle. You can also type the angle into this field.

## Data markers

You can set the style and size of data markers.

### Marker style

1. Click in the Style column for the marker that you want to edit. A pop-up menu will show the available marker styles.
2. Click on the style that you want. The pop-up menu will close.

NOTE: Data markers are the same color as the data line. However, you can set marker colors for caused and out-of-control subgroups, and for the median charts, the median data point.



## Marker size

- Click in the Size column for the marker that you want to edit and scroll up or down to find the desired size.

## Modifying styles

To modify an existing chart style:

1. In the CHARTrunner definitions list, right-click on the name of the chart style that you want to modify.
2. Select Edit from the pop-up menu. This opens the Chart style form.
3. Make desired changes.
4. Click on the OK button.

You can also access the Edit function through the Style Menu.

## Copying styles

To copy a chart style:

1. In the CHARTrunner definitions list, right-click on the name of the chart style that you want to copy.
2. Select Copy from the pop-up menu. This opens the Chart style form.
3. Enter a name for the copied style and click on the OK button.

You can also access the Copy function through the Style Menu.

## Deleting styles

To delete a chart style:

1. In the CHARTrunner definitions list, right-click on the name of the chart style that you want to delete.
2. Select Delete from the pop-up menu. You will be prompted to confirm the delete. Click on the Yes button.

You can also access the Delete function through the Style Menu.

## CHARTrunner file extensions

CHARTrunner uses the following file extensions:

Dashboard definition	CRD
Chart definition	CRF
Multi-chart definition	CRM
Control chart style definition	CSC

Histogram style definition	CSH
Pareto style definition	CSP
Workspace definition	CRW
Out-of-control tests definition	OOO
Pre-2.0 version style definition	CST

## CST file extensions

All Pre-2.0 version styles used CST as the file extension. The new 2.0 (and higher) version replaces CST file extension with three new file extensions (CSC, CSH, CSP) for better control and organization.

The chart definition refers to the style definition to be used for that chart by “style name” only. In other words, there is no information about what folder the style will be found in and no information about what file extension the style will have.

When CHARTrunner is told to fetch the style definition that is named by a chart definition, here are the rules it follows to determine what style definition to actually use:

### Rule 1

If no style name has been specified, use the style definition in the chart folder having the same name as the chart definition, if it exists. This is the “per-chart” style definition. If a (.CSC, .CSP, or .CSH as appropriate) style definition is found, then use it. Else, if a .CST (pre-2.0) style definition is found, then use it (no check is made to assure that the .CST style actually contains the appropriate type of style definition). If the user edits the style while the chart is displayed and a .CST style is being used, when the style is saved it will be saved with the appropriate (.CSC, .CSP, or .CSH) style extension.

### Rule 2

If a style name has been specified and it specifies the full path to the style definition, use it. This “full path” mode is used only in specialized cases (such as SDK programming), because the “Edit Chart Definition” user interface does not allow the user to enter the path to the style definition.

### Rule 3

If a style name has been specified, assume the style definition is found in the current chart folder. If a (.CSC, .CSP, or .CSH as appropriate) style definition is found, use it. Else, if a .CST (pre-2.0) style definition is found, use it (no check is made to assure that the .CST style actually contains the appropriate style definition) - this is done so that if someone points CHARTrunner 2.0 (and higher) to a chart folder containing pre-2.0 charts and styles and one or more charts are using a “per-chart” style definition, the old “per-chart” style will be used.

### Rule 4

If a style name has been specified and it was not found by Rule 3 in the chart folder, assume the style definition (.CSC, .CSP, or .CSH as appropriate) exists in the Styles folder. In normal use most styles will live and be found in the Styles folder because most users are not aware that leaving the style name blank in the chart definition invokes “per-chart” style mode.

Final Rule. If the style definition specified by the chart definition cannot be found, the “Default” chart style will be used. If the “Default” chart style cannot be found, then an “internal program default” chart style definition is used.

The definitions list on the main form does not show any .CST style definitions - it displays only .CSC, .CSP, or .CSH style definitions. If a user has upgraded from a prior version of CHARTrunner and wants to copy the old style definitions into the 3.5 installation Styles folder, it is up to the user to rename the style definition files to have the appropriate .CSC, .CSP, or .CSH file extension.

## ADO data source templates

One of the ways CHARTrunner can get to data for creating charts is via ADO. ADO stands for ActiveX Data Objects. This Microsoft technology allows for access to a wide variety of data sources. If you have data in SQL Server or Oracle, you may want to access this data for CHARTrunner charts via ADO.

On the *Step 2: Data Source* tab of the chart definition form, you must enter information into the Connection string field in order to use a specific ADO data source. To make the job of specifying the connection string for a given ADO provider easier, CHARTrunner keeps a list of ADO data source templates that can be selected via the ADO;OLE DB Provider drop-down list. When a selection is made from the ADO;OLE DB Provider drop-down list, the Connection string field will be updated with a prototype connection string for the selected ADO provider. A selection from the ADO;OLE DB Provider drop-down list is not required when defining a chart. Instead, you can type in the necessary information directly into the Connection string field.

The ADO connection templates are stored in the Ado.ini file located in CHARTrunner's SysData folder.

To create, modify, and save an ADO template, select Edit > ADO data source templates from the menu, and the following form opens.

**ADO connection templates**

ADO connection templates

- MS Remote - SQL Server - OLE DB with RDS DataFactory Handl
- ODBC Driver for Access - Standard security
- ODBC Driver for Access - Workgroup security
- ODBC Driver for dBASE
- ODBC Driver for Excel 97/2000
- ODBC Driver for SQL Server - Standard security**
- ODBC Driver for SQL Server - Trusted Connection security

Create new

Delete

Modify

Help

Currently selected template:

Name:

ODBC Driver for SQL Server - Standard security

Save

User Name (optional):

Build

Password (optional):

Connection string:

Driver={SQL Server}; Server=<server>; DataBase=<database>; Uid={{USER}}; Pwd={{PASSWORD}};

Close

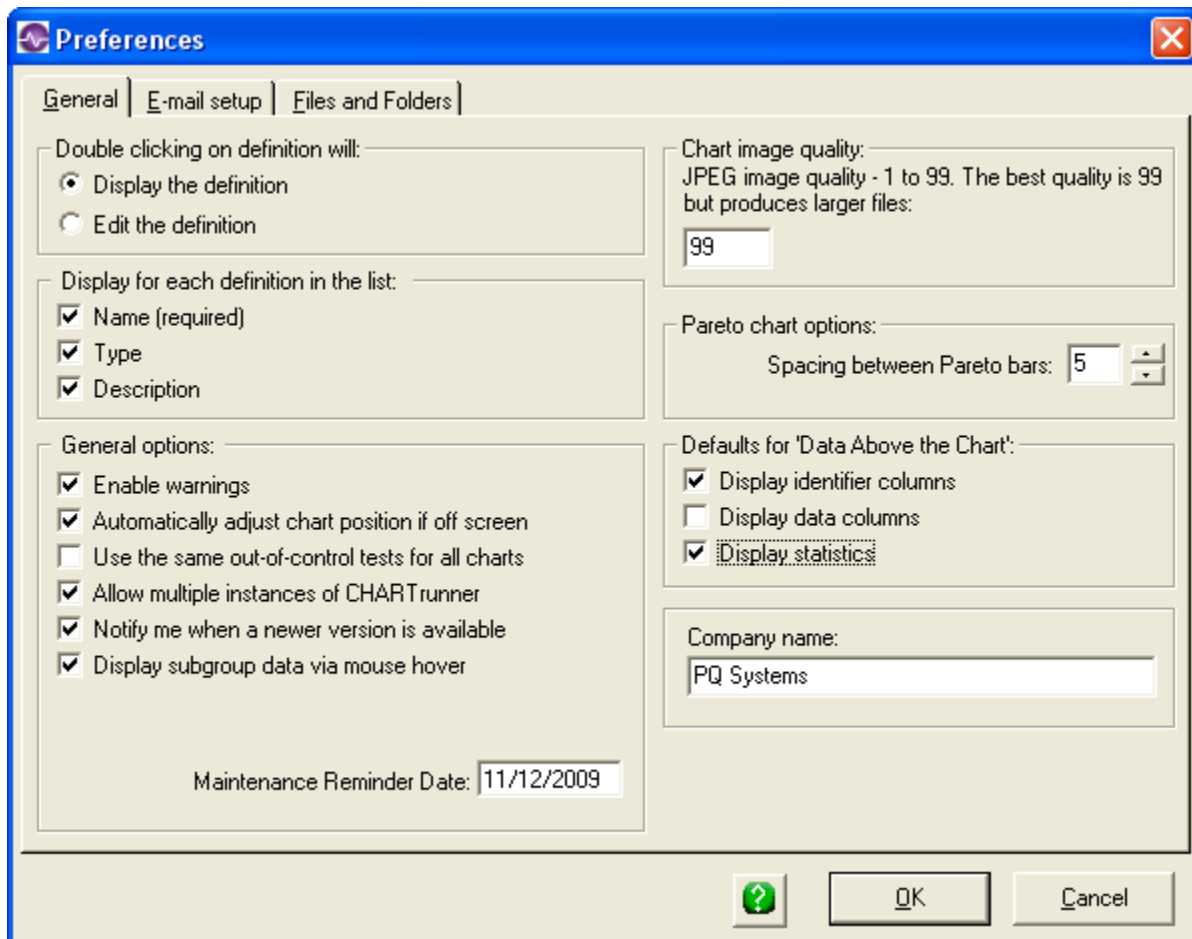
The form shown above allows you to add new templates, change existing templates, or delete templates. If you add a new template, it will then be available as one of the selections in the ADO;OLE DB Provider drop-down list on Step 2: Data Source tab of the chart definition form.

- **Create New** – Click this button to create a new ADO connection template. Enter the information for the new template in the fields of the Currently selected template frame.
- **Delete** – Click this button to delete the currently selected ADO connection template.
- **Modify** – Click this button to edit the currently selected ADO connection template in the fields of the Currently selected template frame.
- **Currently selected template** – This frame contains the following fields and buttons:
  - **Save** – Click this button to save the information you have entered in the fields of the Currently selected template frame.
  - **Build** – Click this button to open the Windows “Data Link Properties” window from which you can build a connection string for the ADO;OLE DB provider that you select.
  - **Name** – The name of the template.
  - **User Name (optional)** – If the ADO provider requires a user name in order to authenticate with the database, you can optionally enter it here. The name you enter here will be placed in the User field on the Step 2: Data source tab. When the data source is opened, the contents of the User field will be substituted into the connection string in place of {{USER}}.
  - **Password (optional)** – If the ADO provider requires a password in order to authenticate with the database, you can optionally enter it here. The password you enter here will be placed in the Password field on the Step 2: Data source tab. When the data source is opened, the contents of the Password field will be substituted into the connection string in place of {{PASSWORD}}.
  - **Connection string** – Enter the connection string to be used with this template. A connection string consists of multiple pieces of information where each piece is separated by a semicolon. Depending on your specific data source, this string can take on many forms.

## Preferences

To set CHARTrunner preferences, select the Setup > Preferences menu on the main form.

## General tab



- Double clicking on chart definition will – This option allows you to specify what will happen when you double-click on a chart definition listed in the CHARTrunner definitions list.
  - Display the definition – The definition will be displayed in a new window.
  - Edit definition – The definition editor will open so that you can edit the definition.
- Display for each definition in the list – This option allows you to specify what information will be displayed about each definition in the CHARTrunner definitions list.
  - Name (required) – The definition is always displayed.
  - Chart type – Select this option to display the definition type.
  - Description – Select this option to display the definition description.
- General options – Select from the following options:
  - Enable warnings – Select this option to have CHARTrunner warn you about missing or improper parameters in definitions. It is recommended that you select this option.
  - Automatically adjust chart position if off screen – Each time a chart display window is closed, CHARTrunner automatically stores the size and position of the chart window in the chart definition. If the last person to view a chart had the display window.

- Use the same out-of-control tests for all charts – When this is selected the out-of-control test rules defined by the Active test definition under Setup > Out-of-control tests is applied to all control charts. When this is not selected, the out-of-control test rules defined in each control chart definition are used for that chart.
- Allow multiple instances of CHARTrunner – When this is selected you may start multiple instances of CHARTrunner, i.e. you may have more than one CHARTrunner main window on your desktop. When this is not selected you will not be permitted to start a second instance of CHARTrunner.
- Notify me when a newer version is available –Select this option to have CHARTrunner periodically check via the Internet for a newer version. When a newer version is detected you will be notified.
- Use Automatically check for product updates –Select this option to have CHARTrunner periodically check via the Internet for a newer version. When a newer version is detected you will be notified.
- Display subgroup data via mouse hover – Select this option to specify the default state for the View > “Enable mouse hover information” menu on the chart display window. When this option is selected and a chart display windows opens, when you let the mouse cursor hover near a data point on the chart a pop-up window appears with summary information about that data point.
- Chart image quality
  - JPEG image quality – When a chart is saved as a JPEG image file, the number you enter here determines the compression level that is used in creating the JPEG image. The higher the number, the better resolution the image will have, but at the expense of larger image file size. You can experiment with different image quality numbers to determine the best tradeoff for your situation.
- Pareto chart options
  - Spacing between Pareto bars – Specify the default spacing between the bars of a Pareto chart (in terms of percentage) for a new chart. Starting with CHARTrunner 2.0, the Pareto bar spacing is a property of the chart definition, so each Pareto chart can specify the spacing that looks best for that chart. When a new Pareto chart is created or a pre-2.0 chart definition is used, the number you enter here will be used as the Pareto bar spacing.
- Defaults for 'Data Above the Chart' – These options determine whether a new chart defaults to displaying the specified information in the 'Data Above the Chart' grid. This grid is configured on the “Chart data display” sub-tab of the “Control chart” tab in the chart definition editor.
  - Display identifier columns – Select this option to automatically display columns that are mapped as Identifier or Unique Identifier.
  - Display data columns – Select this option to automatically display columns that are mapped as chart data, such as Measurement, Data, Data 1 through Data 10, etc.
  - Display statistics – Select this option to automatically display calculated statistics.
- Company name – Enter the company name that will be displayed by the @CONAME chart title code.

## E-mail setup tab

CHARTrunner allows you to send a chart as an e-mail. On this tab, you specify the information CHARTrunner needs to send an e-mail message.

The screenshot shows the 'Preferences' dialog box with the 'E-mail setup' tab selected. The dialog has three tabs: 'General', 'E-mail setup', and 'Files and Folders'. The 'E-mail setup' tab contains the following fields and controls:

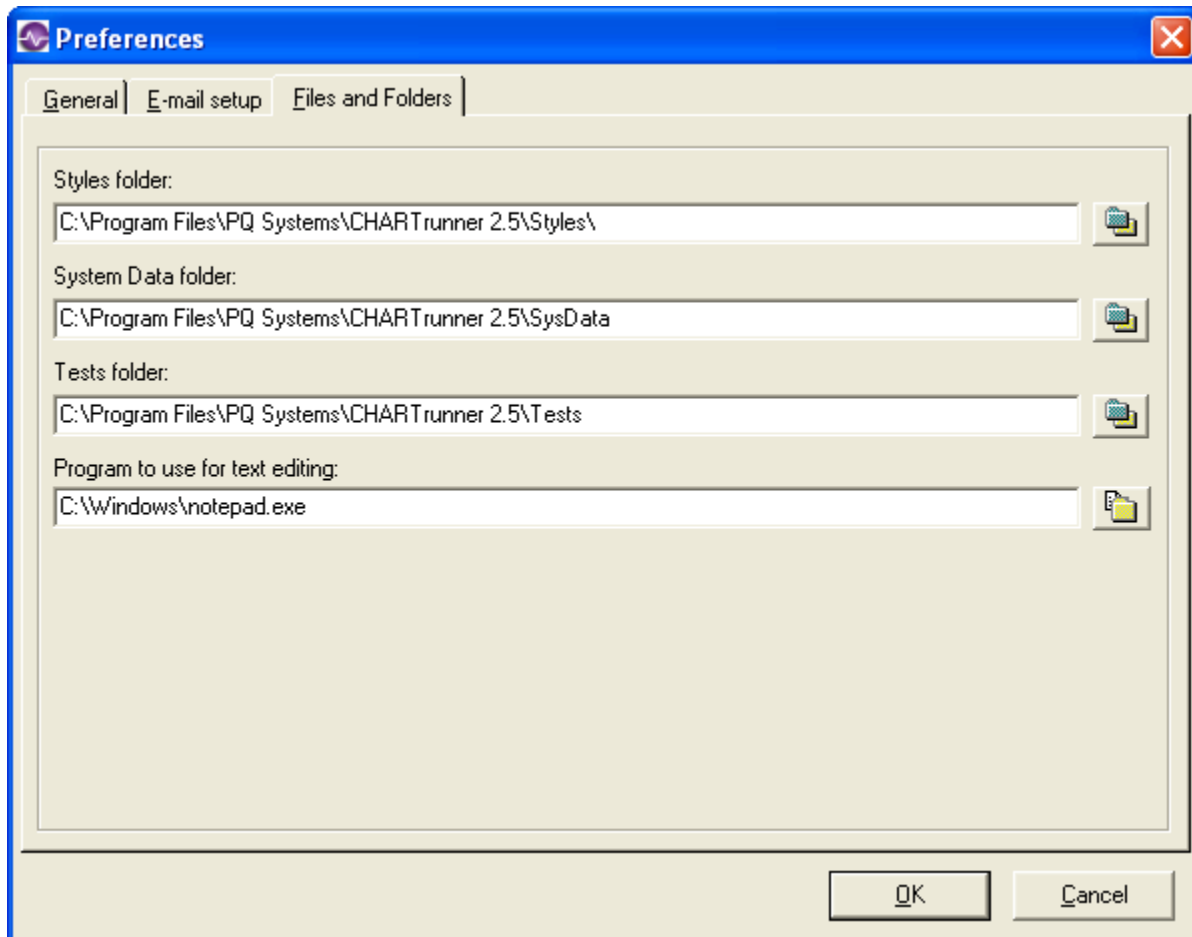
- Outgoing SMTP mail server (IP address, domain name or computer name):** A text box containing 'smtp.YourDomain.com'.
- Send test e-mail:** A button to the right of the SMTP server field.
- Test e-mail status:** A large text area for displaying SMTP command and response logs.
- Connect timeout in seconds:** A text box containing '30'.
- From (default):** A text box containing 'YourName@YourDomain.com'.
- Subject (default):** A text box containing 'CHARTrunner chart'.
- Buttons:** At the bottom right, there is a green question mark icon, an 'OK' button, and a 'Cancel' button.




- **Outgoing SMTP mail server** – CHARTrunner needs to know the IP address (a number like 192.168.0.100) of the SMTP mail server that will be used to deliver e-mail. Instead of entering the IP address, you can use a domain name, such as smtp.mydomain.com, as long as a DNS server is available to translate the specified domain name into an IP address. Or, you can enter the computer name of the SMTP server if a WINS server is available to translate the computer name to an IP address. Check with your IT department to find out what SMTP server is available and how to specify its IP address.
- **Send test e-mail** – Click this button to have CHARTrunner attempt to send a test e-mail message using the SMTP mail server you have specified. The Test e-mail status shows the SMTP commands and responses between CHARTrunner and the SMTP server, and may prove helpful in diagnosing a communications problem.
- **Connect timeout in seconds** – Enter the amount of time in seconds that CHARTrunner waits while attempting to establish communications with the SMTP server.
- **From (default)** – Enter the default From address for e-mails sent from CHARTrunner.
- **Subject (default)** – Enter the default Subject line for e-mails sent from CHARTrunner.




## Files and folders tab

On this tab, you tell CHARTrunner what folder to use for style definitions, system data files such as the default chart definition, and test definitions. You also specify what text editor to use when CHARTrunner opens a definition file in a text editor.



- **Styles folder** – Click the  button to open the folder selection dialog and select the folder where style definitions are saved. If you are on a network and desire to share a common set of style definitions among a group of users, select a folder on a network share and ask your system administrator to assign the appropriate file access rights.
- **System Data folder** – Click the  button to open the folder selection dialog and select the folder where CHARTrunner system data files are saved. If you are on a network and desire to share a common set of system data files among a group of users, select a folder on a network share and ask your system administrator to assign the appropriate file access rights. The CHARTrunner system data folder contains Default.crf, the default chart definition that specifies the initial conditions for a new chart definition.
- **Tests folder** – Click the  button to open the folder selection dialog and select the folder where test definitions are saved. If you are on a network and desire to share a common set of test definitions among a group of users, select a folder on a network share and ask your system administrator to assign the appropriate file access rights. Test definitions contain the test rules for specifying out-of-control conditions on control charts.

**Program to use for text editing** – Click the  button to open the file selection dialog and select the text editor you want to use with CHARTrunner. You can typically use C:\Windows\notepad.exe if you have no other preference. Once an editor has been specified, you can open the highlighted chart, dashboard or style definition in the text editor by pressing Shift-F12 when the definition is selected in the definitions list.

## CHAPTER 14

# CHARTrunner viewer

## In This Chapter

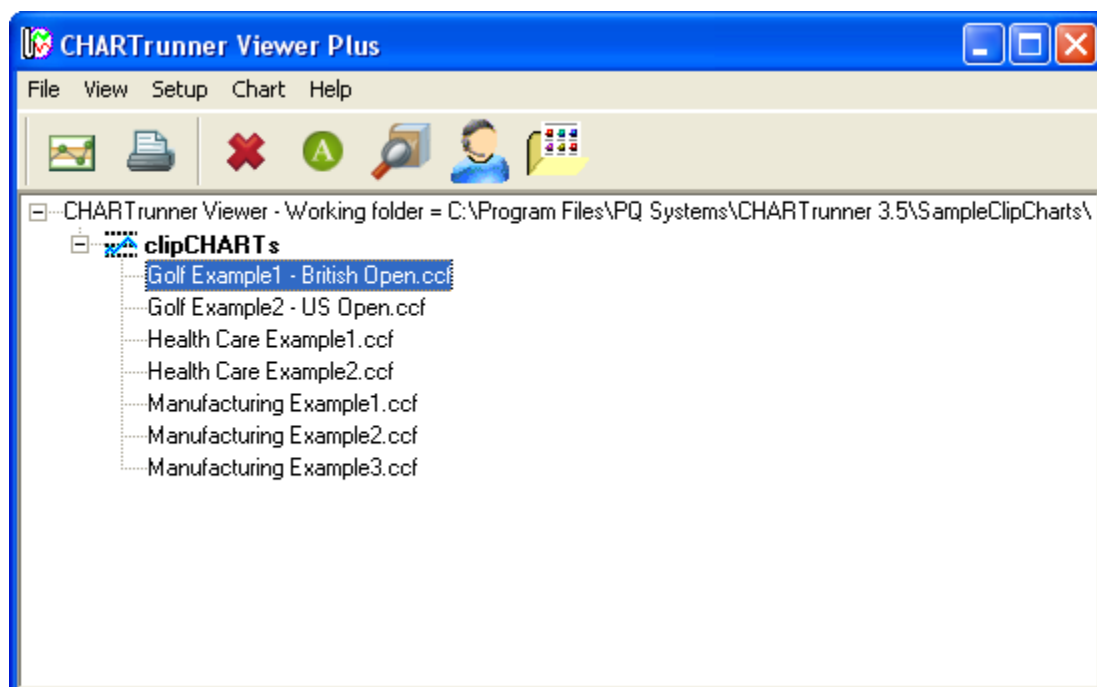
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## The CHARTrunner viewer program


To start CHARTrunner Viewer:

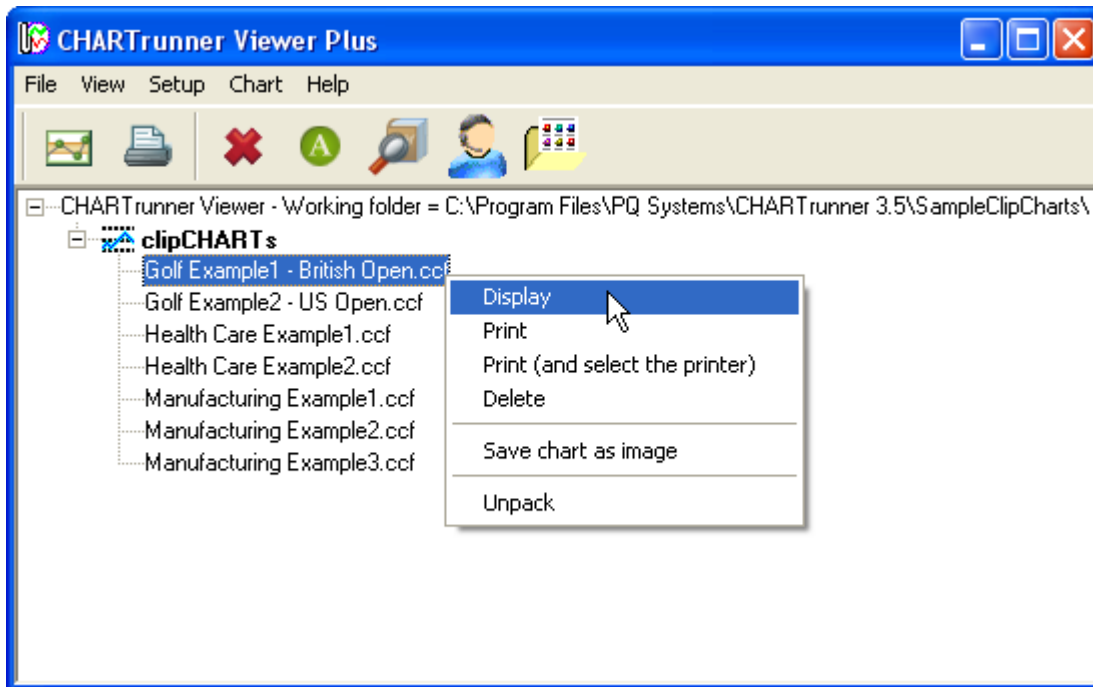
- Click on the Start Menu and select CHARTrunner. This will likely be found under Start, Programs, PQ Systems, CHARTrunner 3.5, CHARTrunner Viewer 3.5.

When you start CHARTrunner Viewer, the first form that you see is the CHARTrunner Viewer Tree. This form shows the clipCHARTs found in the working folder.



Using the CHARTrunner Viewer program is similar to using CHARTrunner.

- Set folder containing clipCHARTs – Right-click on the current working folder and select Set working folder from the pop-up menu. Or, click the  button on the toolbar. Or, open the File menu and select Set folder containing clipCHARTs. Or, press Ctrl-W. The tree will update with the clipCHART files found in the specified working folder.
- Operations on clipCHARTs – Right-click on a clipCHART and the a context menu appears as shown in the figure below (these choices are also available via the Chart menu):



- Display – Display the selected clipCHART in a new chart display window. You may edit the chart definition and style definition to change the appearance of the chart while it is displayed, but your changes will not be saved back into the clipCHART file.
- Print – Print the selected clipCHART to the default Windows printer.
- Print (and select the printer) – Print the selected clipCHART to the Windows printer that you select.
- Delete – Delete the selected clipCHART file to the Recycle Bin. Hold down the Shift key prior to clicking on Delete to permanently delete the clipCHART file.
- Save chart as image – Save the selected clipCHART as an image file. You can control the type, size, and location of the resulting image file.
- Unpack – Unpack the selected clipCHART into the folder that you specify. The resulting files include the chart definition file (\*.CRF), an Access database that contains the chart's data (\*.MDB), and the chart style definition file (\*.CR?). You can use these unpacked files with CHARTrunner.

## Sample clipCHARTs

Some sample clipCHART files are installed in the SampleClipChart folder that is part of the CHARTrunner installation. This folder is typically C:\Program Files\PQ Systems\CHARTrunner 3.5\SampleClipCharts.

## Using clipCHARTs via windows explorer

You may use Windows Explorer to perform operations on clipCHART files. When you right-click on a clipCHART file using Windows Explorer, you may select from the following context menu choices:

- **Display Chart** – Display the selected clipCHART in a new chart display window. You may edit the chart definition and style definition to change the appearance of the chart while it is displayed, but your changes will not be saved back into the clipCHART file.
- **Create Image** – Save the selected clipCHART as an image file. You can control the type, size, and location of the resulting image file.
- **Print to default printer** – Print the selected clipCHART to the default Windows printer.
- **Print** – Print the selected clipCHART to the Windows printer that you select.
- **Unpack** – Unpack the selected clipCHART into the folder that you specify. The resulting files include the chart definition file (\*.CRF), an Access database that contains the chart's data (\*.MDB), and the chart style definition file (\*.CR?). You can use these unpacked files with CHARTrunner.



## CHAPTER 15

# Appendix A: Formulas used by CHARTrunner

Information about the formulas used by CHARTrunner is available by clicking the Help > Formulas reference menu selection.





## CHAPTER 16

## Appendix B: CHARTrunner command line arguments

CHARTrunner allows users to employ command line arguments to perform common tasks such as displaying or printing a specific chart.

To view a summary of the available command line arguments, simply run CrCmdLine25.exe without any arguments. This can be accomplished by double-clicking CrCmdLine25.exe from Windows Explorer.

Command line arguments can be run from the command prompt, the Start Menu's Run function, or from a shortcut. Type CrCmdLine25.exe, followed by as many command arguments as needed. If you want to run several arguments, you can create a text command file as demonstrated below and use the /@ [CommandFile] argument.

Arguments can be delimited with either a backslash (/) or a dash (-). However, you must use the same delimiter throughout.

The following are options for the command line. The [ChartPath] notation represents a full path to a CHARTrunner chart definition file, e.g., C:\Charts\MyChart.crf. The [DefPath] notation represents a full path to a CHARTrunner chart or dashboard definition file. The [DashboardPath] notation represents a full path to a CHARTrunner dashboard definition file. The [FolderName] notation represents a full path to a folder, e.g., C:\Charts. The [OutputSpec] notation represents a full path to a folder, e.g., C:\Charts.

/A [ChartPath]	Save the specified histogram chart as a Cpk analysis web page. You must use /O or /S prior to /A in order to specify the output filename or folder. If you only specify a folder the chart name will be used to create the filename. If /Q appears before /A the operation will be interactive.
/C [ChartPath]	Create a clipCHART of the specified chart.
/D [DefPath]	Display in a window the specified chart.
/E [ChartPath]]...	E-mail the chart image of the specified chart. The parameters shown below, separated by the   character, can be supplied. Only the parameters shown in bold are required. For readability, a space has been used on each side of the   character, but these extra spaces are optional.  /E ChartFile   FromAddress   ToAddress   CcAddress   Subject   Message   ImageWidth   ImageHeight   ImageType
/F [FolderName]	Set the current chart folder to the specified folder.

/G [DefPath]	<p>Create an out-of-control summary file for the specified workspace. You must use /O or /S prior to /G in order to specify the output filename. If the output file has an extension of XLS an Excel file will be created, otherwise a text file will be created. You may optionally include a positive integer after [DefPath] to specify the “Last N” subgroups to analyze on each chart.</p> <p>For example, the following command analyzes the last 10 subgroups of each chart in workspace Ws1.crw and writes the summary to C:\Temp\Ooc.xls:</p> <p>/O C:\Temp\Ooc.xls /G C:\Charts\Ws1.crw 10</p>
/I [DefPath]	Create an image of the specified chart. For a dashboard save all indicator images to the folder specified by /O.
/M [DefPath]	Modify (edit) the specified chart, dashboard or style definition.
/O [OutputSpec]	Specify the output filename or folder (used with /C, /I, and /W). See /S for the “sticky” version.
/P [ChartPath]	Print the specified chart.
/Q	Use prior to /P to select a printer or prior to /A, /E or /I for interaction with the user.
/R	Enable Chart “Review.”
/S [OutputSpec]	Specify the “sticky” output folder (used with /C and /I). This option is equivalent to /O, except it is “sticky” and applies to subsequent commands until another /O or /S is encountered.
/T [ImageFileType]	Specify the graphics image file format. Options are JPG, PNG, BMP, or EMF (used with /I). For a dashboard indicator the allowable options are PNG or EMF.
/U [DashboardPath]	Applies only to a dashboard definition. Update all indicator images in the folder specified by /O. Only those images of type EMF or PNG with a filename that matches an indicator name in the dashboard will be updated.
/V	Display error messages.
/W [ChartPath]	Save the specified chart as a Web page. Use /O prior to /W in order to override the output information specified by the chart definition.
/X	Exit from CHARTrunner. Typically this is the last argument on a command line or the last command in a command file.

/ Y [DashboardPath]	Applies only to a dashboard definition. Update all indicator values by recalculating the chart statistic. Only those indicators that have an associated chart definition, and have not been marked as “Only permit manual update of the statistic value from chart,” will be updated.
/@ [CommandFile]	If you are using a text file for multiple arguments, use this command to read the text file specified by [CommandFile], and process each command line contained therein. The text file can include lines that are blank or commented out with semicolons (;).
/ H or /?	Help for command line parameters. Displays a list of the supported command line parameters

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## Example command line usage

```
"C:\Program Files\PQ Systems\CHARTrunner 3.5\CrCmdLine35.exe" /D  
C:\MyChart.crf
```

```
"C:\Program Files\PQ Systems\CHARTrunner 3.5\CrCmdLine35.exe" /@ C:\  
CHARTrunnerCommands.txt
```

## Example text file containing command arguments

```
; CHARTrunnerCommands.txt

; Display the chart.
/D C:\MyChart.crf

; E-mail the chart to Fred for his review.
/E C:\MyChart.crf | barney@bedrock.org | fred@bedrock.org

; E-mail the chart as a 640x480 PNG to Wilma for her review.
/E C:\MyChart.crf|barney@bedrock.org| wilma@bedrock.org|||640|480|PNG

; Save a PNG image of the chart into our Web site.
/T PNG /O C:\InetPub\wwwroot\ChartImages /I C:\MyChart.crf

; Save the chart as a Web page into our Web site.
/O C:\InetPub\wwwroot\Charts /W C:\MyChart.crf

; Print the chart to CHARTrunner's default printer.
/P C:\MyChart.crf

; Create an out-of-control summary spreadsheet that evaluates the last
; 15 subgroups of each chart in the workspace.
/O C:\Temp\Ooc.xls /G C:\Charts\Ws1.crw 15

; Perform "Update indicator values from chart statistic" on Dashboard1.

/Y C:\Work\Dashboard1.crd

; Perform "Save all indicators as images to specified folder" on Dashboard1.

/T EMF /O "C:\Work\Images" /I C:\Work\Dashboard1.crd

; Perform "Update indicator values from chart statistic" on Dashboard2.

/Y C:\Work\Dashboard2.crd

; Perform "Save all indicators as images to specified folder" on Dashboard2.

/T EMF /O "C:\Work\Images" /I C:\Work\Dashboard2.crd
```

## CHAPTER 17

# Appendix C: Tips and troubleshooting

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## Online information

Visit the PQ Systems knowledge base for the latest information:

<http://www.pqsystems.com/kb/> (<http://www.pqsystems.com/kb/>)

## CHARTrunner performance tip

If you define a CHARTrunner chart that will end up including a large amount of data, the performance can be improved by minimizing the number of columns that you “map” on the Step 3: Data definition tab.

For example, if you are creating a histogram from a single column of data, do not map a bunch of identifier columns unless you want these identifiers to appear when the chart is saved as a Web page.

Also, defining a filter like “Operator=Sam” does NOT require that you map the 'Operator' column as an identifier.

## Comma and decimal separators

In the Windows control panel, under Regional settings, users have an option to set the character to be used as the decimal separator when displaying numbers. In most countries this is set to the standard decimal point. In some countries, however, this is set to a comma. For example:

75.66	most common
75,66	some countries

CHARTrunner has implemented code to support these differences. When a CHARTrunner file is saved, one entry in the file remembers what the decimal separator was when the file was saved. Each time a CHARTrunner file is read, the current Windows setting for the decimal character is compared to the setting stored in the CHARTrunner file. If there are differences, all numbers are reformatted to account for the current Windows setting.

This ensures that a user in a comma-based country can open and use the sample charts even though they were created in a decimal-point-based country. This will also allow the same CHARTrunner file to be used

## Time on the charts

Time on charts will be displayed as AM / PM or military (24-hour clock), depending on the regional settings.

You can format your source application to display the time in the format you want, but when CHARTrunner draws the chart it uses your Regional settings from the Control Panel.

The Time style in the control panel can be hh:mm:ss or HH:mm:ss. The upper case HH indicates military time.

## Defining the advanced tab's week option - what is a week?

In the Advanced row selection form, if you select the option Look at every row of data until column Y changes and specify a date column for column Y, the optional field Form subgroups based upon will appear.

One of the Form subgroups options is Week. CHARTrunner starts a week on Monday and ends on the following Sunday at midnight.

## Filter to exclude outliers

You can create a filter that excludes outlying data points.

To do this, your source data should have both a target value column and an actual value column.

For the example filter, shown below, the source file had a column for target resistance and one for actual resistance. This filter eliminates data points that are more than 5% away from the target value.

**Filter definition**

Select data where the date/time in THIS column:

Is Between: and: ☒ Inclusive

AND (

ActualResistance < (TargetResistance \* 1.05)

AND

ActualResistance > (TargetResistance \* 0.95)

) (Additional Conditions)

Additional Conditions:

See WHERE clause

Clear all OK Cancel

## Filter for missing values as an identifier

If you have null values (or a missing value in an identifier field), you may want to filter so that only the null / missing values are included in the result.

For example, the data might look like this:

Date	Data	Defect
1/1/00	10	
1/2/00	12	
1/3/00	18	

1/4/00	15	Yes
1/5/00	12	
1/6/00	14	
1/7/00	17	
1/8/00	13	Yes
1/9/00	14	

To chart only the values where the "Defect" column is blank, use a filter and type in the "Additional Conditions:" area the following:

(Defect) is null Note the space between "is" and "null"

## Close data source after drawing chart

Although CHARTrunner opens all data sources for read-only access, some data sources may lock in a manner that prevents other users from opening the data source once CHARTrunner has displayed the chart. CHARTrunner version 1.1.183 or higher allows CHARTrunner to close the data source after the chart has been drawn and thus circumvent this problem. Later versions of CHARTrunner by default create new chart definitions with the Close data source after drawing chart option enabled. When this option is enabled, CHARTrunner will open the data source only long enough to get the chart data and will then close the connection to the data source.

To enable this option:

1. Modify the chart definition.
2. Click on the Misc tab.
3. Click on the Close data source after drawing chart option so that the check box is checked.
4. Click on the OK button to save the change.

## Microsoft Access data source

If Microsoft Access is being used to add new data to the Access database, then ensure that the database is not opened by Microsoft Access in exclusive mode. When Microsoft Access opens the database, if the Exclusive box is checked, then CHARTrunner is not able to see the new data.



## Microsoft Excel data source

Under some circumstances you may experience problems when using Microsoft Excel to open or edit a workbook file at the same time that CHARTrunner is using that same workbook file. The issues discussed here do not apply to CHARTrunner-XL.

This issue can be influenced by many factors, such as which program (CHARTrunner or Excel) is first used to open the workbook.

Here is a typical problem: You open the workbook .XLS file (that is not in “shared workbook” mode) using Excel. Then in CHARTrunner you display a chart that fetches its data from the same workbook (it does not matter whether the chart definition has “Close data source after drawing chart” checked or not). Next, you close Excel via File > Exit. Finally, in Windows Explorer you double-click on the workbook file; the program will attempt to open the workbook in Excel. However, instead of successfully opening the workbook, the Excel window appears and then freezes or locks up, and the contents of the workbook never appear in the Excel window. In order to recover from this situation, you must exit from both CHARTrunner and Excel. Oddly, this problem does not occur if instead of opening the workbook via Windows Explorer, you start Excel and then open the workbook.

Another typical problem occurs when your open CHARTrunner chart does not see changes that you make to the worksheet using Excel. In this scenario, you have the workbook open in Excel, make changes to existing data, or add new data, and save the changes to the workbook, but the open CHARTrunner chart does not reflect those changes when the chart is refreshed (either by pressing F5 to manually refresh the chart, or the chart automatically refreshes itself due to the “Refresh interval” specified in the chart definition).

Here are some steps you can take to fix these types of problems:

1. In Excel, mark the workbook as “Shared” so that Excel is more tolerant of concurrent access to the workbook by both Excel and CHARTrunner. By default, Excel workbooks are not created in “shared” mode. In order to place an open workbook in “shared” mode, click on Tools > “Share Workbook...” and put a check in the box to “Allow changes by more than one user at the same time.”
2. In CHARTrunner, ensure that the “Close data source after drawing chart” checkbox is checked on the “Misc” tab of the chart definition.

If you still experience a problem after implementing the two steps mentioned above, then try using an alternate data access type to get to your Excel data. CHARTrunner can get to Excel data via two different data access methods by specifying on the “Step 2: Data source” tab of the chart definition a “Type” of either:

1. “Microsoft Excel” (which uses DAO/Jet).
2. “ADO;OLE DB provider” along with the “OLE DB Provider for Microsoft Jet - Excel 97/2000” connection string (which uses ADO/Jet). See below for more details.

## Getting to Excel data via the ADO;OLE DB provider

You can use ADO to get to Excel data as follows:

1. Edit the CHARTrunner chart definition and select the Step 2: Data source tab.

2. In the Type field, select ADO;OLE DB provider
3. In the ADO;OLE DB Provider field, select:  
OLE DB provider for Microsoft Jet - Excel 97/2000
4. In the Connection String edit the supplied template to specify the full path to the Excel workbook file, for example:  
Provider=MicrosoftJetOLEDB.4.0;Data  
Source=C:\MyData\MyWorkbook.xls;  
Extended Properties="Excel 8.0;HDR=Yes;"  
You will need to enter the full path to your Excel workbook file in place of the  
C:\MyData\MyWorkbook.xls as shown in the example above.

Notice that if you use ADO and draw the chart first, you may not be able to open the worksheet using Microsoft Excel. You may need to first open the worksheet using Microsoft Excel and then draw the chart in CHARTrunner.

## Column to use for order by does not allow you to select anything

When editing a chart definition file that points to an Excel spreadsheet, the Column to use for Order By (on the Step 3: Data definition tab) may not show any entries in the drop-down choice list.

Select Refresh to display identifiers in the Order By field.

## Using the LIKE operator in a filter or SQL expression

You can use the LIKE operator to find values in a field that match the pattern you specify. The syntax looks like this,

expression LIKE 'pattern'

For pattern, you can specify the complete value (such as LIKE 'Smith'), or you can use wildcard characters to find a range of values (for example, LIKE 'S%').

In the filter definition editor that may be opened by clicking the Filtering button on the Step 3: Data definition tab of the chart definition; you may specify the LIKE operator. In that case you should enter the 'pattern' in the field to the right of the LIKE operator.

Unfortunately, the wildcard characters that you may specify can vary from one database to the next. You may have to consult the documentation for your database vendor to determine what wildcard characters are supported. However, the following information may be sufficient:

Microsoft JET database engine – The JET database engine is used when you specify on the Step 2: Data source tab of the chart definition a data source Type of Microsoft Access, Microsoft Excel, Text File, or any other selection that doesn't begin with "ADO..." or "ODBC...". In this case, the following wildcard rules apply:

The following example matches data that begins with the letter P followed by any letter between A and F and three digits:

LIKE 'P[A-F]###'

The following table shows how you can use LIKE to test for different patterns.

Kind of match	Pattern	Match (returns True)	No match (returns False)
Multiple characters	a*a	aa, aBa, aBBBa	aBC
	*ab*	abc, AABb, Xab	aZb, bac
Special character	a[*]a	a*a	aaa
Multiple characters	ab*	abcdefg, abc	cab, aab
Single character	a?a	aaa, a3a, aBa	aBBBa
Single digit	a#a	a0a, a1a, a2a	aaa, a10a
Range of characters	[a-z]	f, p, j	2, &
Outside a range	[!a-z]	9, &, %	b, a
Not a digit	[!0-9]	A, a, &, ~	0, 1, 9
Combined	a[!b-m]#	An9, az0, a99	abc, aj0

- Microsoft SQL Server database engine – The following table describes the permissible wildcard patterns for use with Transact-SQL.

Wildcard Character	Description	Example
%	Any string of zero or more characters.	WHERE title LIKE '%computer%' finds all book titles with the word 'computer' anywhere in the book title.
_ (underscore)	Any single character.	WHERE fname LIKE '_ean' finds all four-letter first names that end with ean (Dean, Sean, and so on).
[ ]	Any single character within the specified range ([a-f]) or set ([abcdef]).	WHERE lname LIKE '[C-P]arsen' finds author last names ending with arsen and beginning with any single character between C and P, for example Carsen,

		Larsen, Karsen, and so on.
[^]	Any single character not within the specified range ([^a-f]) or set ([^abcdef]).	WHERE lname LIKE 'de[^]%' all author last names beginning with de and where the following letter is not l.

- Database engines that follow the ANSI/ISO SQL-92 standard – The following table describes the permissible wildcard patterns for use with a SQL-92 compliant database engine.

Wildcard Character	Description	Example
%	Any string of zero or more characters.	WHERE title LIKE '%computer%' finds all book titles with the word 'computer' anywhere in the book title.
_ (underscore)	Any single character.	WHERE fname LIKE '_ean' finds all four-letter first names that end with ean (Dean, Sean, and so on).

## Accessing charts using windows explorer

Some chart functions are available through Windows Explorer. When you right-click on a CRF, CRM, or CRW file, a pop-up menu will appear with these choices:

- Display (Chart, Multi-chart, or Chart Workspace, depending on the file extension)
- Create clipChart
- Create image
- Create image with prompt (this option allows you to specify file type, size, and name)
- Modify chart
- Print chart
- Send chart as e-mail
- Create Web page.

## Accessing dashboards using windows explorer

Some dashboard functions are available through Windows Explorer. When you right-click on a CRD file, a pop-up menu will appear with these choices:

- Display
- Edit
- Save all indicators as images to folder
- Update all indicator images in folder
- Update indicator values.

## CHAPTER 18

# Appendix D: Data sources

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## Contact technical support if you need help connecting to your data

A good source of information on using CHARTrunner with different data sources is the PQ Systems Knowledgebase at:

**<http://pqsystems.com/kb/>** (<http://pqsystems.com/kb/>)

**<http://www.pqsystems.com/kb/activekb/categories/CHARTrunner/CR+Data+Source/>**  
(<http://www.pqsystems.com/kb/activekb/categories/CHARTrunner/CR+Data+Source/>)

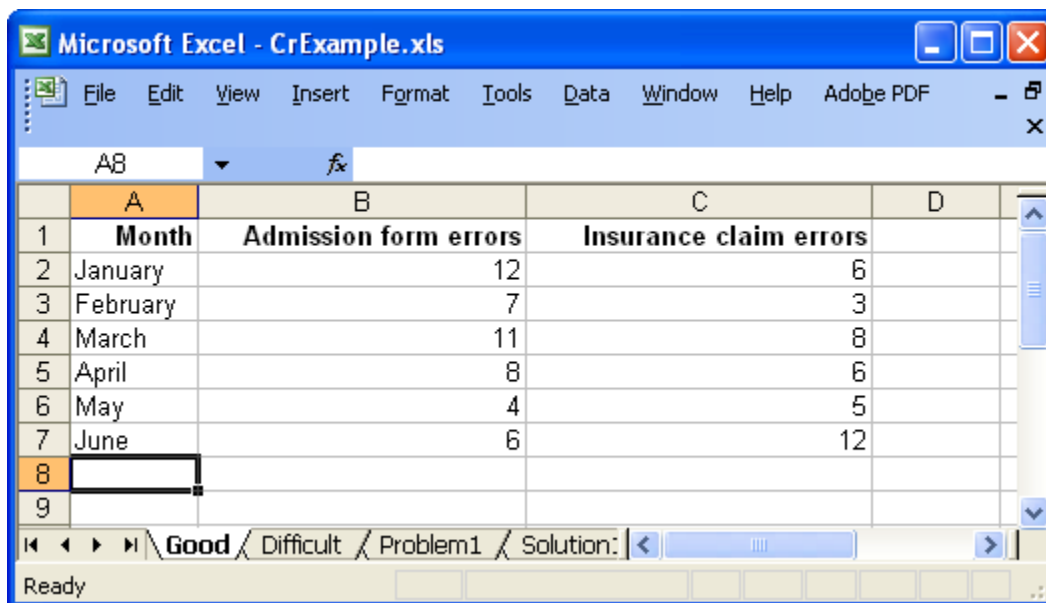
If you find that you are stuck and cannot figure out how to successfully connect to your data source, please contact PQ Systems technical support. We cover a lot of situations in this appendix, but it is impossible to cover all variations for all data sources.

## Using Excel data

CHARTrunner allows you to create charts using data from a variety of sources. However, CHARTrunner thinks about data with a database metaphor. In a database, a table contains many rows (or records) of data. Each row will have the same fields (or columns). For example, if row 1 contains name, address, and ZIP code, then rows 2, 3, 4, etc. will also contain name, address, and ZIP code. Spreadsheets allow such flexibility in arranging data that this assumption of all rows being alike is often not valid.

CHARTrunner treats a spreadsheet like this: the spreadsheet itself (the .xls file) is seen as the database, and each worksheet within the sheet (i.e., Sheet1, Sheet2, etc.) is seen as tables. Additionally, if you have created named regions within the spreadsheet, CHARTrunner will see these as tables.

CHARTrunner will have the easiest time with a spreadsheet formatted like this:



The screenshot shows a Microsoft Excel window titled "Microsoft Excel - CrExample.xls". The menu bar includes File, Edit, View, Insert, Format, Tools, Data, Window, Help, and Adobe PDF. The worksheet contains a table with the following data:

	A	B	C	D
1	Month	Admission form errors	Insurance claim errors	
2	January	12	6	
3	February	7	3	
4	March	11	8	
5	April	8	6	
6	May	4	5	
7	June	6	12	
8				
9				

The status bar at the bottom shows "Ready" and a navigation pane with "Good", "Difficult", "Problem1", and "Solution:".

This is how the CHARTrunner Step 3: Data definition tab might look for this data:

The screenshot shows the CHARTrunner - Data Sources - Using Excel - Good dialog box, specifically the Step 3: Data definition tab. The dialog has a blue title bar and standard Windows window controls. The tabs at the top are Step 1: Chart name/type, Step 2: Data source, Step 3: Data definition (selected), Pareto, Titles, and Misc. The main area is divided into two sections. The first section, 'Source for data records:', has four radio buttons: 'Table' (selected), 'Query or view', 'Stored procedure', and 'Custom query'. To the right of these is a 'Table' label, a 'Keep columns' checkbox (checked), and a dropdown menu showing 'Good\$'. Below these is a 'Column to use for Order By:' label and another dropdown menu. There are also 'Filtering' and 'SQL settings' buttons, and a 'Result records to include:' dropdown set to 'All'. The second section, 'How to treat the columns:', contains a table with four columns: 'Column name', 'Data type', 'Treat as', and 'Label'. The table has three rows of data. Below the table are 'Refresh Columns', 'Validate Chart Data', and 'Clear all' buttons. At the bottom of the dialog are 'View data', 'Save as default', a help icon (a green question mark in a square), 'OK', and 'Cancel' buttons.

Step 1: Chart name/type | Step 2: Data source | **Step 3: Data definition** | Pareto | Titles | Misc.

Source for data records:

- ☒ Table
- ☐ Query or view
- ☐ Stored procedure
- ☐ Custom query

Table ☒ Keep columns

Good\$

Column to use for Order By:

Filtering SQL settings

Result records to include: All

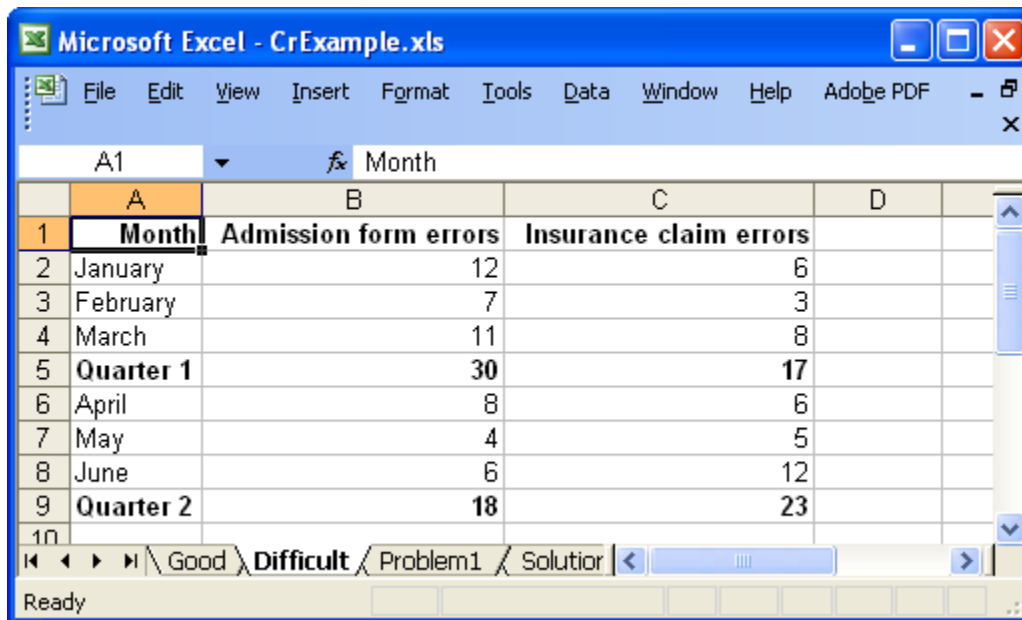
How to treat the columns:

Column name	Data type	Treat as	Label
Month	Text	Categories	Month
Admission form errors	Numeric	Count	Admission form errors
Insurance claim errors	Numeric	Identifier	Insurance claim errors

Refresh Columns Validate Chart Data Clear all

View data Save as default ? OK Cancel

CHARTrunner can understand this data easily. The rows are alike, there is a single row for column headings, there are no blank rows between the data, and no extra rows appear above or below.



Microsoft Excel - CrExample.xls

	A	B	C	D
1	Month	Admission form errors	Insurance claim errors	
2	January	12	6	
3	February	7	3	
4	March	11	8	
5	Quarter 1	30	17	
6	April	8	6	
7	May	4	5	
8	June	6	12	
9	Quarter 2	18	23	
10				

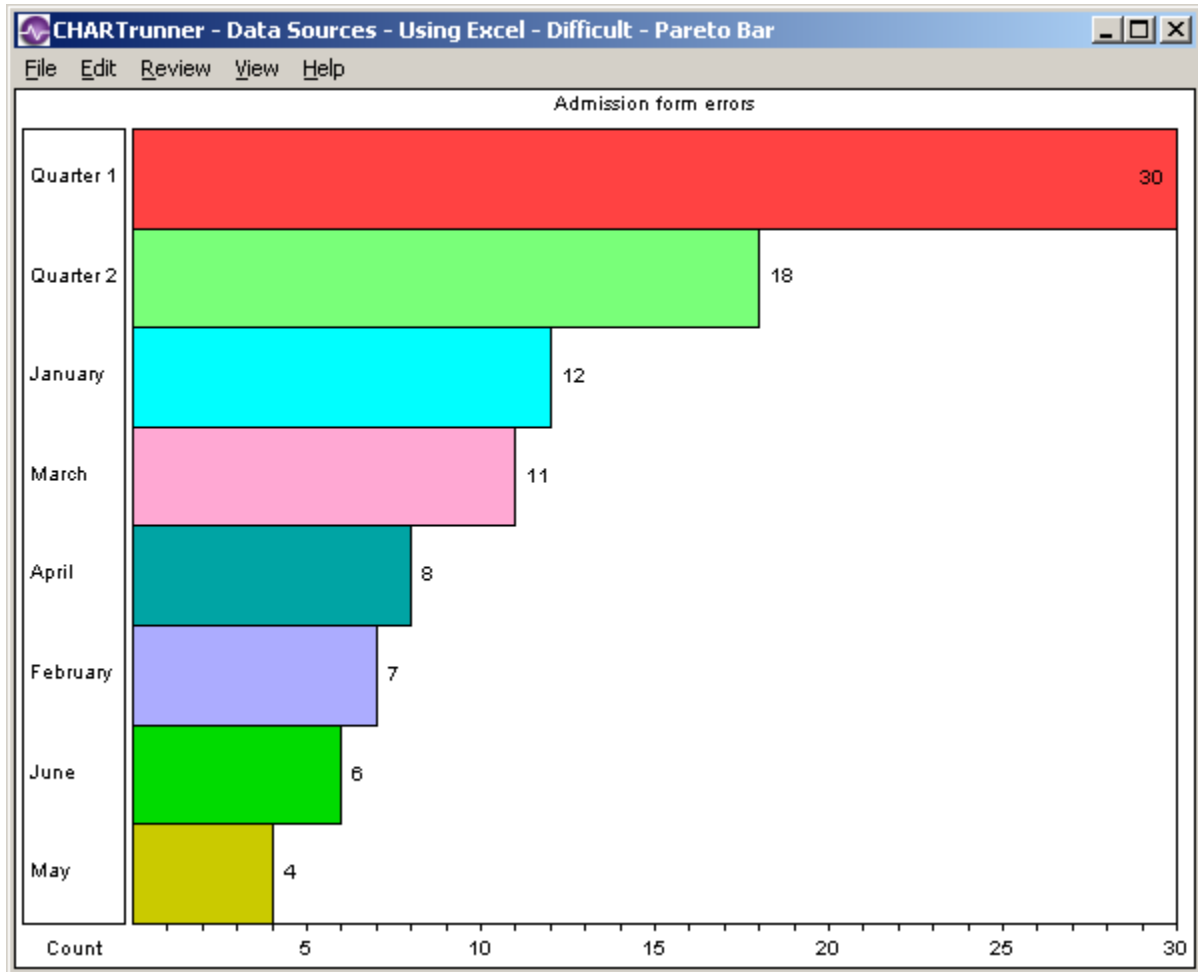
Ready



Shown above is a worksheet that may give CHARTrunner some difficulty:

CHARTrunner will be able to make a chart using this data. However, since the rows summarizing Quarter 1 and Quarter 2 are different from the raw data in the other rows, the chart may not give the results you expect. In other words, the quarterly totals will be seen as data points just like all the monthly values found in the other rows. One way to avoid this problem is to separate the quarterly totals onto a different sheet within the workbook. This way, CHARTrunner can look at the raw data using the familiar database metaphor it is based upon.

Shown below is one possible chart from the previous data. Note that including Quarter 1 and Quarter 2 may not result in the desired outcome:



Shown below is another example of a problematic worksheet and how you can set this up in CHARTrunner:

Microsoft Excel - CrExample.xls

	A	B	C	D	E	F
1						
2	Month	Admission	Claim form			
3	or year	errors / day	errors / day			
4						
5	Jan	12	8			
6	Feb	16	9			
7	March	13	12			
8	April	11	15			
9						
10	Total	52	44			
11						

Ready

Step 1: Chart name/type | Step 2: Data source | Step 3: Data definition | Pareto | Titles | Misc.

Source for data records:

- ☒ Table Table ☒ Keep columns
- ☐ Query or view
- ☐ Stored procedure
- ☐ Custom query

Column to use for Order By:

☐ Filtering

Result records to include: All

How to treat the columns:

Column name	Data type	Treat as	Label
Month	Text	Categories	Month
Admission	Text	Count	Admission

The Step 3: Data definition tab shown above corresponds to the Problem1 tab of the worksheet shown above it.

Note that CHARTrunner uses the first row containing text as the column name. The problem will occur when you attempt to display this chart. The data in the second row of the spreadsheet contains text, and yet CHARTrunner is expecting numbers. Specifically, this is true for the Admission errors / day column. A general rule for CHARTrunner is that if the column contains numbers – such as counts or measurements – there should be no cells in the entire column containing text except the very first row. The next example shows one way to solve this problem without reorganizing your sheet.

In the previous example, the worksheet caused problems for CHARTrunner because of the multi-row column headings and also because of the intervening blank rows. To solve the problem, highlight the cells containing only the data and give them a name in Excel. This is done in Excel with the Insert > Name > Define menu.

Microsoft Excel - CrExample.xls

File Edit View Insert Format Tools Data Window Help

ErrorData Month

	A	B	C	D	E	F
1						
2	Month	Admission	Claim form			
3	of year	errors / day	errors / day			
4	Month	Adm Err	Clm Err			
5	Jan	12	8			
6	Feb	16	9			
7	March	13	12			
8	April	11	15			
9						
10	<b>Total</b>	<b>52</b>	<b>44</b>			

Ready Sum=96

To make this worksheet more useful for CHARTrunner, two things have been changed. First, column names have been added to row 4 to describe the data in a single row. Second, the highlighted region has been given the name ErrorData within Excel.

Now, within CHARTrunner, the Step 3:Data definition tab looks as shown below. Notice that the table name used is ErrorData. CHARTrunner treats named regions within a workbook as if they were named tables in a database. Also note that the column names we defined in row 4 show up under Column name on the Step 3:Data definition tab.

Step 1: Chart name/type | Step 2: Data source | **Step 3: Data definition** | Pareto | Titles | Misc.

Source for data records:

- ☒ Table
- ☐ Query or view
- ☐ Stored procedure
- ☐ Custom query

Table: **ErrorData** ☒ Keep columns

Column to use for Order By:

☐ Filtering

Result records to include:

How to treat the columns:

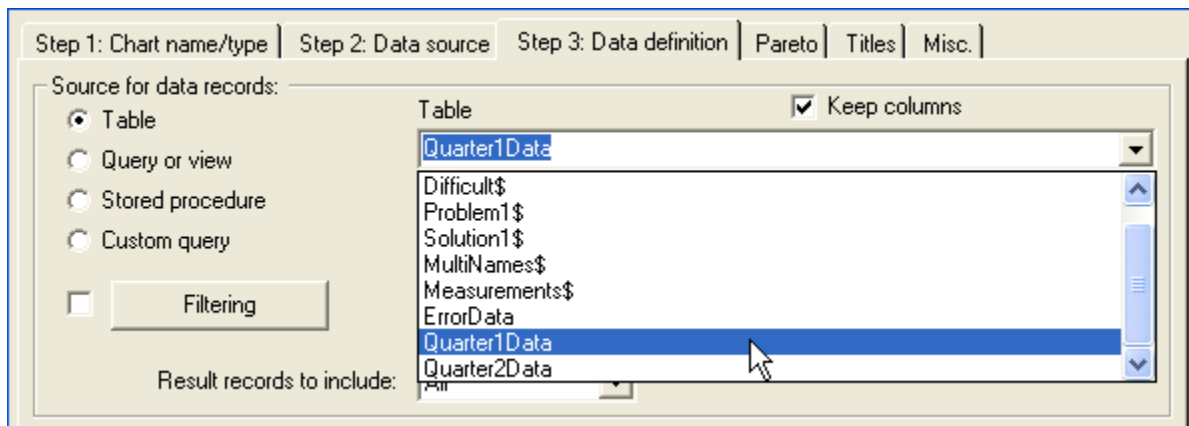
Column name	Data type	Treat as	Label
<b>Month</b>	Text	Categories	Month
Adm Err	Numeric	Count	Adm Err
Cln Err	Numeric	Identifier	Cln Err

Using the technique of defining a named region in Excel allows you to chart only the specific data you define in that named region. Additionally, CHARTrunner will not be confused by extra text either above or below the named region.

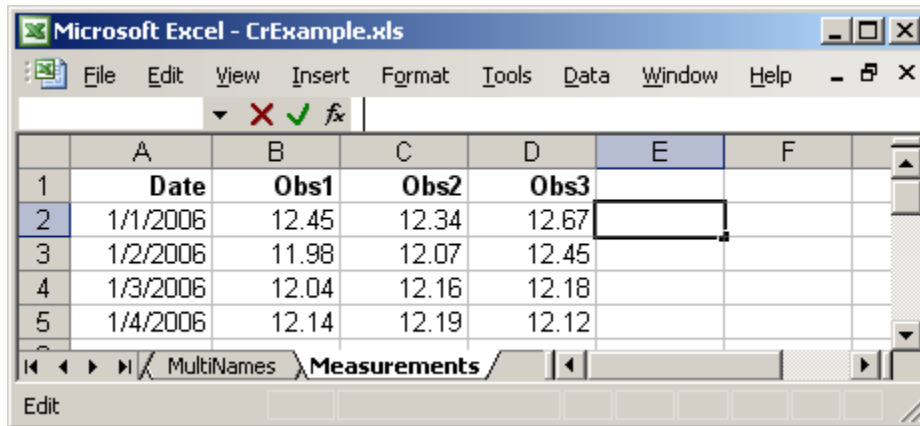
The named region technique mentioned in the previous example can be used in many different situations. For example, here is another worksheet containing data that is summarized on a quarterly basis.

	A	B	C
1	<b>Month</b>	<b>Admission form errors</b>	<b>Insurance claim errors</b>
2	January	12	6
3	February	7	3
4	March	11	8
5	<b>Quarter 1</b>	<b>30</b>	<b>17</b>
6			
7	<b>Month</b>	<b>Admission form errors</b>	<b>Insurance claim errors</b>
8	April	8	6
9	May	4	5
10	June	6	12
11	<b>Quarter 2</b>	<b>18</b>	<b>23</b>

Use Excel to name the first region as Quarter1Data (as shown above) and the second region as Quarter2Data. Once you save the Excel workbook, these two named regions will be available as tables in CHARTrunner. This allows you to create two different charts: one for each quarter.



For X-bar charts and other charts that use data grouped into samples or subgroups, CHARTrunner expects to find one data column for each observation in the subgroup. For example, in the following worksheet, treating the three data columns (Obs1, Obs2 and Obs3) as Measurements will result in a chart where the subgroup size is 3 ( $n=3$ ).



	A	B	C	D	E	F
1	<b>Date</b>	<b>Obs1</b>	<b>Obs2</b>	<b>Obs3</b>		
2	1/1/2006	12.45	12.34	12.67		
3	1/2/2006	11.98	12.07	12.45		
4	1/3/2006	12.04	12.16	12.18		
5	1/4/2006	12.14	12.19	12.12		

## General rules for setting up Excel sheets for use with CHARTrunner

1. Separate the raw data from the summary data. If you currently have summary data in the midst of your raw data, put the raw data on one worksheet within Excel and do the summarizing on a different worksheet (tab) within the same workbook.
2. Have a single row for column headings and leave no blank rows between the column headings and the raw data.
3. Do not use the space above or below your raw data for other spreadsheet data. Instead, move that information off to the side of the raw data range OR put it on a different worksheet within the workbook. If you must put other spreadsheet data below your raw data, highlight your raw data and create a "Named Region" so that CHARTrunner can use only the raw data contained in this region and ignore the other spreadsheet data below your raw data.
4. Do not mix data types within the same column if it is a column you want to use in CHARTrunner. For example, do not have a cell containing text in the middle of a column where all the other values are numbers.
5. Try to keep the raw data contiguous. Avoid intervening blank rows in the midst of the raw data.
6. Arrange your data so it goes down the worksheet rather than across the worksheet. In other words, as you add new data, you should be adding new rows rather than adding new columns.
7. Although CHARTrunner can handle long column names, your charts and data definition forms will look better and be less confusing if you name your spreadsheet columns with relatively short names.
8. Always have column names. If you do not, the first row of your raw data will be ignored as it will be used to provide the column names.
9. If you have data in columns A, B, and C and you are charting data only from column A, be aware that CHARTrunner will use the number of rows that it finds in the column that contains the most rows. For example, if column A contains 25 rows of data, but column B contains 50 rows of data, when you chart column A, the chart will have 25 blank rows at the end of the data. This may cause unexpected results. The way around this problem is to use Named regions as described above.

## Using ODBC data sources

ODBC (Open Database Connectivity) is a Microsoft data access standard that many software vendors use to provide access to their data files or databases.

Many software vendors who support the ODBC standard have their ODBC drivers available for download from their Web sites.

CHARTrunner supports using ODBC via the DSN or DSN-less methods. Of the two, PQ recommends the DSN-less method, if it can be used, because your chart definition does not depend upon a DSN name that must be defined on each computer where that chart is rendered.

## The DSN method of using ODBC

When you select ODBC; Open database connectivity as the Type on the Step 2: Data source tab, you are using the DSN method. The ODBC Driver drop-down list will contain a list of the ODBC “Data Source Names” (DSN) that have been defined on the computer. The contents of the ODBC Driver drop-down list will vary on each PC based on which ODBC drivers have been installed and what DSN's have been defined.

To configure ODBC DSN's, follow these steps:

1. Click on the Windows Start menu.
2. Select Settings; then select Control Panel from the menu.
3. When Control Panel is displayed, select Data Sources (ODBC).
4. Use the ODBC Data Source Administrator program to add/modify/delete the ODBC DSN's that are defined on the computer. The next time you start CHARTrunner, the current list of ODBC DSN's will be displayed in the ODBC Driver drop-down list.

Please note that not all computers ship with all ODBC drivers. If you are trying to access data in some proprietary software or database system, you may have to obtain and install the appropriate ODBC drivers from the software vendor. You will need to do this before you follow the steps above to set up a DSN.

Once you select an ODBC DSN, a connection string similar to that shown below will appear in the Connection string field:

```
DSN=MyDsnName; UID={{USER}}; PWD={{PASSWORD}};
```

The connection string may or may not include the “UID={{USER}}; PWD={{PASSWORD}};” portion, which is used when your database system requires you to log in with a user name and password. If your database does not require this, you may omit this portion of the connection string. You may also omit the UID and PWD when the user and password information was provided when the DSN was configured.

## The DSN-less method of using ODBC

Instead of selecting ODBC; Open database connectivity as the Type on the *Step 2: Data source* tab, you must select ADO;OLE DB provider. This probably seems somewhat counter-intuitive, but what we are going to do is have ADO talk to the ODBC driver in a special way that gets around the need to define a DSN on the computer.

Select a provider that looks like "ODBC Driver for ..." from the ADO;OLE DB Provider drop-down list. Edit the supplied connection string as appropriate for your situation. See the instructions under the topic **"Using ADO;OLE DB data sources."**

Good Connection String Resource – If you need information on the proper format of the connection string for a specific case, refer to Carl Prothman's excellent site which has many examples of ADO;OLE DB and ODBC connection strings.

**<http://www.carlprothman.net/Default.aspx?tabid=81>**  
(<http://www.carlprothman.net/Default.aspx?tabid=81>)

## Using ADO;OLE DB data sources

ADO stands for ActiveX Data Objects. This is a Microsoft standard that many software vendors support as a way to provide access to their application data.

If you select ADO;OLE DB provider as the Type on the *Step 2: Data source* tab, the ADO;OLE DB Provider drop-down list will appear. The contents of this list are determined by the ADO.INI file, which is installed in CHARTrunner's SysData folder. The ADO.INI file contains many standard ADO connection string templates. However, using CHARTrunner, you may add additional templates to the list by using the Edit > ADO Data source templates menu on the CHARTrunner main form.

When you select an OLE DB provider from the drop-down list, a default connection string template will appear in the Connection string field. Please note that the connection string template is in the correct general form for the selected data source, but you will probably have to edit the connection string to handle your specific situation.

For example, the following connection string is the template for connection to a – SQL Server database:

Provider=sqloledb; Data Source=SERVER\_NAME; Initial Catalog=DATABASE\_NAME; Integrated Security=SSPI;

You must edit this connection string and replace SERVER\_NAME and DATABASE\_NAME with information that is specific to your site, such as:

Provider=sqloledb; Data Source=SQLServer12; Initial Catalog= ProductionDB; Integrated Security=SSPI;

Good Connection String Resource - If you need information on the proper format of the connection string for a specific case, refer to Carl Prothman's excellent site which has many examples of ADO;OLE DB and ODBC connection strings.

**<http://www.carlprothman.net/Default.aspx?tabid=81>**  
(<http://www.carlprothman.net/Default.aspx?tabid=81>)



## Using ADO to connect to an XML recordset

ADO stands for ActiveX Data Objects. This is a Microsoft standard that many software vendors support as a way to provide access to their application data. CHARTrunner uses ADO to connect to many different types of data sources.

An ADO recordset may be saved (or persisted) as an XML recordset, and an XML recordset can be “read” by ADO and turned back into a standard ADO recordset. XML stands for Extensible Markup Language. An XML recordset saved as an XML file is simply a text file that contains all the information about the data source, such as column names, column types, and all the data values from the rows and columns of the recordset.

CHARTrunner 2.0 and above allows you to use an XML recordset as the data source for a chart by selecting ADO; XML recordset as the Type on the *Step 2: Data source* tab of the chart definition. Then you enter the URL that will be used to fetch the XML recordset as a Custom query on the *Step 3: Data definition* tab. For example, the following URL simply returns the file Data1.xml, which is a persisted ADO recordset,

**<http://www.charrunner.com/Webdata/Data1.xml>** (<http://www.charrunner.com/webdata/Data1.xml>)

You can use a Web server (HTTP or HTTPS) or an FTP server, and CHARTrunner will fetch the XML recordset via the Internet (or your intranet) and draw a chart based on the data contained in the XML recordset.

Here are some possible scenarios of how XML recordsets could be used with CHARTrunner.

- Periodically update XML recordset files on a server – In this scenario you would periodically update one or more XML recordset files on the server so that the files contain the most recent data available. You could periodically, as a “scheduled task,” run a script that updates the XML recordset files.
- Dynamically generate the XML recordset – In this scenario you would use an ASP or ASP.NET Web page to fetch the chart data, persist the ADO recordset as an XML stream, and return the XML recordset to CHARTrunner. This method allows you to pass query parameters to the URL so that you could, for example, fetch data only between specific starting and ending dates. If you turn “Prompt for parameters” on in the chart definition, then CHARTrunner would prompt you to enter the starting and ending dates before it fetches the data and draws the chart. An example of this technique is included in `cr_xml_recordset.zip`.

Download the following ZIP archive which contains some sample charts that fetch data via the ADO; XML recordset data access method, plus an example ASP Web page that demonstrates how to dynamically query a database and return the results of the query as an XML record-set.

**[http://www.charrunner.com/Webdata/cr\\_xml\\_recordset.zip](http://www.charrunner.com/Webdata/cr_xml_recordset.zip)**  
([http://www.charrunner.com/webdata/cr\\_xml\\_recordset.zip](http://www.charrunner.com/webdata/cr_xml_recordset.zip))

## Using Text or CSV data

You can use a suitably formatted text file as a data source with CHARTrunner.

A text file where each column of data is separated by a comma character is sometimes called a CSV (Comma Separated Values) data file.

Here are some tips for using a text file as a data source.

- On the Step 2: Data source tab:
  - Set the Type to Text File.
  - Specify the folder where the text file is located using the Database or file name field.
- On the Step 3: Data definition tab:
  - Typically you will select Table as the Source for data records. Then in the Table drop-down list you will select the name of the text file you want to use. Any embedded period characters in the file name will be replaced with the “#” character, so the file TextData.txt will appear as TextData#txt in the drop-down list.

If you select Custom query as the Source for data records you must specify the text file name in place of the table name in your SQL SELECT statement. Any embedded period characters in the file name must be replaced with the “#” character. For instance, if the text file name is TextData.txt, then the custom query might look like this:

```
SELECT * FROM [TextData1#txt]
```

- CHARTrunner uses the JET 4.0 database engine to fetch data from a text file data source. By default, JET expects the first row of data to contain the column (or field) names, and each column of data to be separated from the next by the comma character, such as is shown by the following data:

```
Date,Value1,Value2,Value3
1/1/2000,11.6,12.8,12.4
1/2/2000,12.3,12.1,11.9
1/3/2000,15.6,12.3,12.4
```

- If the format of the data in the text file does not have the field names in the first row, or the columns are not separated by the comma character, then CHARTrunner will be unable to read the data file. In that case refer to the following knowledgebase article for assistance:  
<http://www.pqsystems.com/kb/activekb/questions/21/>  
<http://www.pqsystems.com/kb/activekb/questions/21/>

## Using FoxPro data

To use FoxPro 2.0, 2.5, 2.6, or 3.0 data within CHARTrunner, you must follow these steps:

1. On the Step 2: Data source tab, set the Type to ADO;OLE DB Provider.
2. In the ADO;OLE DB Provider field, select ODBC Driver for Visual FoxPro - Without database container from the drop-down list.
3. Edit the Connection string so that it looks like this:
 

```
Provider=MSDASQL.1;Persist Security Info=False;Extended
Properties="Driver={Microsoft Visual FoxPro Driver};
SourceType=DBF; SourceDb=X:\XXXXXX\XXXXX;
```

Exclusive=No;"

Change X:\XXXXXX\XXXXXX to be the location of the folder where the FoxPro table \*.DBF files are located.

4. Go to the Step 3: Data definition tab and select a FoxPro table from the Table drop-down list.
5. Click on SQL Settings and be sure to uncheck the Use brackets setting. If you do not do this, when you try to draw the chart, you will get the following error message: "Item cannot be found in the collection corresponding to the requested name or ordinal."

## Using Paradox 3 data

Paradox 3 databases usually require you to use the "Custom query" option. Selecting "Table" with Paradox 3 databases will give you an error. If you have both the Paradox table AND the primary key table, you might be able to use the "table" option. For example, if you have a Paradox 3.5 table named:

MyData.PD

There should also be a file named:

MyData.PX

This is the "primary key" for the table. Without this .PX file, you will have to use the "Custom Query" option in CHARTrunner and enter a SELECT statement like this:

```
SELECT * FROM MyData
```

The errors you might see are:

"Collating sequence not supported by the operating system"

or

"Operation not supported on a Paradox table with no primary key"

## Using Minitab data

CHARTrunner can chart data that is stored in Minitab files.

By default, Minitab stores data in Projects .MPJ and Worksheets .MTW; but by using the following steps, you can store data in other formats. To do this:

1. While in Minitab, open the File Menu and select Save Current Worksheet As.
2. Select a file type, such as Excel.
3. When creating the chart in CHARTrunner, you would use Excel as the Data Source.

## Using Lotus Notes databases

Following is a brief description for creating a DSN for users to connect to Lotus Notes (\*.nsf) databases with CHARTrunner.

To create a DSN to connect Lotus Notes (\*.nsf) databases with CHARTrunner:

1. You must have one of the following:

Designer clients:

- Lotus Notes (full client) 4.5x, or
- Lotus Notes Designer for Domino 4.6x, or
- Domino Designer 5.0

Lotus Desktop License:

- Lotus Notes Desktop License 4.6x, or
- Lotus Notes 5.0

Lotus Server:

- Lotus Domino Mail Server 4.6x, or
- Lotus Domino R5 Mail Server, or
- Lotus Domino R5 Application Server

2. You must have NotesSQL 2.06 loaded onto your PC. This can be downloaded from [www.lotus.com](http://www.lotus.com).

To use notes databases

1. Set up a System DSN to connect to the Notes database you want to use.
2. In CHARTrunner, set the Data source type on the Step 2: Data Source Tab to ODBC: Open Database Connectivity.
3. The System DSN you have just created will appear in the ODBC Driver List combo box. Select this DSN and continue setting up the chart definition.

## Using Oracle databases

Please refer to the Knowledgebase articles that deal with using Oracle as a CHARTrunner data source.

In particular, these are good reference articles:

**<http://www.pqsystems.com/kb/activekb/questions/17/>**  
(<http://www.pqsystems.com/kb/activekb/questions/17/>)

**<http://www.pqsystems.com/kb/activekb/questions/23/>**  
(<http://www.pqsystems.com/kb/activekb/questions/23/>)

## Using SQL Server databases

Please refer to the Knowledgebase articles that deal with using SQL Server as a CHARTrunner data source.

In particular, these are good reference articles:

***<http://www.pqsystems.com/kb/activekb/questions/18/>***  
(<http://www.pqsystems.com/kb/activekb/questions/18/>)

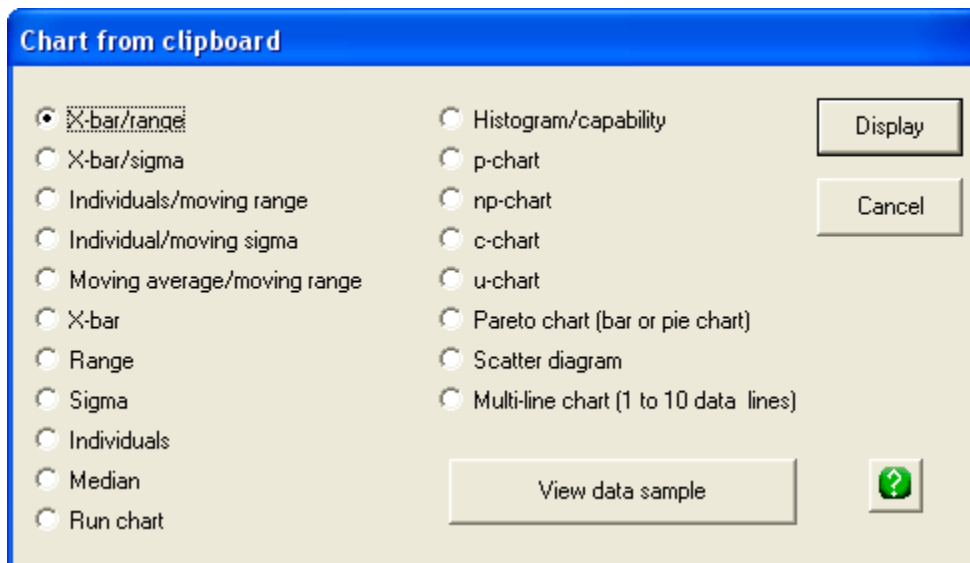
## Charting from data on the clipboard

CHARTrunner can create charts from data that is stored on the Windows clipboard.

You must copy the data to be charted to the clipboard. In many applications, such as Microsoft Excel, you simply select the data of interest and then click Edit > Copy, or press the Ctrl-C key, and the selected data is copied to the clipboard.



After the data to be charted has been copied to the clipboard, click on the toolbar icon (indicated by the mouse pointer) shown above, or select View > Chart from clipboard. The Chart from clipboard window shown below will open.



Select the type of chart that you want to display.

Click on the View data sample button to view a sample of the data that CHARTrunner finds on the clipboard.

Click the Display button to display the specified chart from the clipboard data.

### Tips for charting from the clipboard

CHARTrunner expects data to be separated by either the comma character or the tab character. Data that is copied to the clipboard from Excel is separated by the tab character.

CHARTrunner makes a best guess of how to treat each column of data that it finds on the clipboard. It may be necessary for you to edit the definition of the displayed chart and on the Step 3: Data definition tab manually set the Treat as for each column of data.

Do not include column headings in the data that is copied to the clipboard. CHARTrunner expects that all of the information on the clipboard is actually chartable data. The first non-blank cell in each column of data is examined to determine if it contains a number, a date, or text. When you include column headings, CHARTrunner thinks that each column contains text data.





## CHAPTER 19

# Appendix E: Out-of-control tests and codes

The software includes a number of pre-defined out-of-control test definitions. On a control chart, out-of-control conditions may be labeled with a number. Which out-of-control conditions these numbers represent depends on which test definition you are using. This appendix includes a reference to the number codes and their corresponding test.

NOTE: If you have modified a test definition or are using a custom test definition, note that the tests codes are numbered in the order in which the test parameters appear on the Out-of-control test form.

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## AIAG

Code	Test
1	Beyond Limits
2	7 ascending
3	7 descending
4	7 above centerline
5	7 below centerline

## AT&T

Code	Test
1	2 of 3 above 2 sigma
2	2 of 3 below 2 sigma
3	4 of 5 below 1 sigma
4	4 of 5 below 1 sigma
5	Beyond limits
6	8 above centerline
7	8 below centerline

## Duncan

Code	Test
1	2 of 3 above 2 sigma
2	2 of 3 below 2 sigma
3	4 of 5 below 1 sigma
4	4 of 5 above 1 sigma
5	Beyond limits
6	8 above centerline
7	8 below centerline

## Gitlow attributes

Code	Test
1	Beyond limits
2	8 ascending
3	8 descending

## Gitlow variables

Code	Test
1	2 of 3 above 2 sigma
2	8 ascending
3	8 descending
4	4 of 5 above 1 sigma
5	Beyond limits
6	8 above centerline
7	8 below centerline

## Hughes

Code	Test
1	2 of 3 above 2 sigma
2	2 of 3 below 2 sigma
3	3 of 7 above 2 sigma
4	4 of 10 above 2 sigma
5	4 of 10 below 2 sigma
6	3 of 7 below 2 sigma
7	Beyond limits
8	7 ascending
9	7 descending
10	7 above centerline
11	7 below centerline
12	10 of 11 above centerline
13	10 of 11 below centerline
14	12 of 14 above centerline
15	12 of 14 below centerline

## Juran

Code	Test
1	2 of 3 above 2 sigma
2	2 of 3 below 2 sigma
3	4 of 5 below 1 sigma
4	4 of 5 above 1 sigma
5	Beyond limits
6	6 ascending
7	6 descending
8	9 above centerline
9	9 below centerline
10	8 beyond 1 sigma

## Shewhart

Code	Test
1	2 of 3 above 2 sigma
2	2 of 3 below 2 sigma
3	4 of 5 below 1 sigma
4	4 of 5 above 1 sigma
5	Beyond limits
6	8 above centerline
7	8 below centerline

## SQCpack

Code	Test
1	Beyond limits
2	7 ascending
3	7 descending
4	7 above centerline
5	7 below centerline

## Western

Code	Test
1	4 of 5 beyond 1 sigma
2	2 of 3 beyond 2 sigma
3	Beyond limits
4	8 above centerline
5	8 below centerline

## Swed Eisenhart run chart tests (1% risk)

Code	Test
1	SwedEisenhart too little variation (1% risk)
2	SwedEisenhart too much variation (1% risk)
3	SwedEisenhart run
4	SwedEisenhart trend

NOTE: The Swed Eisenhart tests are generally applied only to run charts. These are often used in healthcare applications, and they are described in the book *Improving Healthcare with Control Charts* by Raymond G. Carey, Ph.D.

To determine if a point violates one of the rules, a lookup table is used. The lookup table is based on the number of data points on the chart and the number of runs present. When a data point violates a rule, it is displayed using the “OOC data” marker style that is defined by the style definition used by the chart.

The tests that are named too much variation and too little variation use two different lookup tables. These tables are calculated differently based on the risk of failing the run test for random patterns of data. One table is based on a 1% risk, and the other table is based on a 5% risk. This is why CHARTrunner offers both a 1% and a 5% version of the Swed Eisenhart tests.

If you have any doubt about which set to use, select the 1% tests. Different practitioners have different preferences for how sensitive they want these tests to be. For example, Robert Lloyd prefers the tests based on 1% risk while Lloyd Provost recommends the tests be based on 5% risk.

## Swed Eisenhart run chart tests (5% risk)

Code	Test
1	SwedEisenhart too little variation (5% risk)

- 2 SwedEisenhart too much variation (5% risk)
- 3 SwedEisenhart run
- 4 SwedEisenhart trend

NOTE: The Swed Eisenhart tests are generally applied only to run charts. These are often used in healthcare applications, and they are described in the book *Improving Healthcare with Control Charts* by Raymond G. Carey, Ph.D.

To determine whether a point violates one of the rules, a lookup table is used. The lookup table is based on the number of data points on the chart and the number of runs present. When a data point violates a rule, it is displayed using the “OOC data” marker style that is defined by the style definition used by the chart.

The tests that are named too much variation and too little variation use two different lookup tables. These tables are calculated differently based on the risk of failing the run test for random patterns of data. One table is based on a 1% risk, and the other table is based on a 5% risk. This is why CHARTrunner offers both a 1% and a 5% version of the Swed Eisenhart tests.

If you have any doubt about which set to use, select the 1% tests. Different practitioners have different preferences for how sensitive they want these tests to be. For example, Robert Lloyd prefers the tests based on 1% risk while Lloyd Provost recommends the tests be based on 5% risk.

## Healthcare basic

Code	Test
1	1 beyond limits
2	6 ascending (n<20)
3	6 descending (n<20)
4	7 ascending only (n>=20)
5	7 descending only (n>=20)
6	8 above centerline
7	8 below centerline

From *Quality Health Care* by Robert Lloyd page 210 – 216

## Healthcare extended

Code	Test
1	1 beyond limits
2	6 ascending (n<20)
3	6 descending (n<20)
4	7 ascending only (n>=20)
5	7 descending only (n>=20)

6	8 above centerline
7	8 below centerline
8	2 of 3 above 2 sigma
9	2 of 3 below 2 sigma
10	4 of 5 above 1 sigma
11	4 of 5 below 1 sigma

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## Healthcare advanced

Code	Test
1	1 beyond limits
2	6 ascending (n<20)
3	6 descending (n<20)
4	7 ascending only (n>=20)
5	7 descending only (n>=20)
6	8 above centerline
7	8 below centerline
8	2 of 3 above 2 sigma
9	2 of 3 below 2 sigma
10	4 of 5 above 1 sigma
11	4 of 5 below 1 sigma
12	15 within sigma
13	8 beyond 1 sigma
14	14 alternating

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