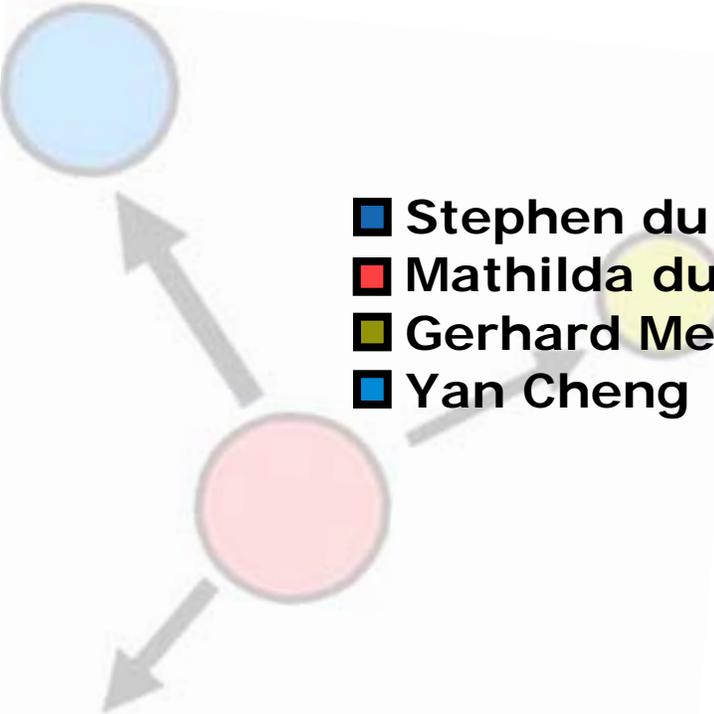
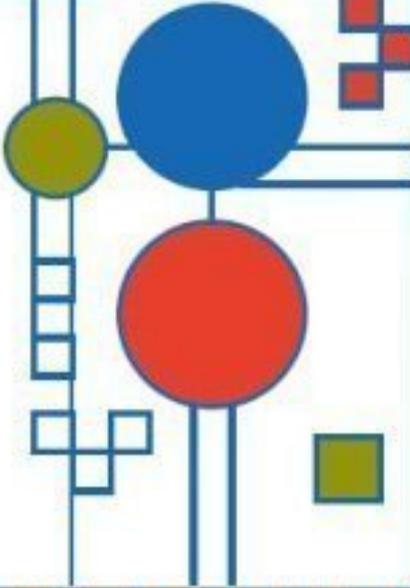


- 
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 - Yan Cheng



LISREL for Windows: Interactive Graphics User's Guide

SSI SCIENTIFIC
SOFTWARE
INTERNATIONAL

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Introduction

LISREL for Windows (Jöreskog & Sörbom 2005) is a Windows application for structural equation modeling, multilevel structural equation modeling, multilevel linear and nonlinear modeling, generalized linear modeling and formal inference-based recursive modeling. It also includes other statistical methods such as exploratory factor analysis, multiple linear regression analysis, two stage least squares regression analysis, logistic regression analysis, Probit regression analysis, censored regression analysis and bootstrapping.

However, it also includes an interactive graphics module which allows users to construct univariate, bivariate or multivariate graphs. The univariate graphs are bar charts, pie charts and histograms, the bivariate graphs are Box-and-Whisker plots, three dimensional bar charts, scatter plots and line plots and multivariate graphs are scatter plot matrices. These graphs can only be created interactively. In other words, they cannot be created by using syntax files. Once the graphs are created, they can be exported as Windows metafiles which can be inserted or imported in applications such as Microsoft Word, Microsoft PowerPoint and Microsoft Excel.

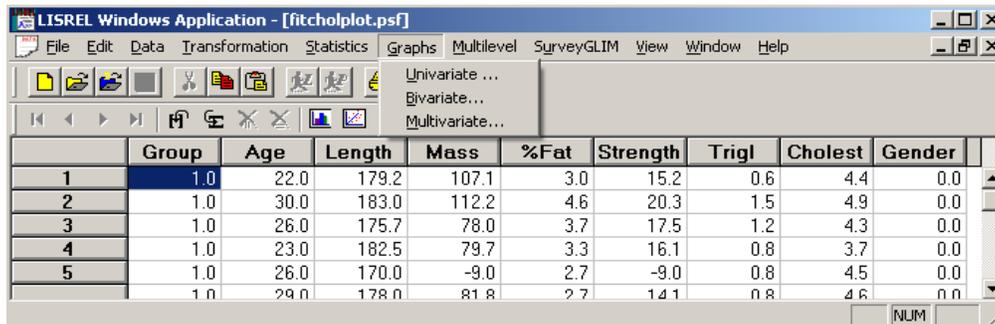
This document is an online guide for using the interactive graphics module of LISREL for Windows to prepare graphical displays. It supersedes sections 6 and 7 of Chapter 2 and section 7 of Chapter 7 of Du Toit & Du Toit (2001). First, we review the graphical user interface of the graphics module of LISREL for Windows. Thereafter, we provide illustrative examples of all the available graphs by using fitness data.

Graphical user interface

The graphical user interface (GUI) of the interactive graphics module consists of the three options and dialog boxes on the Graphs menu of the PSF (PRELIS System File) window of LISREL for Windows. This GUI allows the user to create univariate, bivariate and multivariate graphs interactively. The Graphs menu, it's options and the corresponding dialog boxes are reviewed in this section.

The Graphs menu

The **Graphs** menu is located on the PSF window of LISREL for Windows which is used to display, manipulate and process raw data. In other words, one needs to create a PSF and open it in a PSF window before using any option of the **Graph** menu interactively. To illustrate this, the PSF window for the file **fitcholplot.psf** in the **TUTORIAL** subfolder with the **Graphs** menu expanded is shown below.



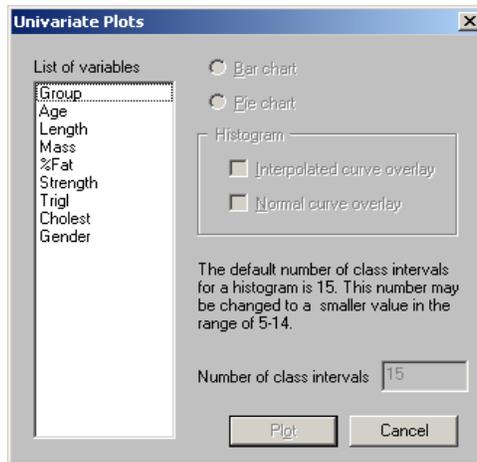
The screenshot shows the LISREL Windows Application window with the title bar "LISREL Windows Application - [fitcholplot.psf]". The menu bar includes File, Edit, Data, Transformation, Statistics, Graphs, Multilevel, SurveyGLIM, View, Window, and Help. The Graphs menu is expanded, showing three options: Univariate..., Bivariate..., and Multivariate... Below the menu is a data table with the following content:

	Group	Age	Length	Mass	%Fat	Strength	Trigl	Cholest	Gender	
1	1.0	22.0	179.2	107.1	3.0	15.2	0.6	4.4	0.0	
2	1.0	30.0	183.0	112.2	4.6	20.3	1.5	4.9	0.0	
3	1.0	26.0	175.7	78.0	3.7	17.5	1.2	4.3	0.0	
4	1.0	23.0	182.5	79.7	3.3	16.1	0.8	3.7	0.0	
5	1.0	26.0	170.0	-9.0	2.7	-9.0	0.8	4.5	0.0	
	1.0	29.0	178.0	81.8	2.7	14.1	0.8	4.6	0.0	

The **Graphs** menu allows the user to create data-based graphs. The **Univariate...** option provides the user access to the **Univariate Plots** dialog box, the **Bivariate...** option provides the user access to the **Bivariate Plots** dialog box and the **Multivariate...** option provides the user access to the **Scatter Plot Matrix** dialog box. Each of these dialog boxes is discussed separately in the next three sections.

The Univariate Plots dialog box

The **Univariate Plots** dialog box allows the user to create bar charts or pie charts for categorical variables or histograms for continuous variables. It is accessed by selecting the **Univariate...** option on the **Graphs** menu. This selection loads the **Univariate Plots** dialog box shown in the image below.



The first step is to select a label from the **List of variables** list box.

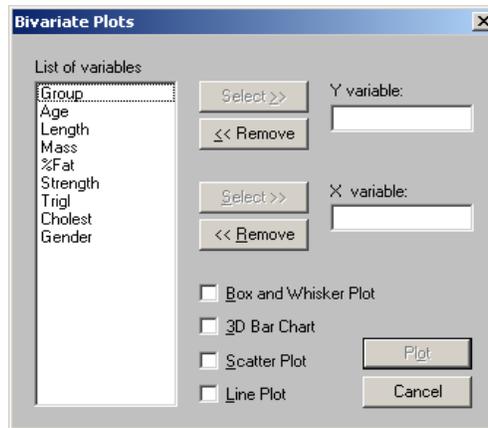
When a categorical variable is selected, the **Bar chart** and **Pie chart** radio buttons are activated. Select the desired chart by activating the corresponding radio button.

If a continuous variable is selected, the **Histogram** section is activated. The **Interpolated curve overlay** and the **Normal curve overlay** check boxes are not checked by default. The user may request the desired curve(s) by checking the corresponding check box(es). The default number of class intervals for a histogram is 15. The user may enter an integer between 5 and 14 in the **Number of class intervals** string box if 15 is not desired.

Once the user is done with the **Univariate** dialog box, click on the **Plot** button to open the specified plot in a graph window.

The Bivariate Plots dialog box

The **Bivariate Plots** dialog box allows the user to create Box-and-Whisker plots, three dimensional bar charts, scatter plots and line plots. It is accessed by selecting the **Bivariate...** option on the **Graphs** menu. This selection loads the following **Bivariate Plots** dialog box.



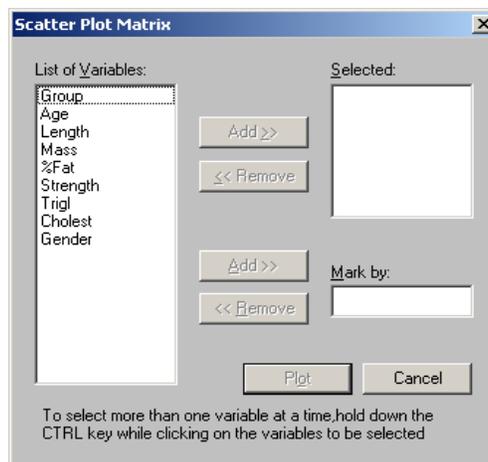
The user can specify the variable to be plotted on the vertical axis by first selecting the label from the **List of variables** list box and then by clicking on the upper **Select** button to add the variable to the **Y variable** grid box. Similarly, the variable to be plotted on the horizontal axis can be selected by clicking on the lower **Select** button to add the variable to the **X variable** grid box.

As shown in the **Bivariate Plots** dialog box, there are four types of bivariate plots available, namely **Box and Whisker Plot**, **3D Bar Chart**, **Scatter Plot** and **Line Plot**. Only the scatter and line plot can be requested together by checking the **Scatter Plot** and **Line Plot** check boxes. The other two plots can only be requested one at a time by checking the corresponding check box.

Once the user is done with the **Bivariate** dialog box, click on the **Plot** button to open the specified plot in a graph window.

The Multivariate Plots dialog box

The **Multivariate Plots** dialog box allows the user to create a scatter plot matrix. It is accessed by selecting the **Multivariate...** option on the **Graphs** menu. This selection loads the following **Scatter Plot Matrix** dialog box.



The user specifies the variables to be plotted by first selecting the labels from the **List of Variables** list box and then by clicking on the upper **Add** button to add the variable to the **Selected** variable list box.

Select the variable to be plotted in different colors by first selecting the label from the **List of Variables** list box and then by clicking on the lower **Add** button to add the variable to the **Marked by** variable grid box. Note that only categorical variables can be used for this purpose.

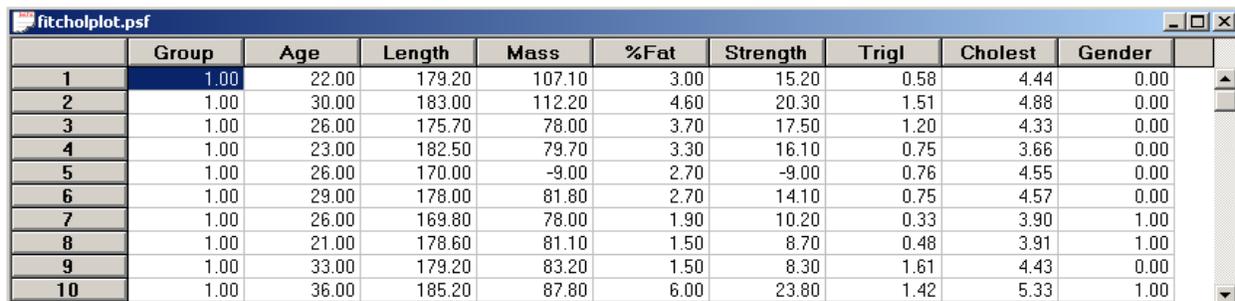
Once the user is done with the **Bivariate** dialog box, click on the **Plot** button to open the specified plot in a graph window.

Examples

LISREL for Windows allows the user to create bar charts, histograms, pie charts, Box and Whisker plots, 3-dimensional bar charts, scatter plots, line plots and scatter plot matrices interactively. We illustrate each of these graphs in the subsequent sections by using fitness data. This data set is described in the next section.

The data

We use **fitcholplot.psf** in the **TUTORIAL** subfolder to demonstrate the graphical display features of LISREL for Windows. There are 60 cases and 8 variables in the data set. The first 10 observations are shown in the following PSF window.



	Group	Age	Length	Mass	%Fat	Strength	Trigl	Cholest	Gender
1	1.00	22.00	179.20	107.10	3.00	15.20	0.58	4.44	0.00
2	1.00	30.00	183.00	112.20	4.60	20.30	1.51	4.88	0.00
3	1.00	26.00	175.70	78.00	3.70	17.50	1.20	4.33	0.00
4	1.00	23.00	182.50	79.70	3.30	16.10	0.75	3.66	0.00
5	1.00	26.00	170.00	-9.00	2.70	-9.00	0.76	4.55	0.00
6	1.00	29.00	178.00	81.80	2.70	14.10	0.75	4.57	0.00
7	1.00	26.00	169.80	78.00	1.90	10.20	0.33	3.90	1.00
8	1.00	21.00	178.60	81.10	1.50	8.70	0.48	3.91	1.00
9	1.00	33.00	179.20	83.20	1.50	8.30	1.61	4.43	0.00
10	1.00	36.00	185.20	87.80	6.00	23.80	1.42	5.33	1.00

The -9 entries represent missing values in this data set. There are 3 observations with missing values.

The variables in the data set are:

- Group is the group ID (1 for a weightlifter, 2 for a student and 3 for a marathon athlete).
- Age is the age in years.
- Length is the height in cm.
- Mass is the weight in kg.
- %Fat is the percentage fat.
- Strength represents the breast-strength in lb.
- Trigl is the triglycerides.
- Cholest represents the total cholesterol.
- Gender is the gender of the respondent.

The continuous variables in this data set are Age, Length, Mass, %Fat, Strength, Trigl and Cholest. The nominal variables are Group and Gender. More details about the data are available in Du Toit,

Steyn and Stumpf (1986).

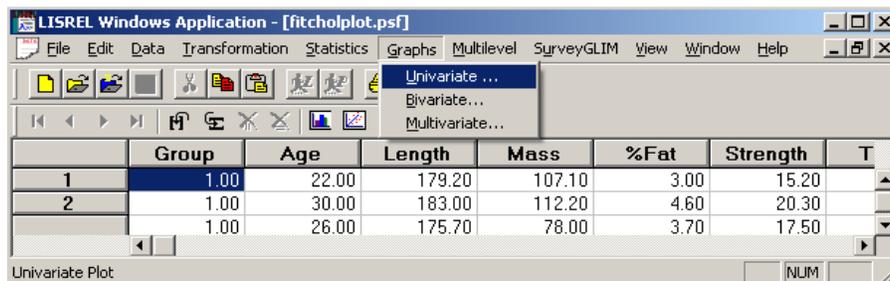
Univariate plots for fitness data

We now use the data in **fitcholplot.psf** to demonstrate how to produce a bar chart, a pie chart and a histogram with LISREL for Windows.

Bar chart

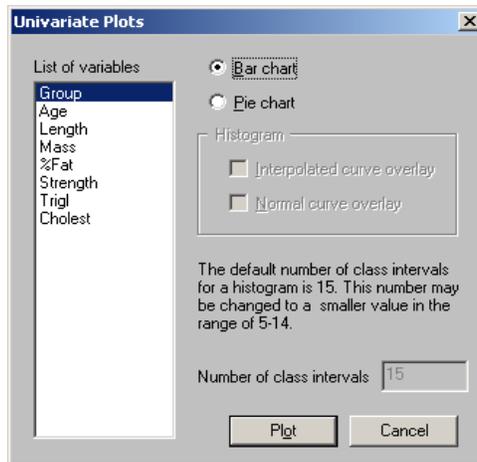
We can use the following steps to produce a bar chart for the nominal variable Group in **fitcholplot.psf** interactively.

- Select the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **PRELIS data (*.psf)** option from the **Files of type** drop-down list box.
- Browse for the file **fitcholplot.psf** in the **TUTORIAL** subfolder and select it.
- Click on the **Open** button to open **fitcholplot.psf** in a PSF window.
- Select the **Univariate** option on the **Graphs** menu as shown below



to activate the **Univariate Plots** dialog box.

- Select the variable Group from the **List of variables** list box.
- Activate the **Bar chart** radio button on the **Univariate Plots** dialog box to produce the following dialog box.

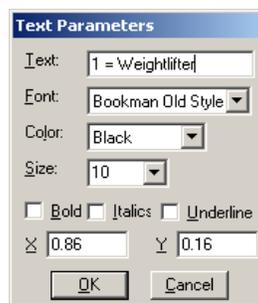


- o Click on the **Plot** button to generate the following graph window.

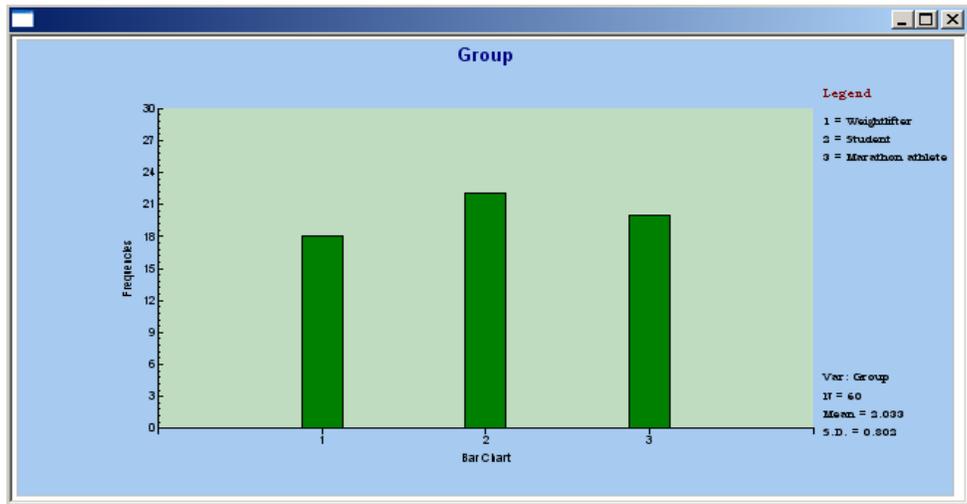


The default legend shows the categories of the variable Group and the values assigned to each category. To change the legend of each category, we proceed as follows.

- o Double-click on the Cat1:1 description to activate the **Text Parameters** dialog box.
- o Change the text Cat1:1 to 1 = Weightlifter in the **Text** string field to produce the following dialog box.

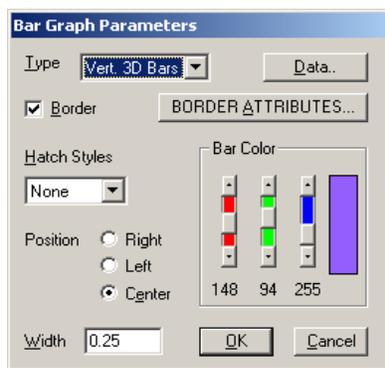


- Click on the **OK** button to return to the Graph window.
- Repeat this procedure to change the descriptions of categories 2 and 3 to 2 = Student and 3 = Marathon athlete respectively
- Click on the **OK** button to produce the following graph window.

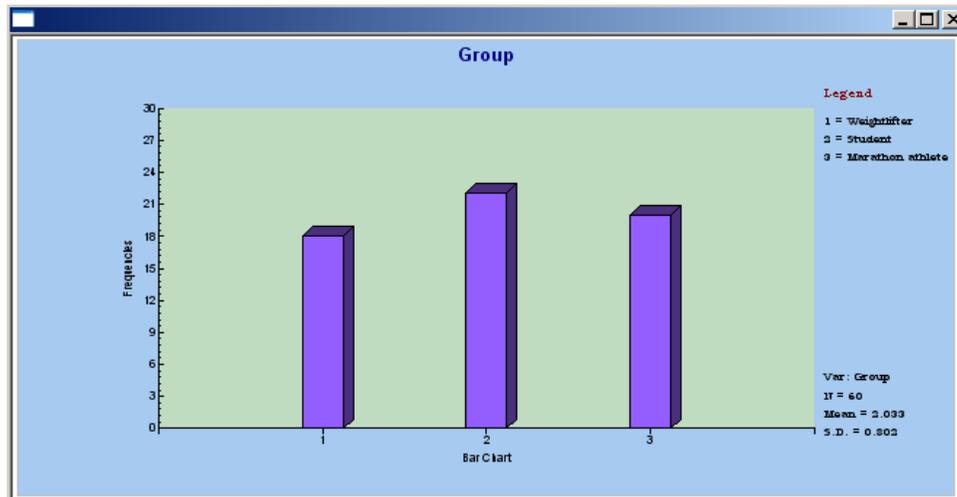


The bar chart above shows that the number of individuals in the first three groups are almost equal ($n = 18, 22$ and 20). The appearance of the vertical bars above can be changed as follows.

- Double-click on one of the bars until the **Bar Graph Parameters** dialog box is activated.
- Select **Vert. 3-D bars** from the **Type** drop-down list box.
- Use the **Bar Color** sliders to select the desired colors to create the following dialog box.



- Click on the **OK** button to produce the following graph window.

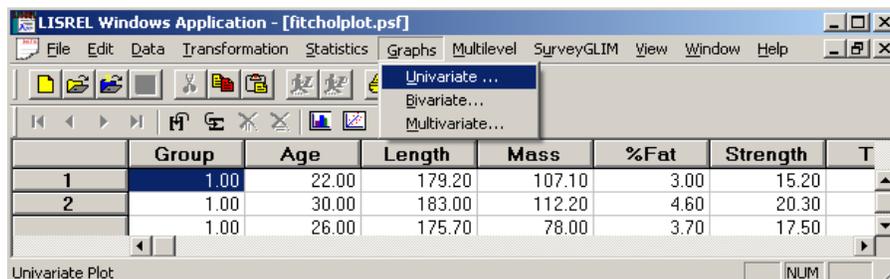


The above chart may now be printed by selecting the **Print** option on the **File** menu. Alternatively, it can be exported as a Windows metafile (*.wmf) by selecting the **Export as Metafile** option on the **File** menu. The corresponding Windows metafile is saved in the **TUTORIAL** subfolder.

Pie chart

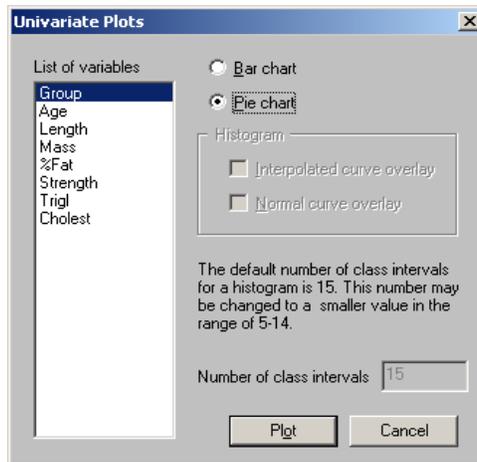
We now illustrate how to produce a pie chart for the nominal variable **Group** in **fitcholplot.psf** interactively. This is accomplished as follows.

- Select the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **PRELIS data (*.psf)** option from the **Files of type** drop-down list box.
- Browse for the file **fitcholplot.psf** in the **TUTORIAL** subfolder and select it.
- Click on the **Open** button to open **fitcholplot.psf** in a PSF window.
- Select the **Univariate** option on the **Graphs** menu as shown below

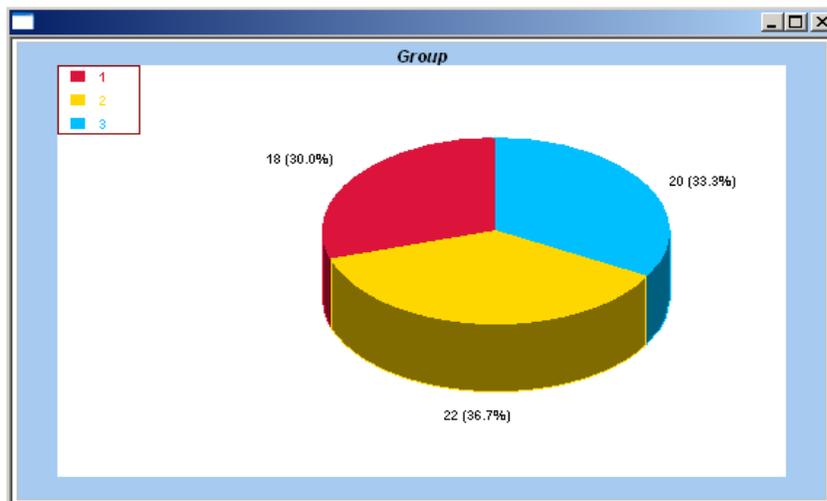


to activate the **Univariate Plots** dialog box.

- Select the variable **Group** from the **List of variables** list box.
- Activate the **Pie chart** radio button to produce the following dialog box.



- Click on the **Plot** button to produce the following graph window.



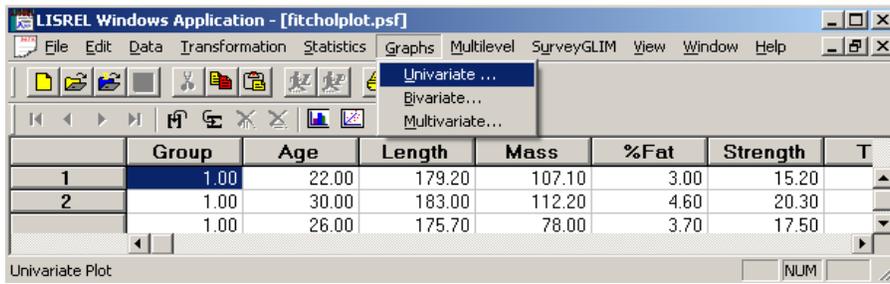
The above chart may now be printed by selecting the **Print** option on the **File** menu. Alternatively, it can be exported as a Windows metafile (*.wmf) by selecting the **Export as Metafile** option on the **File** menu. The corresponding Window metafile is saved as **fitcholplot.wmf** in the current working folder.

Histogram

Suppose we want to obtain a histogram with a Normal curve overlay for the continuous variable **Strength** in **fitcholplot.psf**. We achieve this interactively as follows.

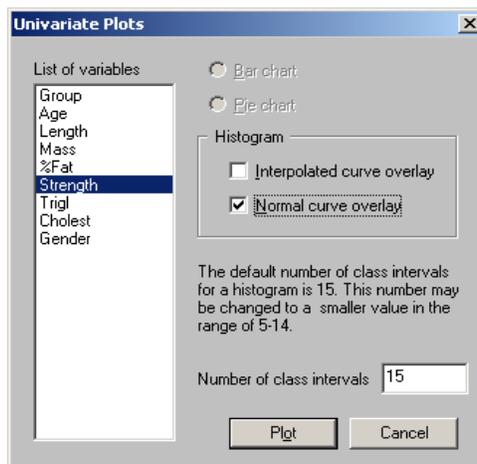
- Select the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **PRELIS data (*.psf)** option from the **Files of type** drop-down list box.
- Browse for the file **fitcholplot.psf** in the **TUTORIAL** subfolder and select it.
- Click on the **Open** button to open **fitcholplot.psf** in a PSF window.

- Select the **Univariate** option on the **Graphs** menu as shown below

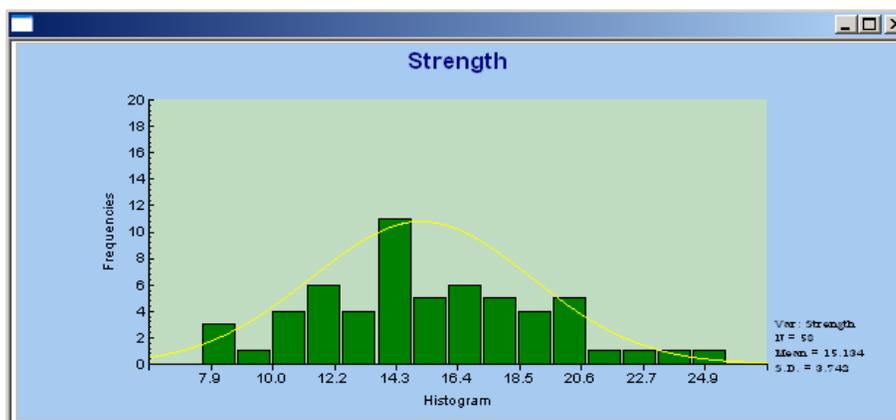


to activate the **Univariate Plots** dialog box.

- Select the variable Strength from the **List of variables** list box.
- Check the **Normal curve overlay** check box on the **Histogram** section to produce the following dialog box.



- Click on the **Plot** button to produce the following graph window.



The above chart may now be printed by selecting the **Print** option on the **File** menu. It can also be

exported as a Windows metafile (*.wmf) by selecting the **Export as Metafile** option on the **File** menu. This metafile is saved in the **TUTORIAL** subfolder.

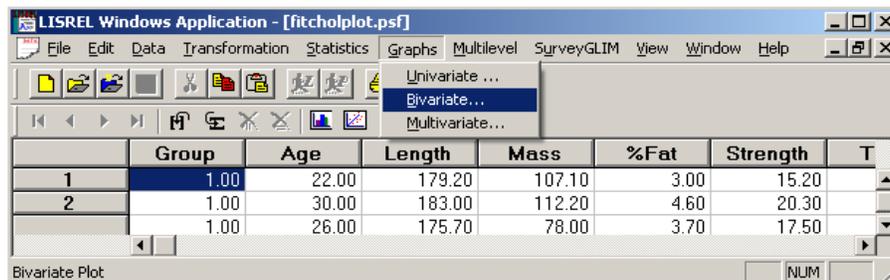
Bivariate plots for fitness data

In this section, we illustrate how to produce a Box-and-Whisker plot, a three-dimensional bar chart, a scatter plot and a line plot with LISREL for Windows.

Box and Whisker plot

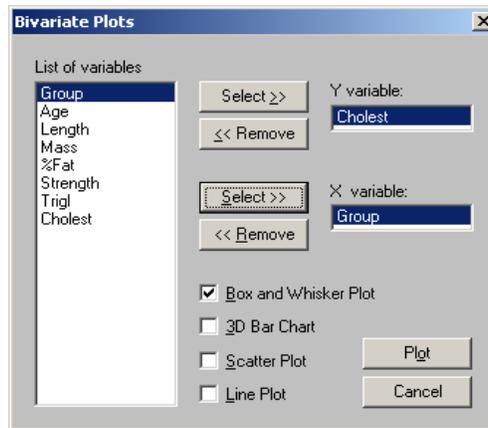
We now illustrate how to produce a Box and Whisker plot for the continuous variable Cholest for the three groups in **fitcholplot.psf** interactively. We accomplish this as follows.

- Select the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **PRELIS data (*.psf)** option from the **Files of type** drop-down list box.
- Browse for the file **fitcholplot.psf** in the **TUTORIAL** subfolder and select it.
- Click on the **Open** button to open **fitcholplot.psf** in a PSF window.
- Select the **Bivariate** option on the **Graphs** menu as shown below

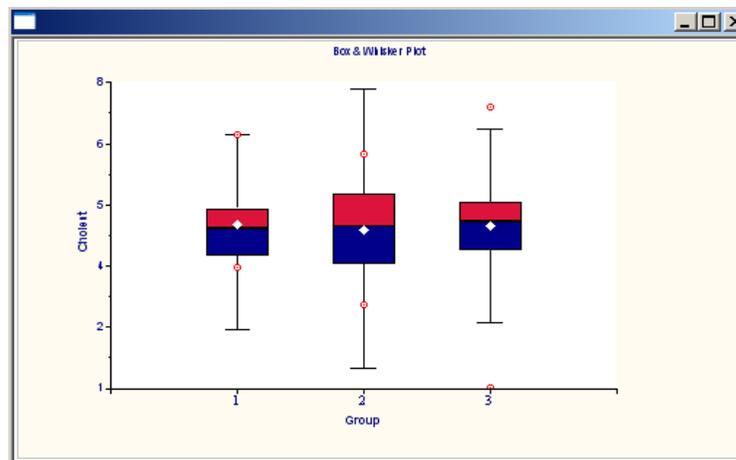


to activate the **Bivariate Plots** dialog box.

- Select the variable Cholest from the **List of variables** list box.
- Click on the upper **Select** button to add the variable Cholest to the **Y variable** grid box.
- Select the variable Group from the **List of variables** list box.
- Click on the lower **Select** button to add the variable Group to the **X variable** grid box.
- Check the **Box and Whisker Plot** check box to produce the following dialog box.



- Click on the **Plot** button to open the following graph window.



The above chart may now be printed by selecting the **Print** option on the **File** menu. Alternatively, it can be exported as a Windows metafile (*.wmf) by selecting the **Export as Metafile** option on the **File** menu. The corresponding Windows metafile **fitcholplot.wmf** is saved in the **TUTORIAL** subfolder.

3D bar chart

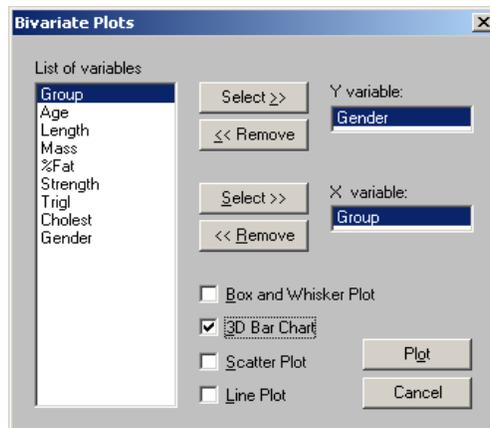
To produce a 3D bar chart of the two nominal variables Gender and Group in **fitcholplot.psf**, we proceed as follows.

- Select the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **PRELIS data (*.psf)** option from the **Files of type** drop-down list box.
- Browse for the file **fitcholplot.psf** in the **TUTORIAL** subfolder and select it.
- Click on the **Open** button to open **fitcholplot.psf** in a PSF window.
- Select the **Bivariate** option on the **Graphs** menu as shown below

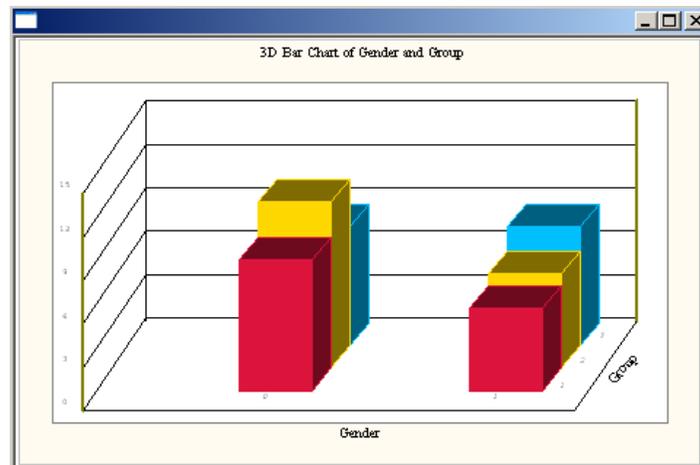
	Group	Age	Length	Mass	%Fat	Strength	T
1	1.00	22.00	179.20	107.10	3.00	15.20	
2	1.00	30.00	183.00	112.20	4.60	20.30	
	1.00	26.00	175.70	78.00	3.70	17.50	

to activate the **Bivariate Plots** dialog box.

- Select the variable Gender from the **List of variables** list box.
- Click on the upper **Select** button to add the variable Gender to the **Y variable** grid box.
- Select the variable Group from the **List of variables** list box.
- Click on the lower **Select** button to add the variable Group to the **X variable** grid box.
- Check the **3D Bar Chart** check box to produce the following dialog box.



- Click on the **Plot** button to open the following graph window.

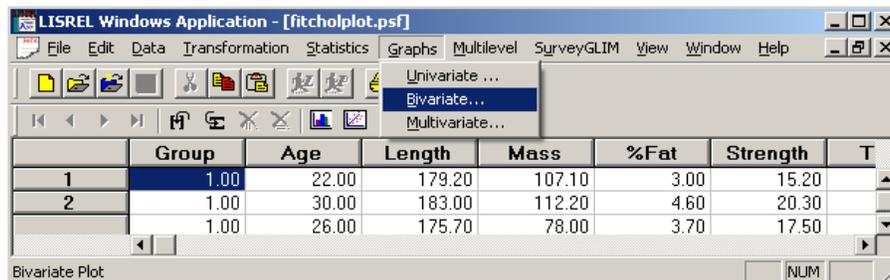


The above plot may now be printed by selecting the **Print** option on the **File** menu. It can also be exported as a Windows metafile (*.wmf) by selecting the **Export as Metafile** option on the **File** menu. The resulting metafile **fitcholplot.wmf** is saved to the **TUTORIAL** subfolder.

Scatter plot

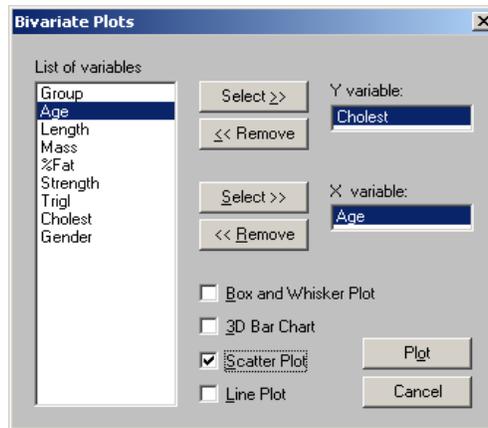
Suppose we want to produce a scatter plot of the continuous variables **Cholest** and **Age** in **fitcholplot.psf**. We accomplish this as follows.

- Select the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **PRELIS data (*.psf)** option from the **Files of type** drop-down list box.
- Browse for the file **fitcholplot.psf** in the **TUTORIAL** subfolder and select it.
- Click on the **Open** button to open **fitcholplot.psf** in a PSF window.
- Select the **Bivariate** option on the **Graphs** menu as shown below

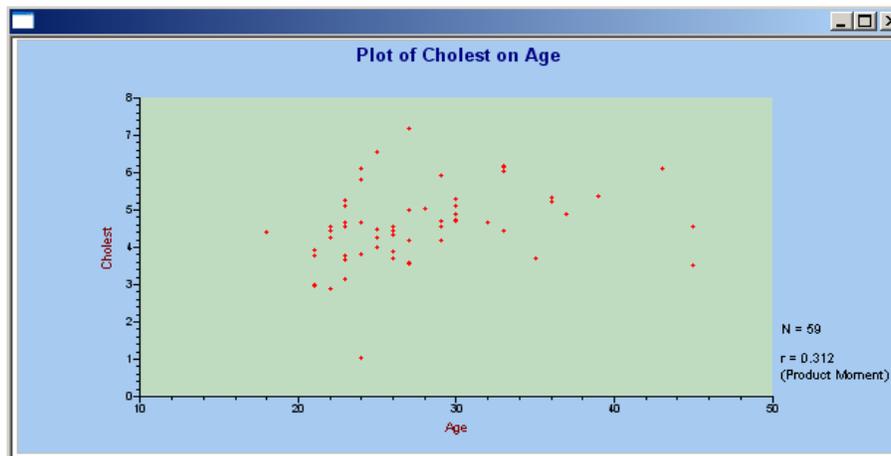


to activate the **Bivariate Plots** dialog box.

- Select the variable **Cholest** from the **List of variables** list box.
- Click on the upper **Select** button to add the variable **Cholest** to the **Y variable** grid box.
- Select the variable **Age** from the **List of variables** list box.
- Click on the lower **Select** button to add the variable **Age** to the **X variable** grid box.
- Check the **Scatter Plot** check box to produce the following dialog box.



- Click on the **Plot** button to open the following graph window.



The above scatter plot may now be printed by selecting the **Print** option on the **File** menu. Alternatively, it can be exported as a Windows metafile (*.wmf) by selecting the **Export as Metafile** option on the **File** menu. The corresponding Windows metafile **fitcholplot.wmf** is saved in the **TUTORIAL** subfolder.

Line plot

Next, we illustrate how to create a line plot of the continuous variables Cholest and %Fat in **fitcholplot.psf**.

- Select the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **PRELIS data (*.psf)** option from the **Files of type** drop-down list box.
- Browse for the file **fitcholplot.psf** in the **TUTORIAL** subfolder and select it.
- Click on the **Open** button to open **fitcholplot.psf** in a PSF window.
- Select the **Bivariate** option on the **Graphs** menu as shown below

The screenshot shows the LISREL Windows Application window with a data table and the Bivariate Plots dialog box open. The data table has the following content:

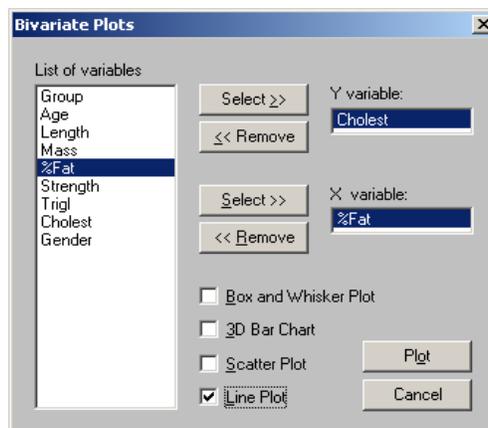
	Group	Age	Length	Mass	%Fat	Strength	T
1	1.00	22.00	179.20	107.10	3.00	15.20	
2	1.00	30.00	183.00	112.20	4.60	20.30	
	1.00	26.00	175.70	78.00	3.70	17.50	

The Bivariate Plots dialog box shows the following settings:

- List of variables: Group, Age, Length, Mass, %Fat, Strength, Trigl, Cholest, Gender
- Y variable: Cholest
- X variable: %Fat
- Line Plot:
- Box and Whisker Plot:
- 3D Bar Chart:
- Scatter Plot:

to activate the **Bivariate Plots** dialog box.

- Select the variable Cholest from the **List of variables** list box.
- Click on the upper **Select** button to add the variable Cholest to the **Y variable** grid box.
- Select the variable %Fat from the **List of variables** list box.
- Click on the lower **Select** button to add the variable Age to the **X variable** grid box.
- Check the **Line Plot** check box to produce the following dialog box.



- Click on the **Plot** button to open the following graph window.

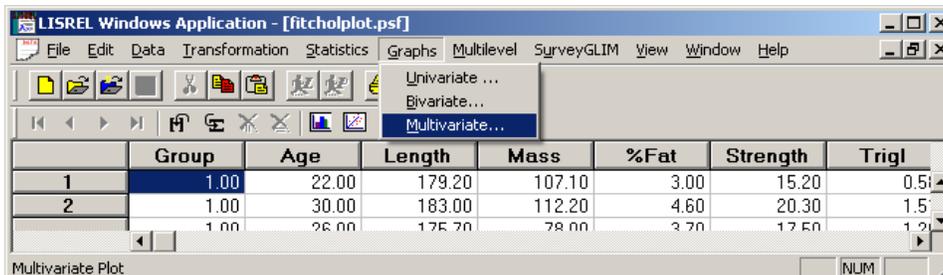


The plot above may now be printed by selecting the **Print** option on the **File** menu. Alternatively, it can be exported as a Windows metafile (*.wmf) by selecting the **Export as Metafile** option on the **File** menu. The corresponding Windows metafile **fitcholplot.wmf** is saved in the **TUTORIAL** subfolder.

Multivariate plot (scatter plot matrix) for fitness data

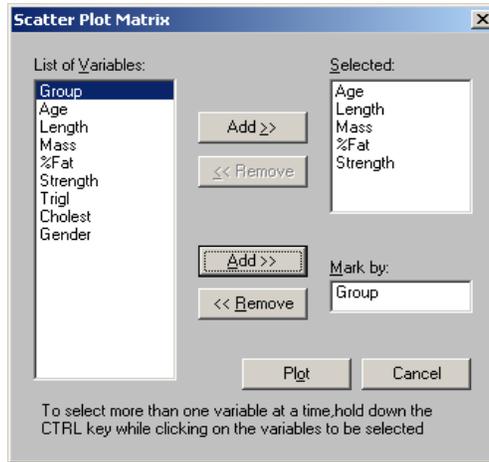
We obtain a scatter plot matrix for the continuous variables Age, Length, Mass, %Fat and Strength in **fitcholplot.psf** marked by the variable Group as follows.

- Select the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **PRELIS data (*.psf)** option from the **Files of type** drop-down list box.
- Browse for the file **fitcholplot.psf** in the **TUTORIAL** subfolder and select it.
- Click on the **Open** button to open **fitcholplot.psf** in a PSF window.
- Select the **Multivariate** option on the **Graphs** menu as shown below

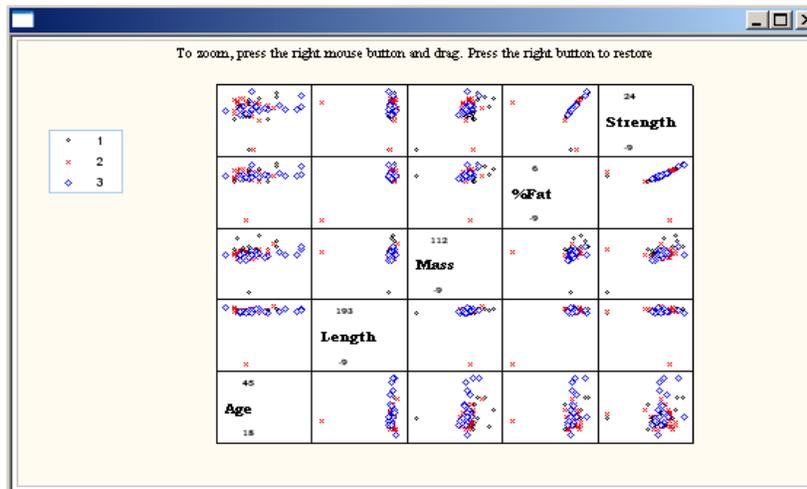


to activate the **Multivariate Plots** dialog box.

- Select the variables Age, Length, Mass, %Fat and Strength from the **List of variables** list box.
- Click on the upper **Add** button to add them to the **Selected** list box.
- Select the variable Group from the **List of variables** list box.
- Click on the lower **Add** button to produce the following dialog box.



- o Click on the **Plot** button to open the following graph window.



The above chart may now be printed by selecting the **Print** option on the **File** menu. It can also be exported as a Windows metafile (*.wmf) by selecting the **Export as Metafile** option on the **File** menu. The corresponding Windows metafile **fitcholplot.wmf** is saved in the **TUTORIAL** subfolder.

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