

## Chapter 165

# Scatter Plots with Error Bars

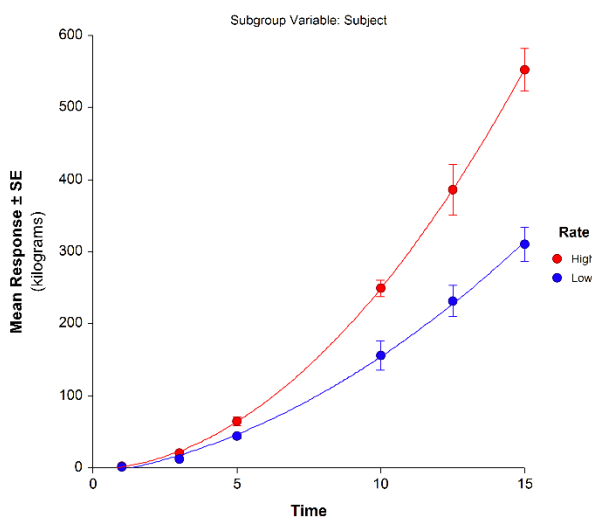
## Introduction

The Scatter Plots with Error Bars procedure extends the capability of the basic scatter plot by allowing you to plot the variability in Y and X corresponding to each point. Each point on the plot represents the mean or median of one or more values for Y and X within a subgroup. Error bars can be drawn in the Y or X direction, representing the variability associated with each Y and X center point value. The error bars may represent the standard deviation (SD) of the data, the standard error of the mean (SE), a confidence interval, the data range, or percentiles. This plot also gives you the capability of graphing the raw data along with the center and error-bar lines.

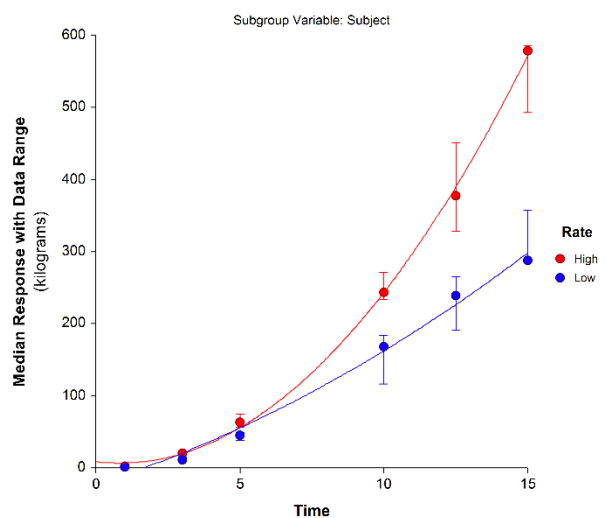
This procedure makes use of all of the additional enhancement features available in the basic scatter plot, including trend lines (least squares), confidence limits, polynomials, splines, loess curves, and border plots.

The following graphs are examples of scatter plots with error bars that you can create with this procedure. This chapter contains information only about options that are specific to the Scatter Plots with Error Bars procedure. For information about the other graphical components and scatter-plot specific options available in this procedure (e.g. regression lines, border plots, etc.), see the chapter on Scatter Plots.

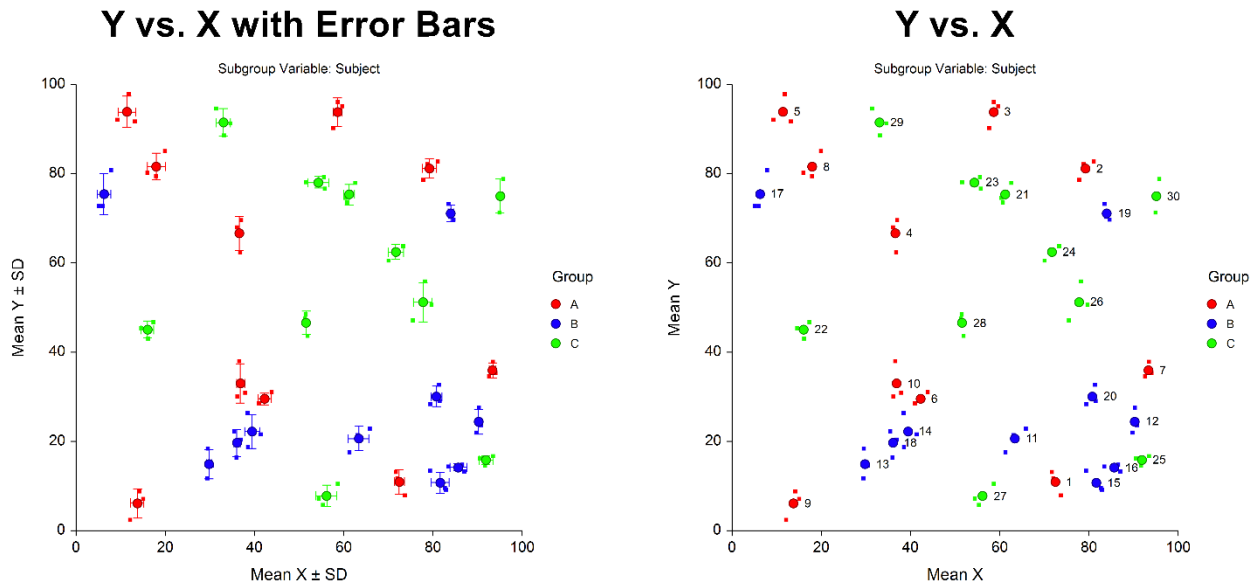
### Response vs. Time with Error Bars



### Response vs. Time with Error Bars



Scatter Plots with Error Bars



## Data Structure

This procedure accepts data in four different input formats. The type of plot that can be created depends on the input format.

A grouping variable may be used to divide the points into groups (e.g., age group or gender). Missing values are handled according to the Missing Values input option.

## Y and/or X Error Bars (One Y, One X, and a Subgroup (Subject) Variable)

In this type, Y and X values are contained in two separate columns. A required Subgroup (Subject) Variable is used to break the Y and X values into subgroups for mean and variance calculations. Each center point on the plot and the associated error bars correspond to the average (or median) Y and X values and associated variability computed for each unique subgroup variable value. A separate point is plotted for each subgroup.

### One Y Variable, One X Variable, and a Subgroup (Subject) Variable

Subject	Y	X
1	13.15	71.65
1	7.89	73.73
1	11.73	72.02
2	78.6	77.8
2	82.14	78.78
2	82.73	81.05
3	90.25	57.62
3	96.07	58.67
3	95.14	59.67
4	69.6	36.98
4	62.37	36.77
4	67.99	36.05

## Scatter Plots with Error Bars

**Y and/or X Error Bars (Data for Both Y and X in Multiple Columns)**

In this type, each subgroup (or “subject”) is represented by a single row, with multiple Y and X columns entered for each individual. Each point on the plot and the associated error bars correspond to the average (or median) Y and X values and the associated variability computed for each row. A separate point is plotted for each row.

**Data for Y and X in Multiple Columns**

Subject	Y_1	Y_2	Y_3	X_1	X_2	X_3
1	13.15	7.89	11.73	71.65	73.73	72.02
2	78.6	82.14	82.73	77.8	78.78	81.05
3	90.25	96.07	95.14	57.62	58.67	59.67
4	69.6	62.37	67.99	36.98	36.77	36.05

**Y Error Bars (Data for Y in Multiple Columns with One X Variable)**

In this type, each subgroup (or “subject”) is represented by a single row, with multiple Y columns and one X column entered for each individual. Each point on the plot and the associated error bars correspond to the average (or median) Y values and the Y variability computed for each row. A separate point is plotted for each row.

**Data for Y in Multiple Columns with One X Variable**

Subject	Y_1	Y_2	Y_3	X
1	13.15	7.89	11.73	71.65
2	78.6	82.14	82.73	77.8
3	90.25	96.07	95.14	57.62
4	69.6	62.37	67.99	36.98

**X Error Bars (Data for X in Multiple Columns with One Y Variable)**

In this type, each subgroup (or “subject”) is represented by a single row, with multiple X columns and one Y column entered for each individual. Each point on the plot and the associated error bars correspond to the average (or median) X values and the X variability computed for each row. A separate point is plotted for each row.

**Data for X in Multiple Columns with One Y Variable**

Subject	Y	X_1	X_2	X_3
1	13.15	71.65	73.73	72.02
2	78.6	77.8	78.78	81.05
3	90.25	57.62	58.67	59.67
4	69.6	36.98	36.77	36.05

**Lines and Border Plots**

All regression lines, border plots, and other calculations are made using the center points (means and/or medians), not the raw data. The raw data, however, can be included on the plot.

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## Procedure Options

This section describes the options available in the Scatter Plot with Error Bars procedure.

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### Variables Tab

This panel specifies which variables are used in the scatter plot with error bars.

#### Data Input Type

There are two ways to organize the data in the database for input into this procedure:

- **Y and/or X Error Bars (One Y, One X, and a Subgroup (Subject) Variable)**

In this type, Y and X values are contained in two separate columns. A required Subgroup (Subject) Variable is used to break the Y and X values into subgroups for mean and variance calculations. Each center point on the plot and the associated error bars correspond to the average (or median) Y and X values and associated variability computed for each unique subgroup variable value. A separate point is plotted for each subgroup.

- **Y and/or X Error Bars (Data for Both Y and X in Multiple Columns)**

In this type, each subgroup (or “subject”) is represented by a single row, with multiple Y and X columns entered for each individual. Each point on the plot and the associated error bars correspond to the average (or median) Y and X values and the associated variability computed for each row. A separate point is plotted for each row.

If only one column is entered for either X or Y, no error bars will be plotted on the corresponding axis.

- **Y Error Bars (Data for Y in Multiple Columns with One X Variable)**

In this type, each subgroup (or “subject”) is represented by a single row, with multiple Y columns and one X column entered for each individual. Each point on the plot and the associated error bars correspond to the average (or median) Y values and the Y variability computed for each row. A separate point is plotted for each row.

If only one column is entered for Y, no error bars will be plotted.

- **X Error Bars (Data for X in Multiple Columns with One Y Variable)**

In this type, each subgroup (or “subject”) is represented by a single row, with multiple X columns and one Y column entered for each individual. Each point on the plot and the associated error bars correspond to the average (or median) X values and the X variability computed for each row. A separate point is plotted for each row.

If only one column is entered for X, no error bars will be plotted.

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#### Variables – Data Input Type = “Y and/or X Error Bars (One Y, One X, and a Subgroup (Subject) Variable)”

##### Y (Vertical) Variable

Specify a column whose values are to be summarized using the Subgroup (Subject) Variable. The means (or medians) are plotted on the vertical axis. Each Y center point value on the plot and the associated vertical error bars correspond to the mean (or median) Y values and variability computed for each unique subgroup variable value.

## Scatter Plots with Error Bars

### X (Horizontal) Variable

Specify a column whose values are to be summarized using the Subgroup (Subject) Variable. The means (or medians) are plotted on the horizontal axis. Each X center point value on the plot and the associated horizontal error bars correspond to the mean (or median) X values and variability computed for each unique subgroup variable value.

### Subgroup (Subject) Variable

The values in this column are used to separate the data into subgroups for summary statistic calculations. Summary measures (mean, median, and variability) are calculated for both the Y and X variables for each unique value in this variable. A separate point is plotted for each unique subgroup variable value.

### Data Labels

If you activate Data Labels on the plot, the values in this variable will be used to label the individual points.

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## Variables – Data Input Type = “Y and/or X Error Bars (Data for Both Y and X in Multiple Columns)”

### Y (Vertical) Variable(s)

Specify one or more columns containing data to be summarized and plotted on the vertical axis. The mean, median, and variability for all of columns entered will be calculated within each row. Each Y center point value on the plot and the associated vertical error bars correspond to the mean (or median) Y values and variability computed for each row.

If only one column is entered, no vertical error bars will be plotted.

### X (Horizontal) Variable(s)

Specify one or more columns containing data to be summarized and plotted on the horizontal axis. The mean, median, and variability for all of columns entered will be calculated within each row. Each X center point value on the plot and the associated horizontal error bars correspond to the mean (or median) X values and variability computed for each row.

If only one column is entered, no horizontal error bars will be plotted.

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## Variables – Data Input Type = “Y Error Bars (Data for Y in Multiple Columns with One X Variable)”

### Y (Vertical) Variable(s)

Specify one or more columns containing data to be summarized and plotted on the vertical axis. The mean, median, and variability for all of columns entered will be calculated within each row. Each Y center point value on the plot and the associated vertical error bars correspond to the mean (or median) Y values and variability computed for each row.

If only one column is entered, no vertical error bars will be plotted.

### X (Horizontal) Variable

Specify a column with values to be plotted on the horizontal axis.

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## Variables – Data Input Type = “X Error Bars (Data for X in Multiple Columns with One Y Variable)”

### Y (Vertical) Variable

Specify a column with values to be plotted on the vertical axis.

## Scatter Plots with Error Bars

### X (Horizontal) Variable(s)

Specify one or more columns containing data to be summarized and plotted on the horizontal axis. The mean, median, and variability for all of columns entered will be calculated within each row. Each X center point value on the plot and the associated horizontal error bars correspond to the mean (or median) X values and variability computed for each row.

If only one column is entered, no horizontal error bars will be plotted.

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## Variables – Common Options

### Grouping (Symbol) Variable

This variable may be used to separate the observations into groups. For example, you might want to use different plotting symbols to distinguish observations from different groups. You designate the grouping variable here. Each unique value of this column is plotted with a different symbol. The symbols are selected by clicking on the plot format button and then clicking on the symbol format button.

### Data Label Variable

*(Not available if Data Input Type = “Y and/or X Error Bars (One Y, One X, and a Subgroup (Subject) Variable)”)*

A data label is text that is displayed beside each point. A column containing the data labels is specified here. The values may be text or numeric. The data labels will not be shown unless you activate them by clicking the plot format button and checking “Labels.”

When Data Input Type = “Y and/or X Error Bars (One Y, One X, and a Subgroup (Subject) Variable),” the Subgroup (Subject) Variable values are used as the data labels on the plot (when activated).

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## Missing Values

### Missing Values

This option allows you to specify how rows with missing values are handled. The options are

- **Include Rows with Missing Y’s or X’s**

Rows that contain either a missing Y value or a missing X value are included in mean, median, and variance calculations.

- **Exclude Rows with Missing Y’s or X’s**

Rows that contain either a missing Y value or a missing X value are not included in mean, median, and variance calculations. If a missing Y or X value is encountered, the entire row is ignored.

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## Format Options

### Variable Names

This option selects whether to display variable names, labels, or both.

### Value Labels

This option selects whether to display only values, value labels, or both. Use this option if you want the group variable to automatically attach labels to the values (like 1=Yes, 2=No, etc.).

## Scatter Plots with Error Bars

### Scatter Plot with Error Bars Format

#### Format

Click the format button to change the plot settings (see Scatter Plot with Error Bars Window Options below).

#### Edit During Run

Checking this option will cause the Scatter Plot Format window to appear when the procedure is run. This allows you to modify the format of the graph with the actual data.

### Symbol Size Options

(Not available if Data Input Type = “Y and/or X Error Bars (One Y, One X, and a Subgroup (Subject) Variable)”)

#### Symbol Size Variable

This optional variable can be used to specify a proportional size for the data points.

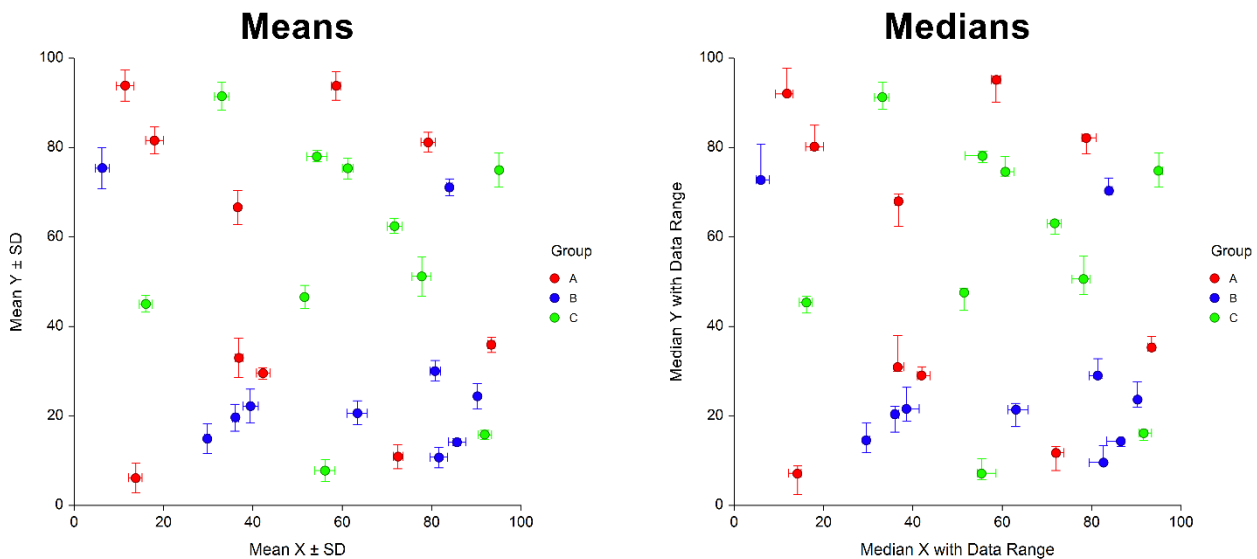
## Scatter Plot with Error Bars Window Options

This section describes the specific options available on the Scatter Plot with Error Bars window, which is displayed when the Plot Format button is clicked. For information about the other graphical components and scatter-plot specific options available in this procedure (e.g. symbols, regression lines, data labels, etc.), see the chapter on Scatter Plots. Common plot options, such as axes, labels, legends, and titles are documented in the Graphics Components chapter.

## Scatter Plot Tab

### Estimation of Center

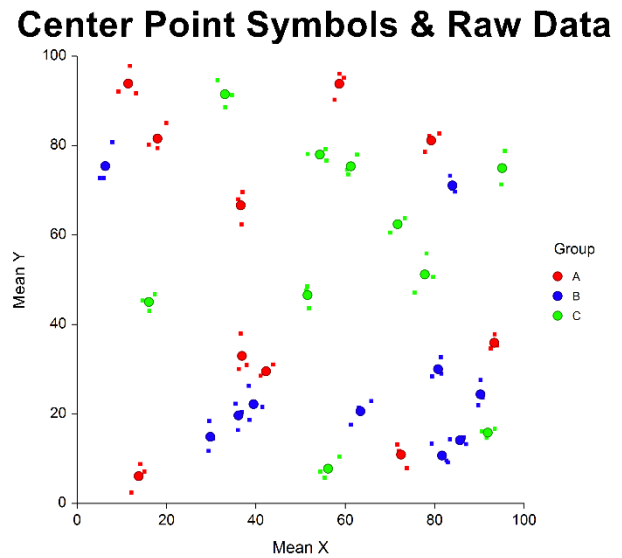
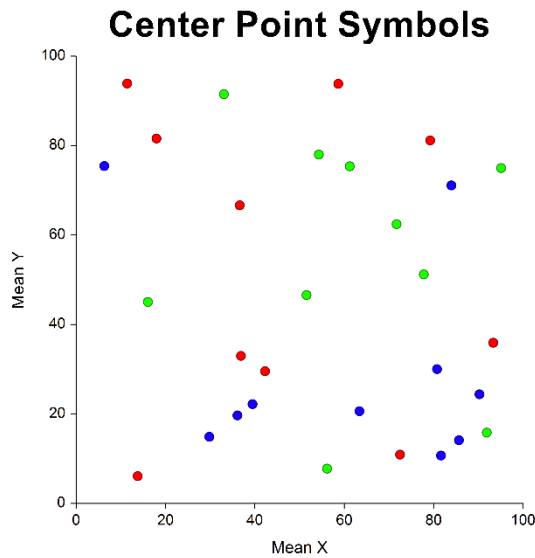
You can choose whether to plot means or medians for Y and X.



## Scatter Plots with Error Bars

### Symbols

You can choose whether to plot the center points, the raw data values, or both. You can also modify the appearance of all symbols on the plot.

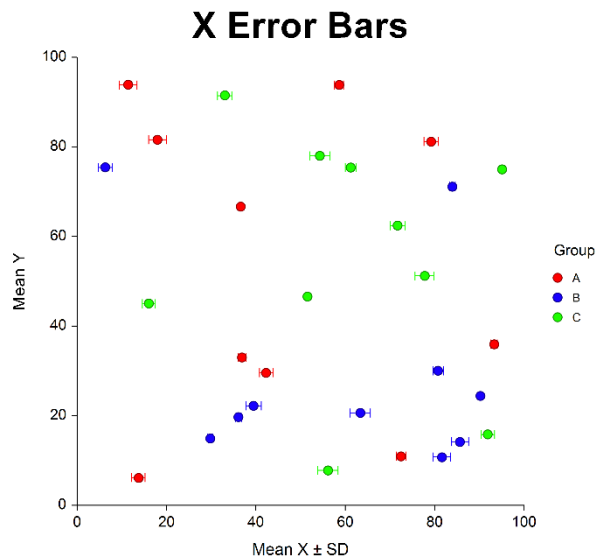
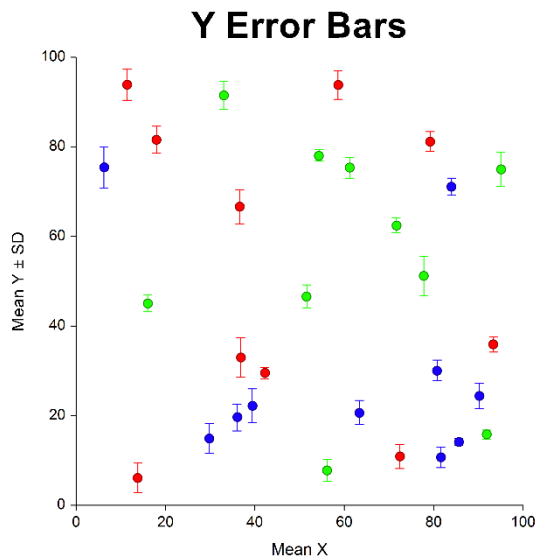


### Variation (Error Bars)

You can modify the content and appearance of the vertical and horizontal error bars using these options. We will highlight the most commonly-used options.

#### Y and X Error Bar Lines

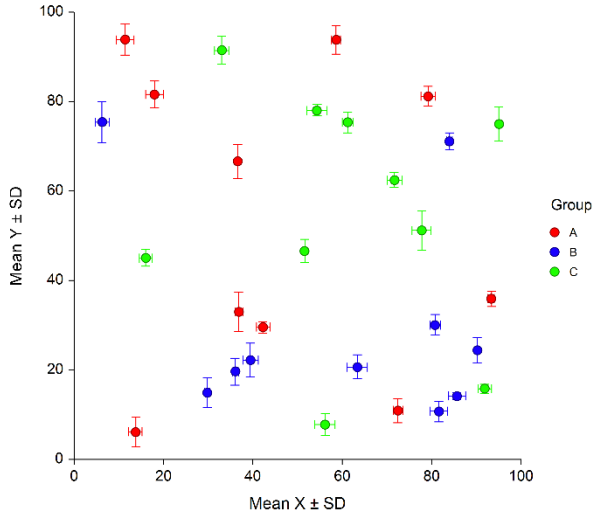
Select the error bars to be displayed.





### Scatter Plots with Error Bars

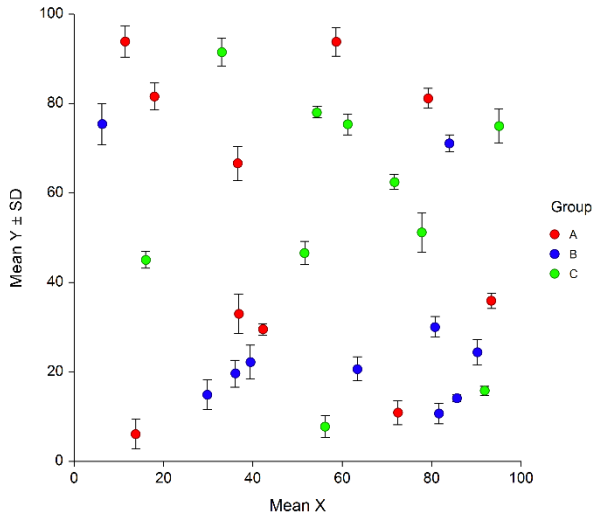
#### Y and X Error Bars



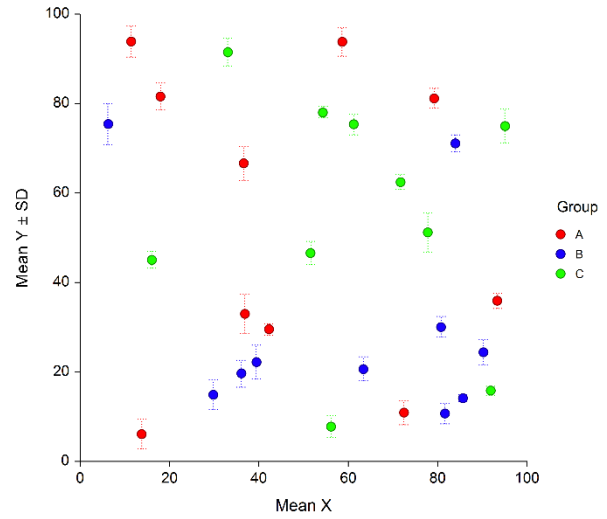
#### Line Color and Style

Specify the color and style of error bar lines. The lines and symbols are completely customizable.

#### Black Error Bars



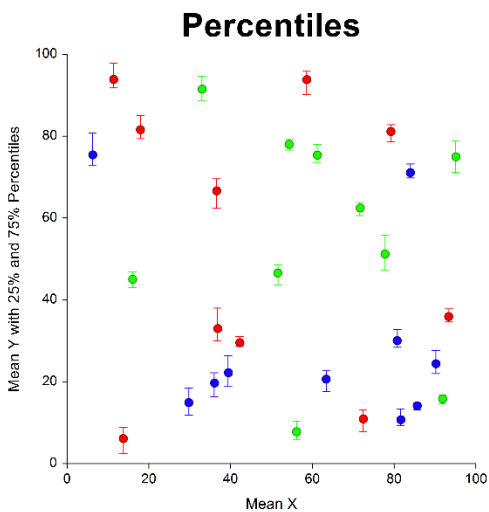
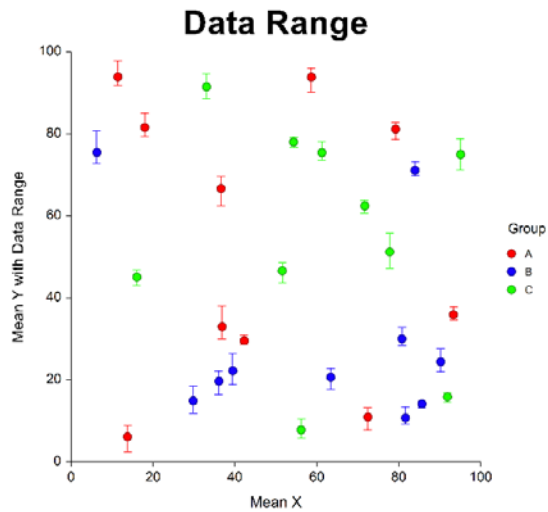
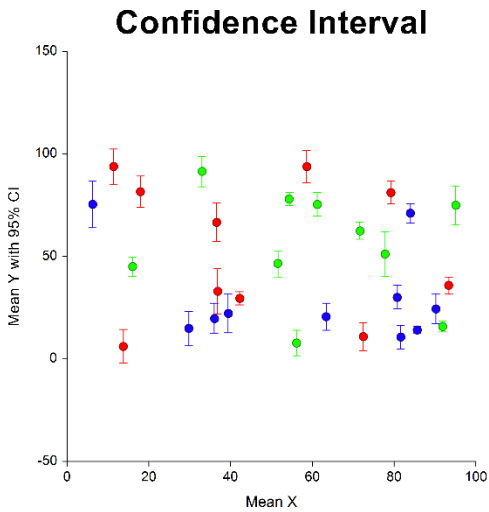
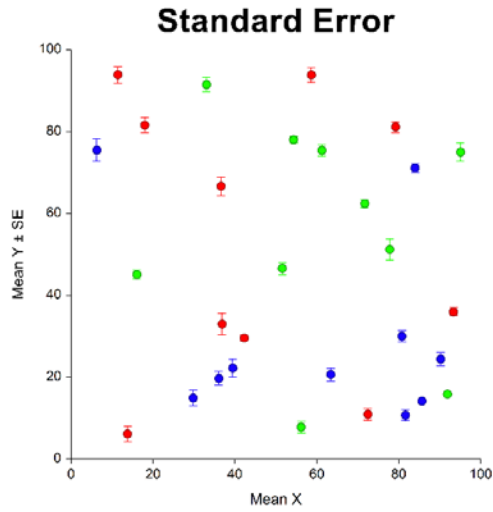
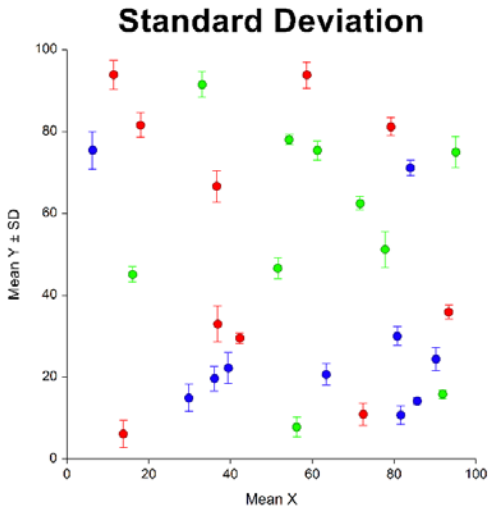
#### Dotted Error Bars



### Scatter Plots with Error Bars

#### Type

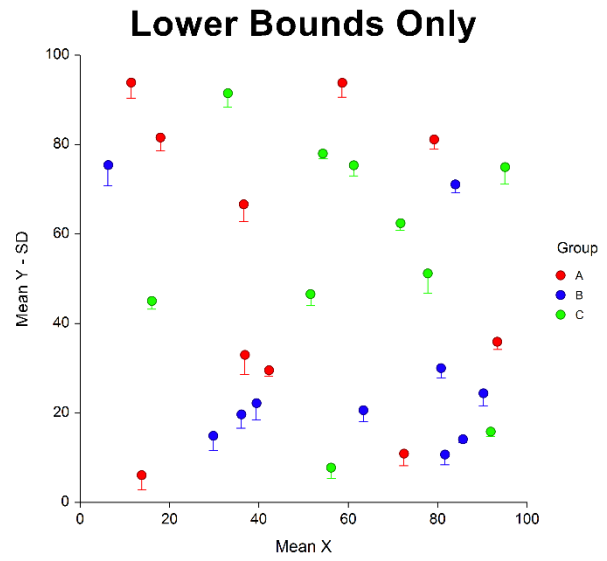
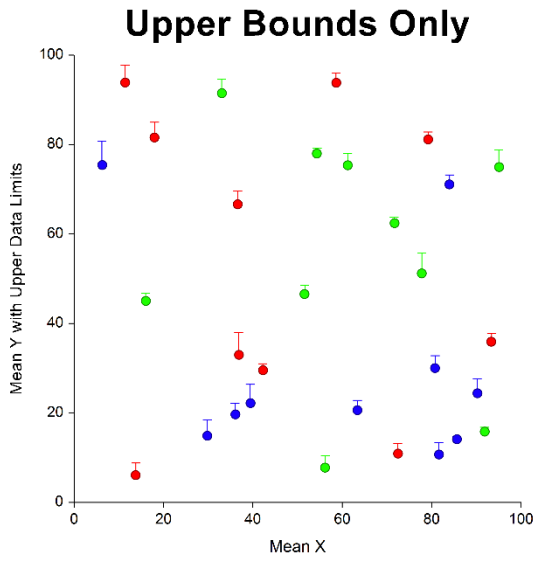
Specify whether to use the standard deviation (SD) of the data, the standard error of the mean (SE), a confidence interval, the data range, or percentiles in computing the length of the error bars and their bounds.



### Scatter Plots with Error Bars

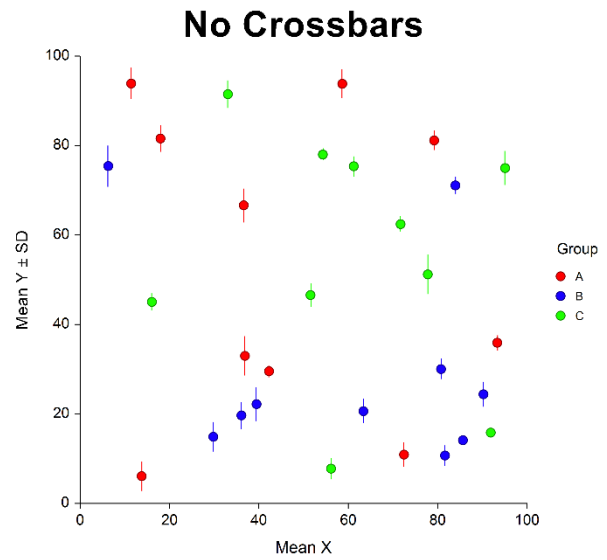
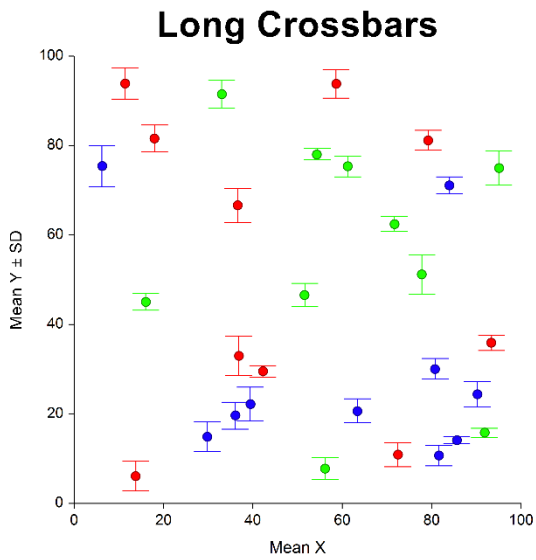
#### Direction

Specify whether error bars extend up or down (right or left) from the center point.



#### Crossbars

Specify whether or not to include crossbars and their size.



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## Example 1 – Creating a Scatter Plot with Error Bars using a Subgroup (Subject) Variable

This example demonstrates how to generate a simple scatter plot with error bars from data that includes a subgroup variable. The data used are contained in the `ScatPlotError1` dataset. In this example, `Response` is the Y variable and `Time` is the X variable. Each response is repeated three times for each time value.

You may follow along here by making the appropriate entries or load the completed template **Example 1** by clicking on `Open Example Template` from the `File` menu of the `Scatter Plots with Error Bars` procedure window.

### 1 Open the `ScatPlotError1` dataset.

- From the `File` menu of the `NCSS Data` window, select **Open Example Data**.
- Click on the file `ScatPlotError1`.
- Click **Open**.

### 2 Open the `Scatter Plots with Error Bars` window.

- Using the `Graphics` menu or the `Procedure Navigator`, find and select the **Scatter Plots with Error Bars** procedure.
- On the menus, select **File**, then **New Template**. This will fill the procedure with the default template.

### 3 Specify the variables.

- For **Data Input Type** select **Y and/or X Error Bars (One Y, One X, and a Subgroup (Subject) Variable)**.
- For **Y (Vertical) Variable** enter “**Response**”.
- For **X (Horizontal) Variable** enter “**Time**”.
- For **Subgroup (Subject) Variable** enter “**Subject**”.
- For **Grouping (Symbol) Variable** enter “**Rate**”.

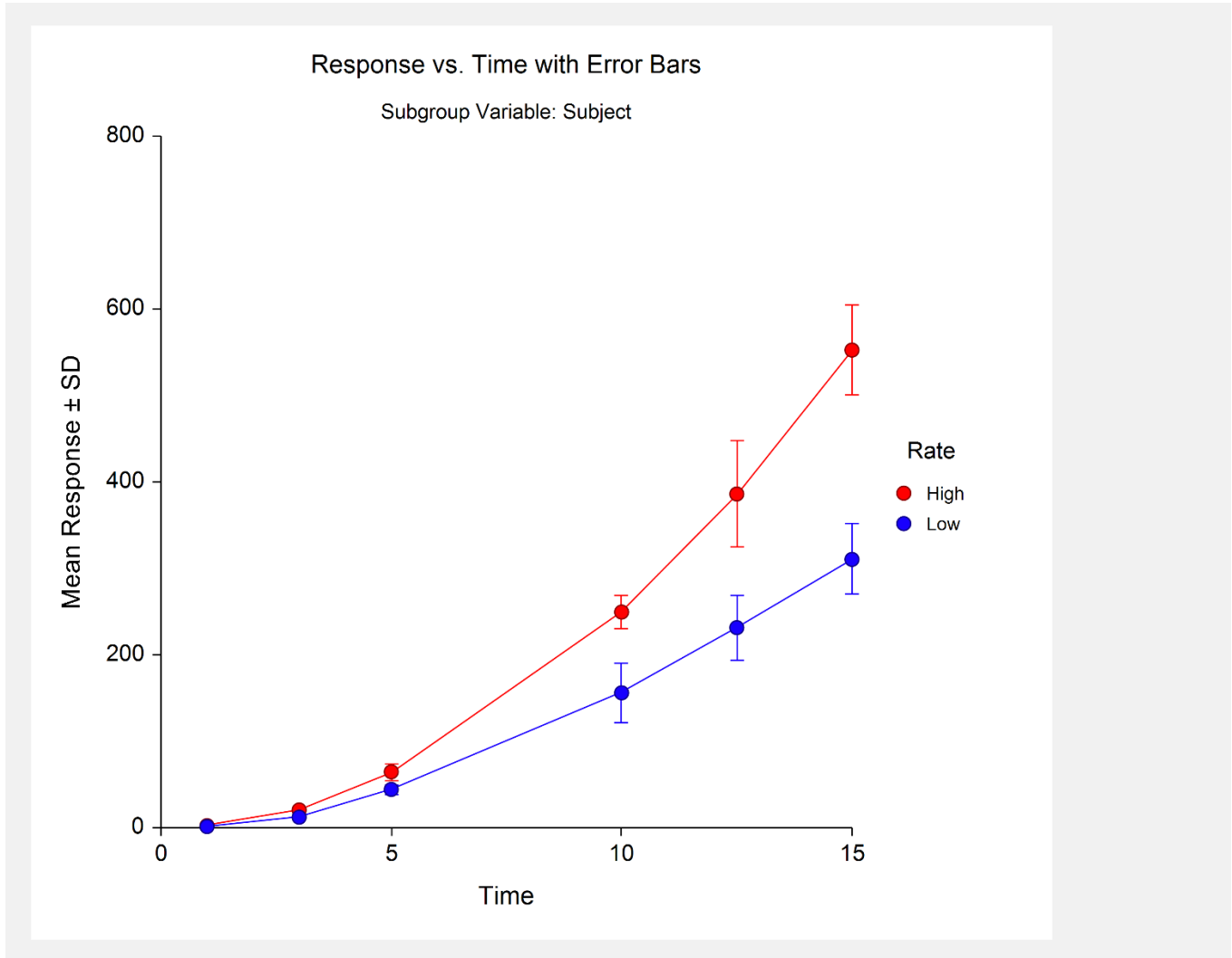
### 4 Edit the Plot.

- Click on the **Plot Format** button.
- On the **Scatter Plot** tab, change the **Y Error Bar Variation Line Type** to **Standard Deviation (SD)**.
- Select the **More Lines** tab, and put a checkmark next to **Line** under **Connect Center Points**.
- Click **OK** to save the plot settings.

### 5 Run the procedure.

- From the `Run` menu, select **Run Procedure**. Alternatively, just click the green `Run` button.

## Scatter Plot Output



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## Example 2 – Creating a Scatter Plot with Error Bars from Data with Y's and X's in Multiple Columns

This example demonstrates how to generate a simple scatter plot with both Y and X error bars from data where X and Y measurements are stored in multiple columns. In this example, we'll plot medians instead of means. The data used are contained in the ScatPlotError2 dataset.

You may follow along here by making the appropriate entries or load the completed template **Example 2** by clicking on Open Example Template from the File menu of the Scatter Plots with Error Bars procedure window.

### 1 Open the ScatPlotError2 dataset.

- From the File menu of the NCSS Data window, select **Open Example Data**.
- Click on the file **ScatPlotError2**.
- Click **Open**.

### 2 Open the Scatter Plots with Error Bars window.

- Using the Graphics menu or the Procedure Navigator, find and select the **Scatter Plots with Error Bars** procedure.
- On the menus, select **File**, then **New Template**. This will fill the procedure with the default template.

### 3 Specify the variables.

- For **Data Input Type** select **Y and/or X Error Bars (Data for Both Y and X in Multiple Columns)**.
- For **Y (Vertical) Variable(s)** enter “**Y\_1, Y\_2, Y\_3**”.
- For **X (Horizontal) Variable(s)** enter “**X\_1, X\_2, X\_3**”.
- For **Grouping (Symbol) Variable** enter “**Group**”.

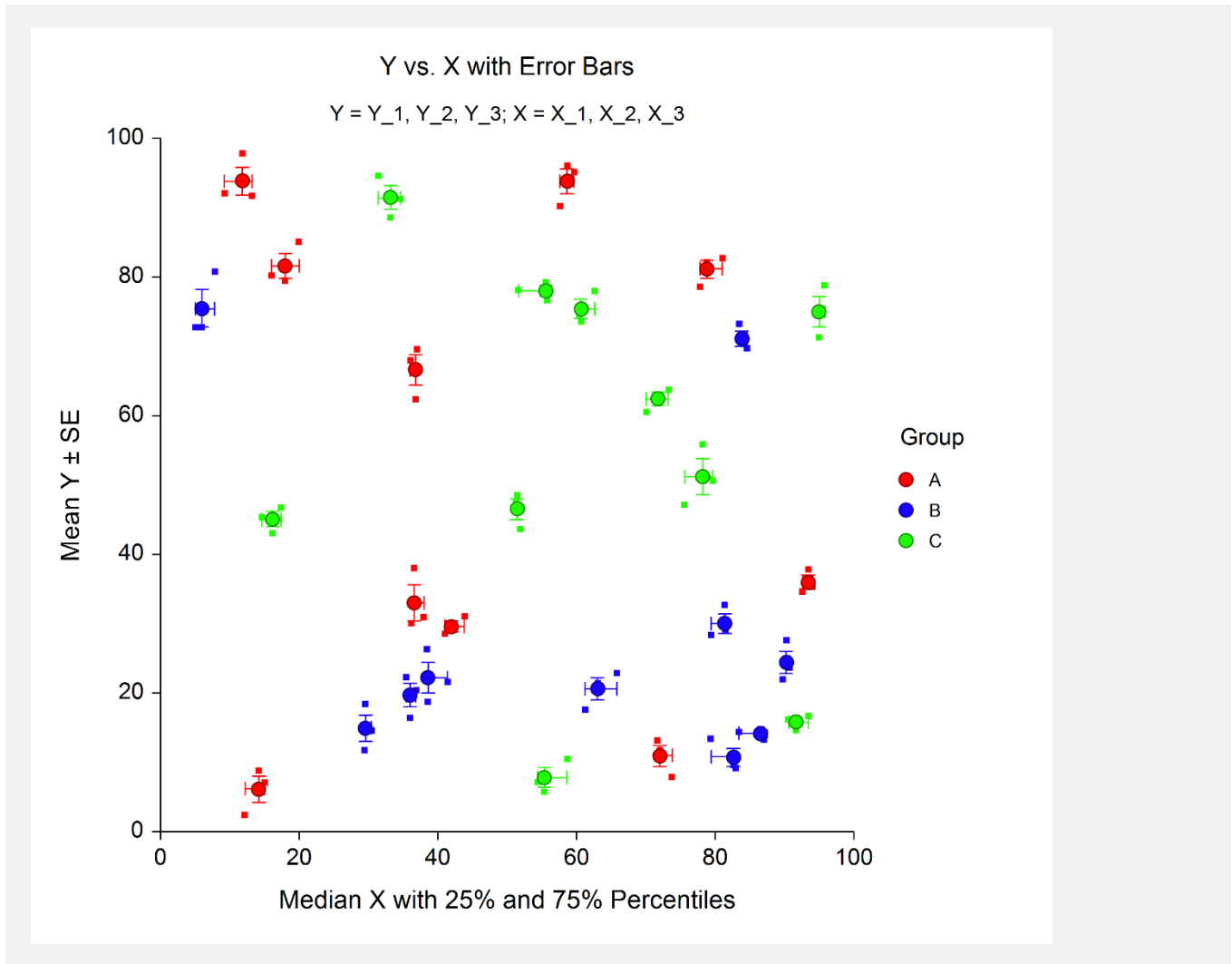
### 4 Edit the Plot.

- Click on the **Plot Format** button.
- On the **Scatter Plot** tab, change the **X Center Estimation Type** to **Median**.
- On the **Scatter Plot** tab, put a checkmark next to **Raw Data** under **Symbols**.
- Click **OK** to save the plot settings.

### 5 Run the procedure.

- From the Run menu, select **Run Procedure**. Alternatively, just click the green Run button.

## Scatter Plot Output



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## Example 3 – Creating a Scatter Plot with Y Error Bars from Data with Multiple Y Variables and One X Variable

This example shows how to generate a simple scatter plot with Y error bars from data where Y measurements are stored in multiple columns. The data used are contained in the ScatPlotError2 dataset.

You may follow along here by making the appropriate entries or load the completed template **Example 3** by clicking on Open Example Template from the File menu of the Scatter Plots with Error Bars procedure window.

### 1 Open the ScatPlotError2 dataset.

- From the File menu of the NCSS Data window, select **Open Example Data**.
- Click on the file **ScatPlotError2**.
- Click **Open**.

### 2 Open the Scatter Plots with Error Bars window.

- Using the Graphics menu or the Procedure Navigator, find and select the **Scatter Plots with Error Bars** procedure.
- On the menus, select **File**, then **New Template**. This will fill the procedure with the default template.

### 3 Specify the variables.

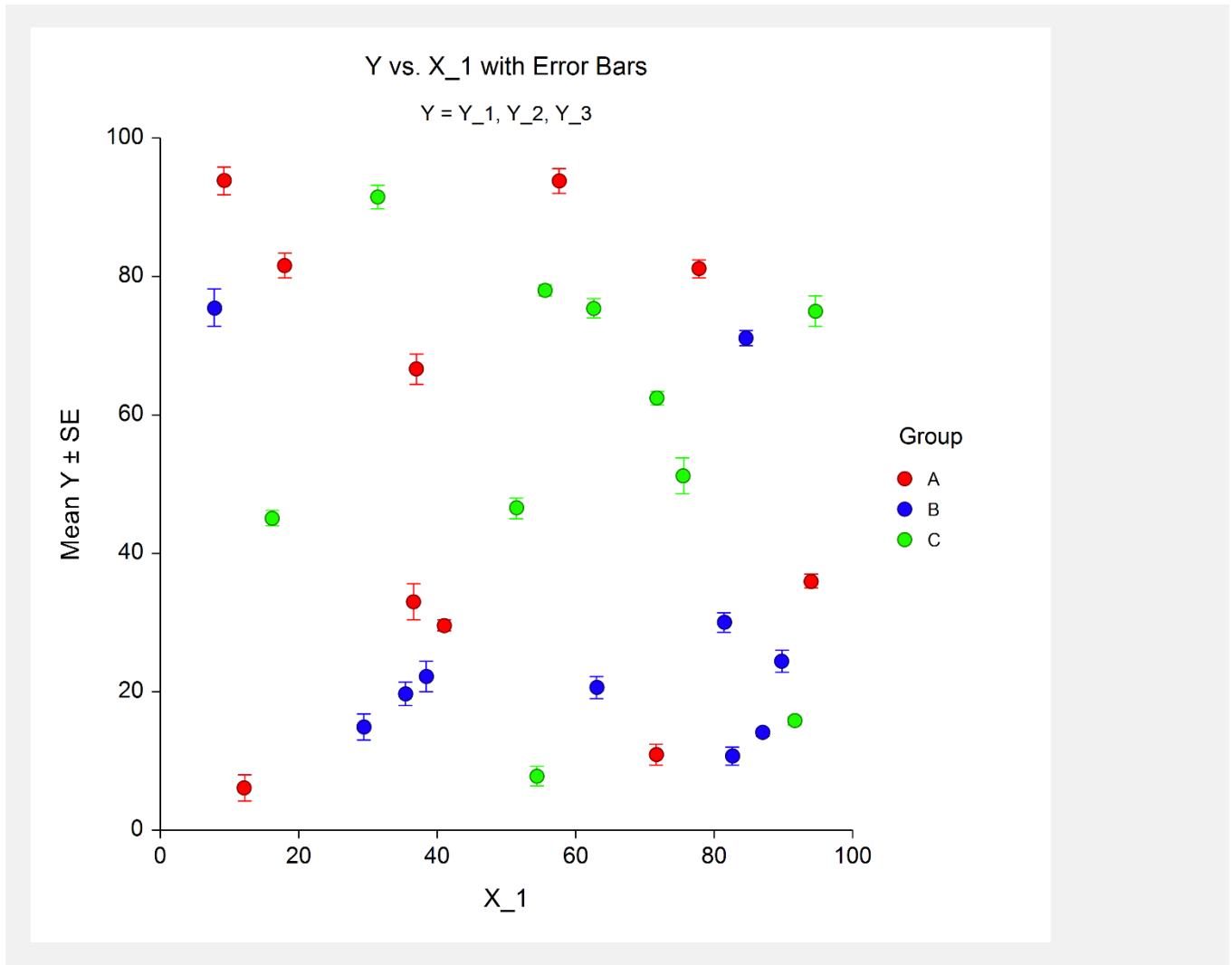
- For **Data Input Type** select **Y Error Bars (Data for Y in Multiple Columns with One X Variable)**.
- For **Y (Vertical) Variable(s)** enter “**Y\_1, Y\_2, Y\_3**”.
- For **X (Horizontal) Variable** enter “**X\_1**”.
- For **Grouping (Symbol) Variable** enter “**Group**”.

### 4 Run the procedure.

- From the Run menu, select **Run Procedure**. Alternatively, just click the green Run button.



# Scatter Plot Output



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## Example 4 – Creating a Scatter Plot with 95% Confidence Interval Limits for X from Data with Multiple X Variables and One Y Variable

This example shows how to generate a simple scatter plot with 95% confidence intervals for X from data where X measurements are stored in multiple columns. The data used are contained in the ScatPlotError2 dataset.

You may follow along here by making the appropriate entries or load the completed template **Example 3** by clicking on Open Example Template from the File menu of the Scatter Plots with Error Bars procedure window.

### 1 Open the ScatPlotError2 dataset.

- From the File menu of the NCSS Data window, select **Open Example Data**.
- Click on the file **ScatPlotError2**.
- Click **Open**.

### 2 Open the Scatter Plots with Error Bars window.

- Using the Graphics menu or the Procedure Navigator, find and select the **Scatter Plots with Error Bars** procedure.
- On the menus, select **File**, then **New Template**. This will fill the procedure with the default template.

### 3 Specify the variables.

- For **Data Input Type** select **X Error Bars (Data for X in Multiple Columns with One Y Variable)**.
- For **Y (Vertical) Variable** enter “**Y\_1**”.
- For **X (Horizontal) Variable(s)** enter “**X\_1, X\_2, X\_3**”.
- For **Grouping (Symbol) Variable** enter “**Group**”.

### 4 Edit the Plot.

- Click on the **Plot Format** button.
- On the **Scatter Plot** tab, put a checkmark next to **Raw Data** under **Symbols**.
- On the **Scatter Plot** tab, change the **X Error Bar Variation Line Type** to **Confidence Interval**.
- Click **OK** to save the plot settings.

### 5 Run the procedure.

- From the Run menu, select **Run Procedure**. Alternatively, just click the green Run button.

Scatter Plots with Error Bars

Scatter Plot Output

