SAS/STAT® 12.3 User's Guide
The Power and Sample Size Application (Chapter)

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Chapter 72
The Power and Sample Size Application

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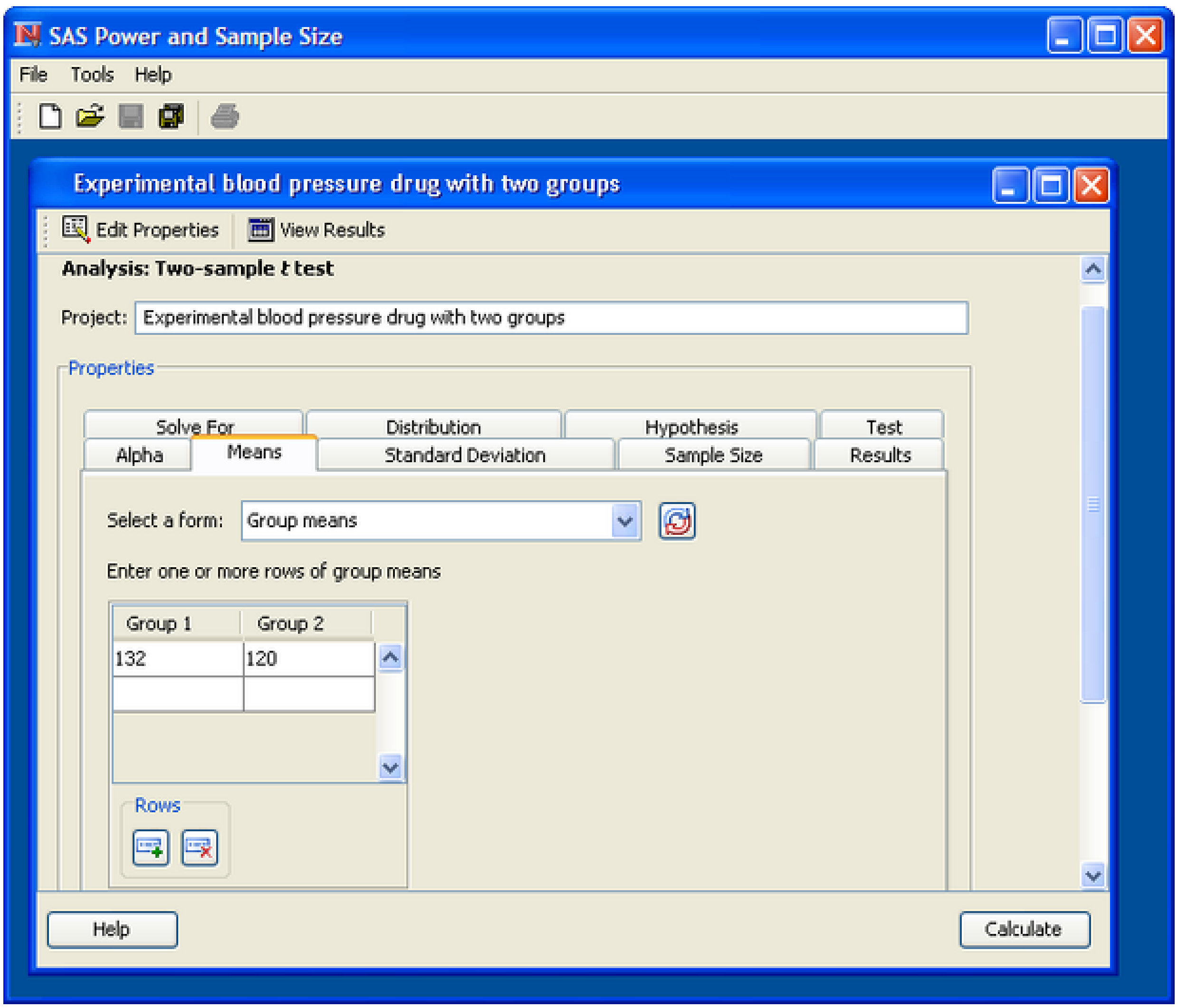
Overview: PSS Application

SAS Power and Sample Size

The SAS Power and Sample Size application (PSS) is a desktop application that provides easy access to power analysis and sample size determination techniques. The application is intended for students and researchers as well as experienced SAS users and statisticians.

Figure 72.1 shows the graphical user interface. PSS relies on the SAS/STAT procedures POWER and GLMPOWER for its computations.

Figure 72.1 PSS Application



This section describes the statistical tasks that are available with the application as well as its principal features.

Analyses

PSS provides power and sample size computations for a variety of statistical analyses. Included are *t* tests for means; equivalence tests and confidence intervals for means and proportions; exact binomial, chi-square, Fisher's exact, and McNemar tests for proportions; correlation and regression (multiple and logistic); one-way analysis of variance; linear models; tests of distribution; and rank tests for comparing survival curves.

Table 72.1 lists the analyses that are available.

Table 72.1 Available Analyses

Category	Analysis
Means	One-sample *t* test
	Paired *t* test
	Two-sample *t* test
Confidence intervals	One proportion
	One-sample means
	Paired means
	Two-sample means
Equivalence tests	One proportion
	One-sample means
	Paired means
	Two-sample means
Proportions	One proportion
	Two correlated proportions
	Two independent proportions
Correlation and regression	Pearson correlation coefficient
	Logistic regression with a binary response
	Multiple regression
Analysis of variance and linear models	One-way ANOVA
	General linear univariate models
Survival analysis	Two-sample survival rank tests
Distribution tests	Wilcoxon Mann-Whitney test for two distributions

Features

PSS provides multiple input parameter options, stores the results in a project format, displays power curves, and produces narratives for the results. Narratives are descriptions of the input parameters and include a statement about the computed power or sample size. The SAS log and SAS code are also available.

All analyses offer computation of power or sample size. Some analyses offer computation of sample size per group as well as total sample size.

Where appropriate, several alternate ways of entering values for certain parameters are offered. For example, in the two-sample *t* test analysis, means can be entered for individual groups or as a difference. The null mean difference can be specified as a default of zero or can be explicitly entered.

Information about existing analyses is stored in a project format. You can access each project to review the results or to edit your input parameters and produce another analysis.

Getting Started: PSS Application

Overview

This section is intended to get you off to a quick start with PSS. More detailed information about using the application is found in “How to Use: PSS Application” on page 6166 and in the example sections.

To start the application on a PC using the Windows operating system, select **Start►Programs►SAS►SAS Power and Sample Size 3.1** (or the latest release).

When you first use the application for a release, you are asked some configuration questions. For more information see the section “Configuration” on page 6182.

As an initial step, you also must define a SAS connection. If you have Foundation SAS software installed on the PC that you are using for PSS, this step can be done for you automatically. To define a connection or to determine whether one has already been defined, see the section “SAS Connections” on page 6166.

The Basic Steps

Here are the basic steps that you follow to use PSS.

1. Start a new project by selecting **File►New** on the menu bar or clicking the **New** icon on the toolbar.
2. In the New window, select the desired analysis type and click **OK**.

   A project window for the analysis type appears with the Edit Properties page displayed. (The tabs on the Edit Properties page and their content vary according to the analysis type.)
3. Click each tab to enter the relevant data for the analysis. (For more information about the types of data to enter, see the example sections.)
4. After you have entered all the data, click the **Calculate** button.
5. After PSS calculates the results, the project window displays the View Results page with the Summary Table tab displayed by default.
6. To view other results or to review the SAS code or the SAS log, click any of the tabs on the left side of the View Results page.
7. To print any results page, select **File►Print** on the menu bar.

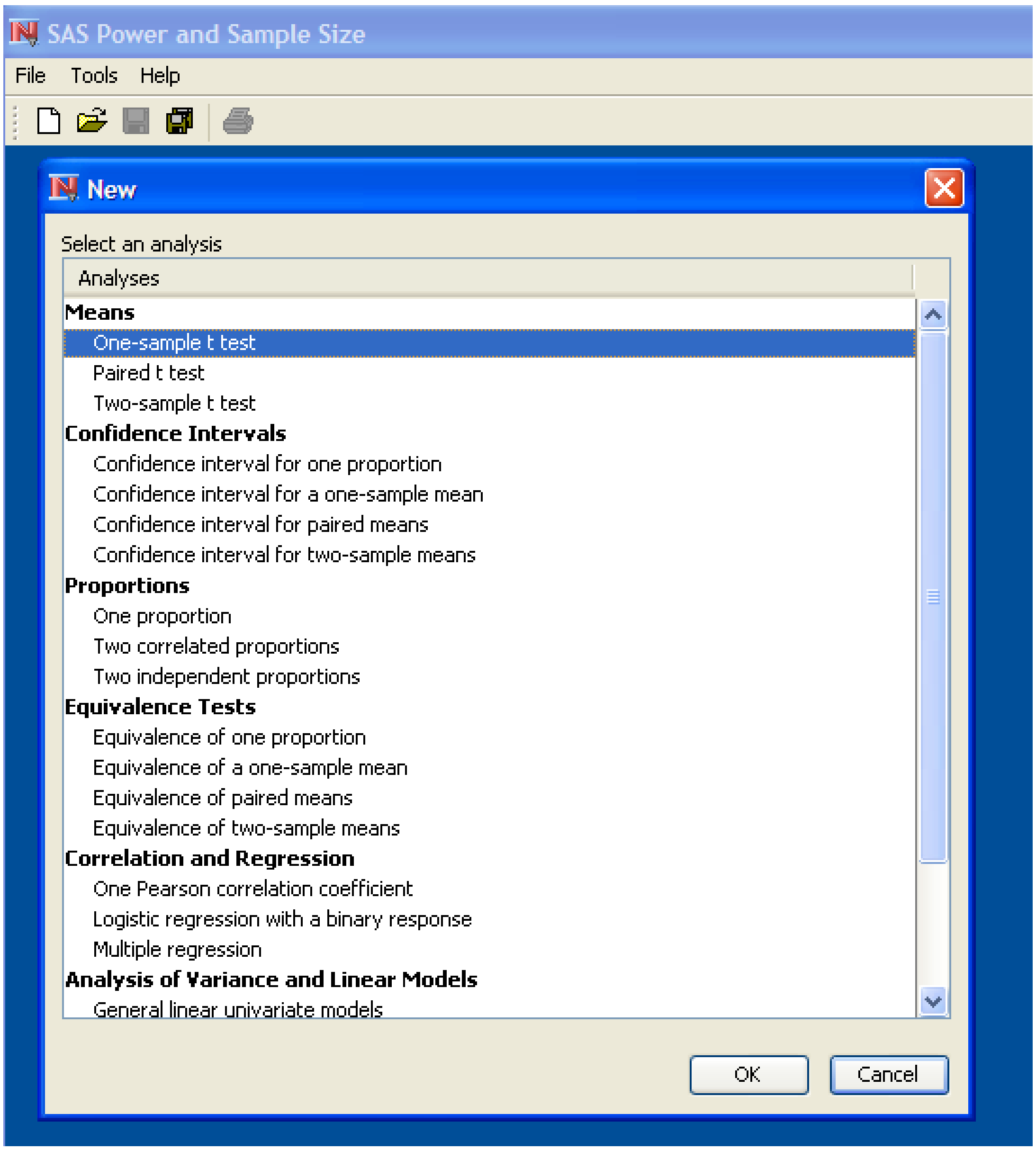
The remainder of this section takes you through a simple example.

A Simple Example

Suppose you want to determine the power for a new marketing study. You want to compare car sales in the southeastern region to the national average of 1.0 car per salesperson per day. You believe that the actual average for the region is 1.6 cars per salesperson per day. You want to test if the mean for a single group is larger than a specific value, so the one-sample *t* test is the appropriate analysis. The conjectured mean is 1.6 and the null mean is 1.0. You intend to use a significance level of 0.05 for the one-sided test. You want to calculate power for two standard deviations, 0.5 and 0.75, and two sample sizes, 10 and 20 dealerships.

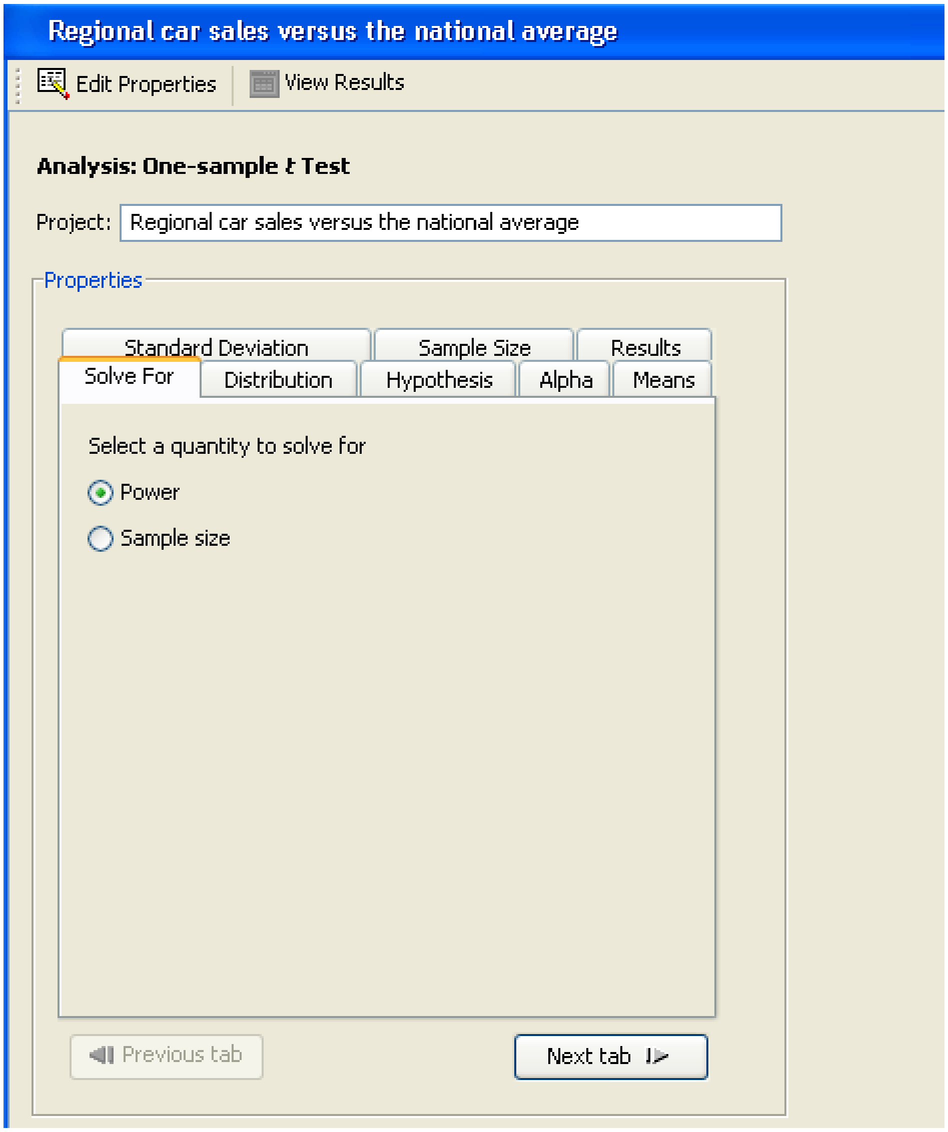
First, open a new project by selecting **File►New** on the menu bar or clicking the **New** icon on the toolbar. The New window appears. Then, select the appropriate analysis.

Figure 72.2 New Window



For this example, the selected analysis is the **One-sample t test** in the **Means** section, as shown at the top of Figure 72.2. Select the analysis from the list and click **OK**. The **One-sample t test** project window appears with the Edit Properties page displayed, as shown in Figure 72.3.

Figure 72.3 Edit Properties Page



Enter a descriptive label of the project in the **Project:** field. For the example, change the description to `Regional car sales versus the national average`. The description is used to identify the project when you reopen it from the Open window.

Select **File►Save** to save the description change. Note in Figure 72.3 that the title bar of the window contains your project description after you have saved the change.

Properties of the project are displayed on several tabs. You can change from tab to tab by clicking a tab or by clicking the **Next tab** or **Previous tab** buttons. To display help about the properties for a tab, click the **Help** button at the bottom of the Edit Properties page.

Entering Parameter Values

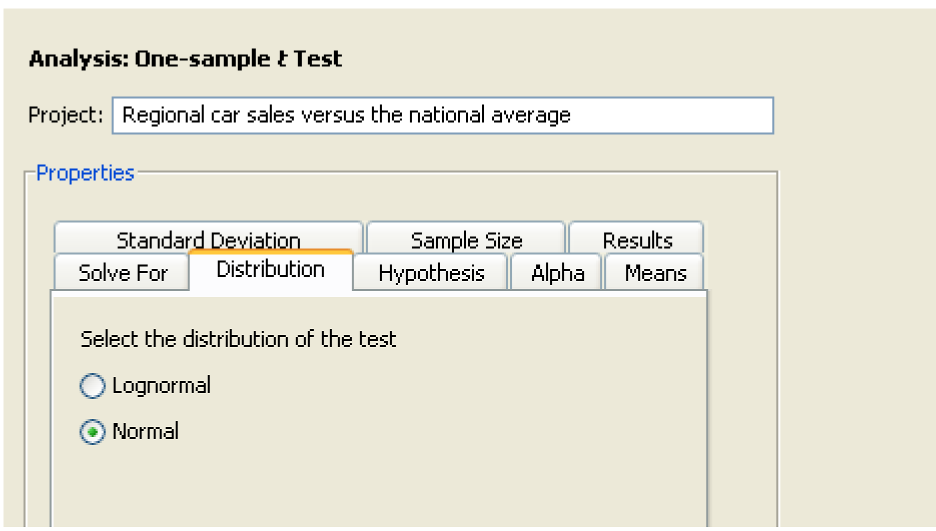
First, click the **Solve For** tab and choose to calculate power or sample size. For this example, select the **Power** option, as shown in Figure 72.3.

Next, you must provide values for two analysis options and four parameters. These parameters are set in separate tabs on the Edit Properties page and are labeled **Distribution**, **Hypothesis**, **Alpha**, **Mean**, **Standard Deviation**, and **Sample Size**.

Distribution

Click the **Distribution** tab to select a **Normal** or **Lognormal** distribution. For the example, you are using means rather than mean ratios, so select **Normal**, as shown in Figure 72.4.

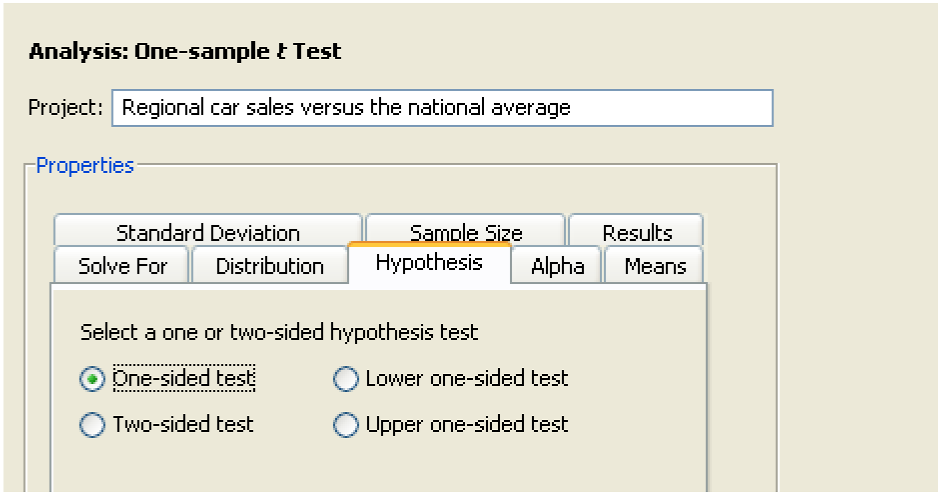
Figure 72.4 Distribution Tab



Hypothesis

Click the **Hypothesis** tab to select a one- or two-sided test. Because you are interested only in whether the southeastern region produces higher daily car sales than the national average, select **One-sided test**, as shown in Figure 72.5.

Figure 72.5 Hypothesis Tab

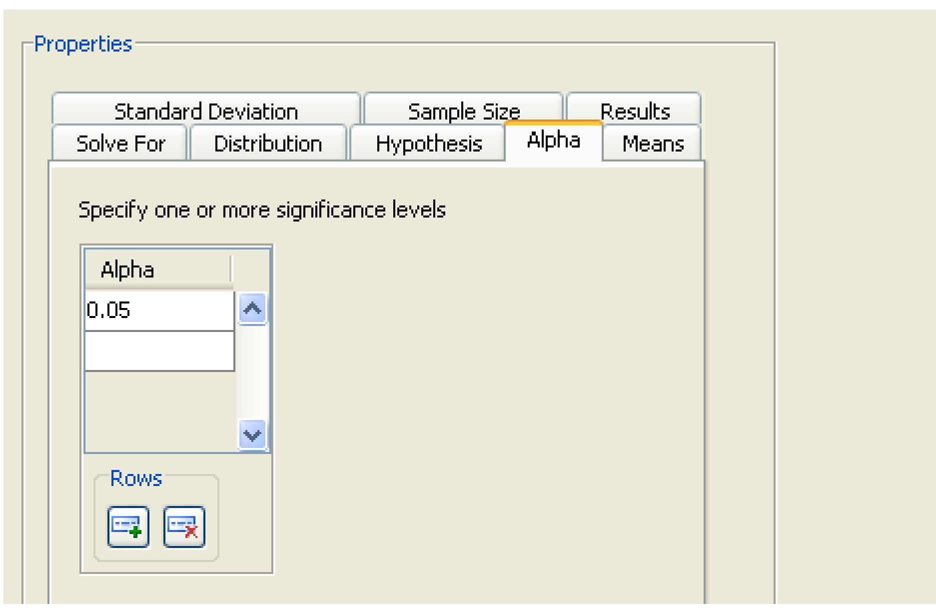


There are three one-sided test options: **One-sided test**, **Upper one-sided test**, and **Lower one-sided test**. The **Upper one-sided test** option would also be appropriate for this example.

Alpha

Click the **Alpha** tab to specify one or more significance levels. Enter `0.05`, as shown in Figure 72.6.

Figure 72.6 Alpha Tab

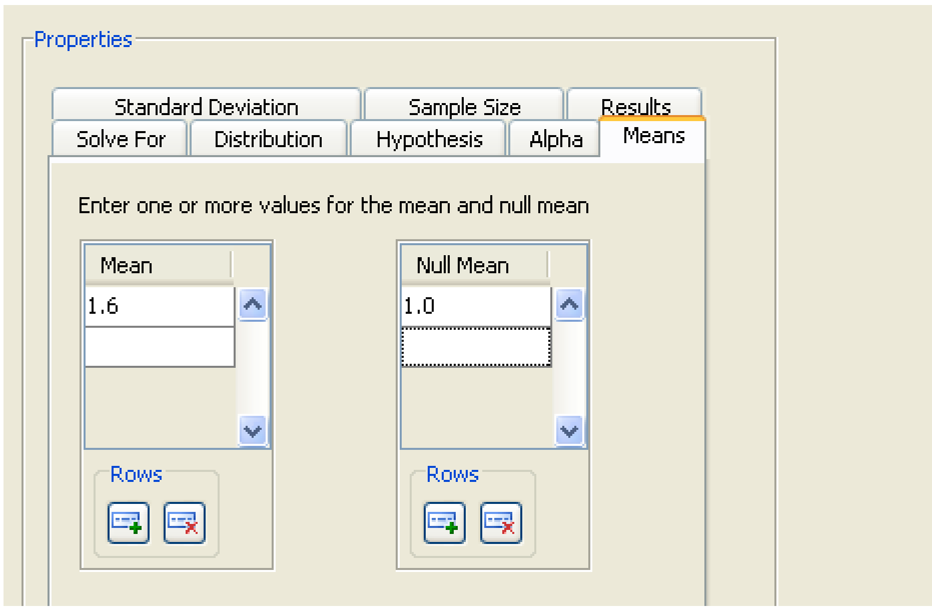


This value will be the default unless the default has been changed in the Preferences window. To set preferences, select **Tools►Preferences** on the menu bar. For more information about setting preferences, see the section "Setting Preferences" on page 6169.

Mean

Click the **Means** tab to enter one or more means and null means. For the example, enter `1.6` in the Mean table and `1.0` in the Null Mean table. Figure 72.7 shows the entered values.

Figure 72.7 Means Tab

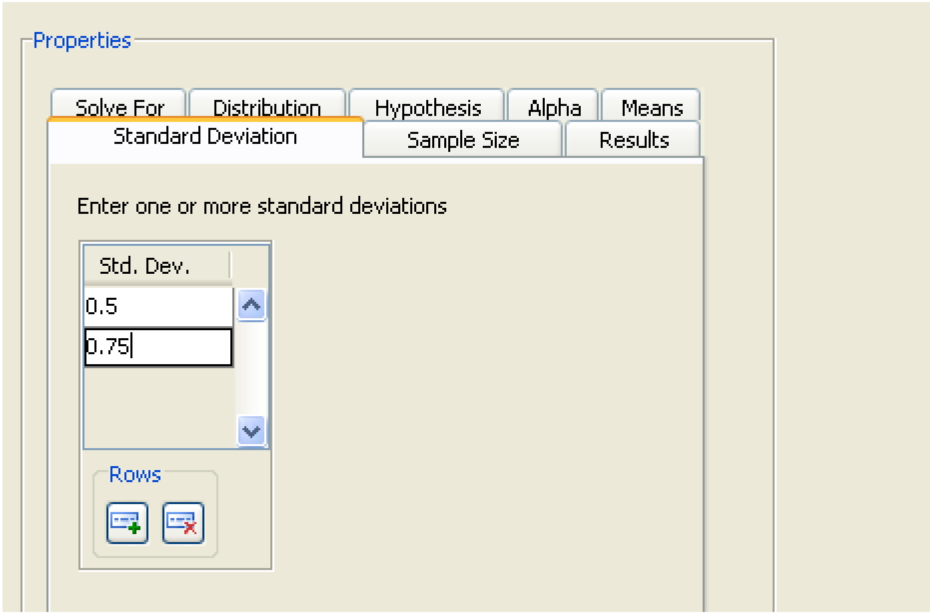


Note that additional input rows are available if you want to enter additional sets of parameters. You can also append and delete rows using the  and  buttons beneath the table. In addition, by selecting a row and right-clicking, you can choose to insert and delete rows in the body of the table from a pop-up menu.

Standard Deviation

Click the **Standard Deviation** tab to enter standard deviations. You are interested in two standard deviations, `0.5` and `0.75`. Enter them in the table, as shown in Figure 72.8.

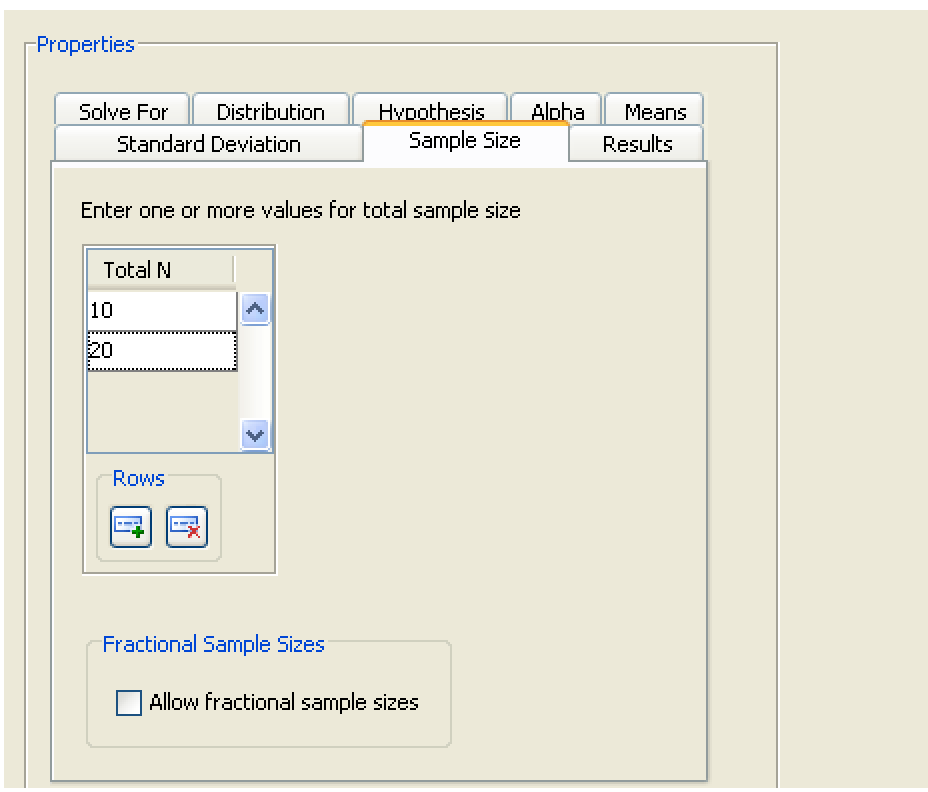
Figure 72.8 Standard Deviation Tab



Sample Size

You want to be able to sample between `10` and `20` dealerships. Click the **Sample Size** tab and enter these two values, as shown in Figure 72.9.

Figure 72.9 Sample Size Tab



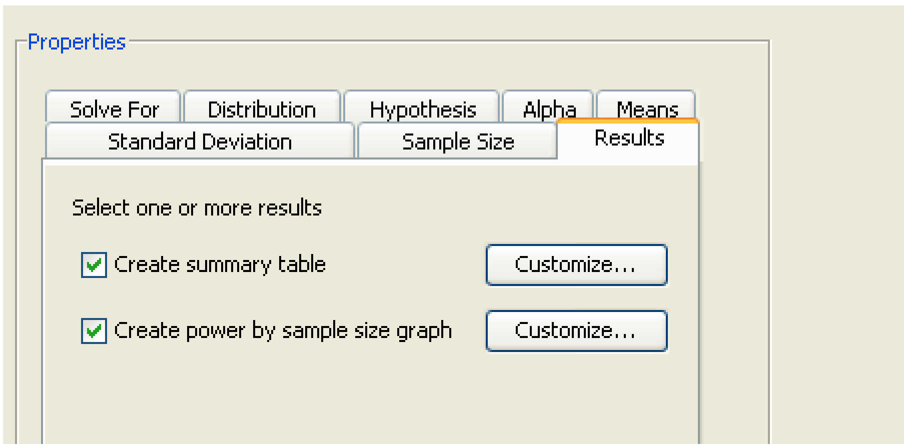
Scenarios

The input values are combined into one or more scenarios. In this case, each of the two standard deviations is combined with each of the two sample sizes for a total of four scenarios. Then power is computed for each scenario. In this example, only a single value or setting is present for the mean, null mean, and alpha level, so they are common to all scenarios.

Results Options

Click the **Results** tab to select results options including a Summary Table and a Power by Sample Size graph.

Figure 72.10 Results Tab

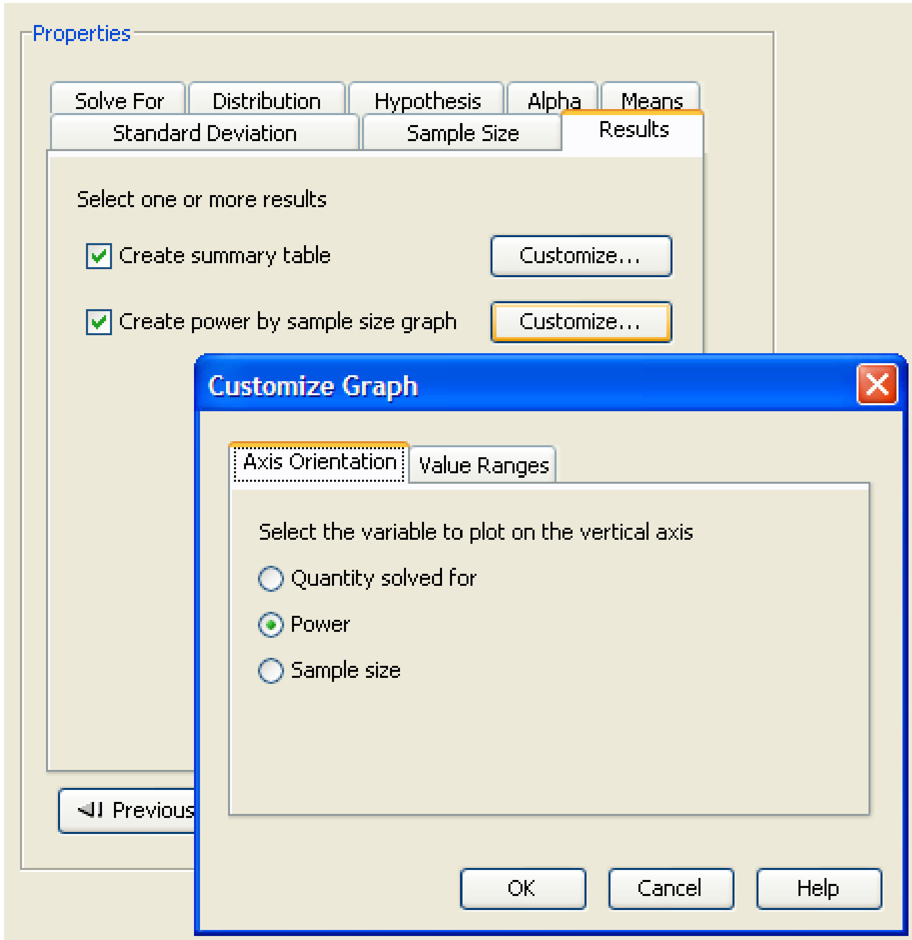


For this example, select both results check boxes: **Create summary table** and **Create power by sample size graph**, as shown in Figure 72.10. These selections can also be set as preferences; see the section "Setting Preferences" on page 6169.

Customizing the Power by Sample Size Graph

Click the **Customize** button beside the **Create power by sample size graph** check box to customize the graph. The Customize Graph window contains two tabs: **Axis Orientation** and **Value Ranges**, as shown in Figure 72.11.

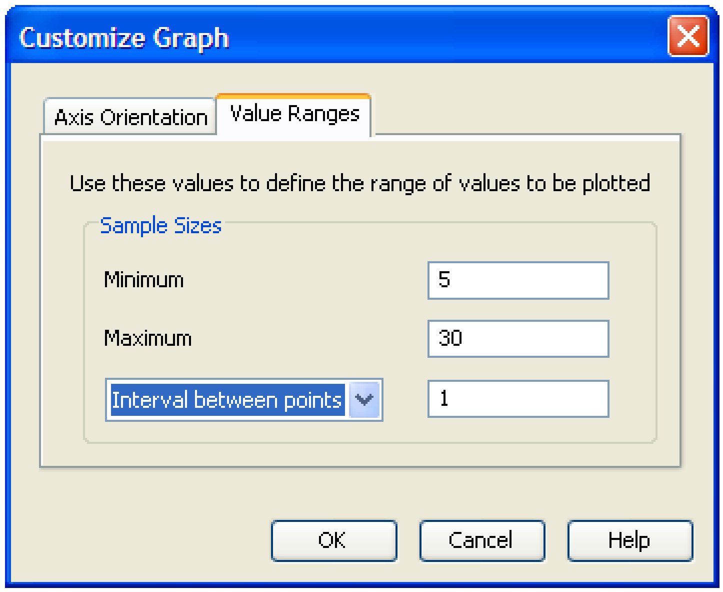
Figure 72.11 Customize Graph Window with Axis Orientation Tab



Click the **Axis Orientation** tab to select which quantity you would like to plot on the vertical axis. You can choose to display the quantity solved for (either power or sample size) on the vertical axis or you can choose to display power or sample size on the vertical axis with the other quantity appearing on the horizontal axis. The default is **Quantity solved for** (or power) on the vertical axis, which is appropriate for this graph.

The summary table is created using the two sample sizes specified in the Sample Size table, 10 and 20. If you want to create a graph that contains more than these two sample sizes, you can do so by customizing the value ranges for the graph. Click the **Value Ranges** tab to set the axis range for sample sizes, as shown in Figure 72.12.

Figure 72.12 Customize Graph Window with Value Ranges Tab



Enter `5` for the minimum and `30` for the maximum. Also, select **Interval between points** in the drop-down list and enter a value of `1`. These values set the sample size axis to range from 5 to 30 in increments of 1. The completed Value Ranges section of the window is shown in Figure 72.12.

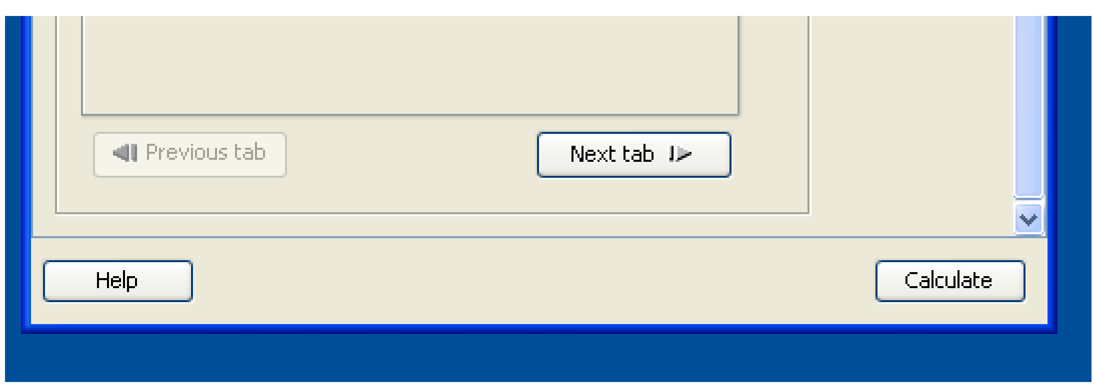
When you solve for power, you can set a range for sample size values, but not for the powers; and vice versa when you solve for sample size. That is, you cannot set the range of axis values for the quantity that you are solving for.

Click **OK** to save the values that you have entered and return to the Edit Properties page.

Performing the Analysis

You have now specified all of the necessary input values. Click **Calculate** to perform the analysis, as shown in Figure 72.13.

Figure 72.13 Calculate Button on the Edit Properties Page



Alternatively, you could choose to save the information that you have entered by selecting **File►Save** from the menu bar or clicking the **Save** toolbar icon, and perform the analysis at another time. No error checking is done when you save the project.

You can close the project by selecting **File►Close** on the menu bar or clicking the window close **X** in the upper right corner of the project window. You can reopen a project by selecting **File►Open** on the menu bar or clicking the **Open** toolbar icon.

For this example, click **Calculate**.

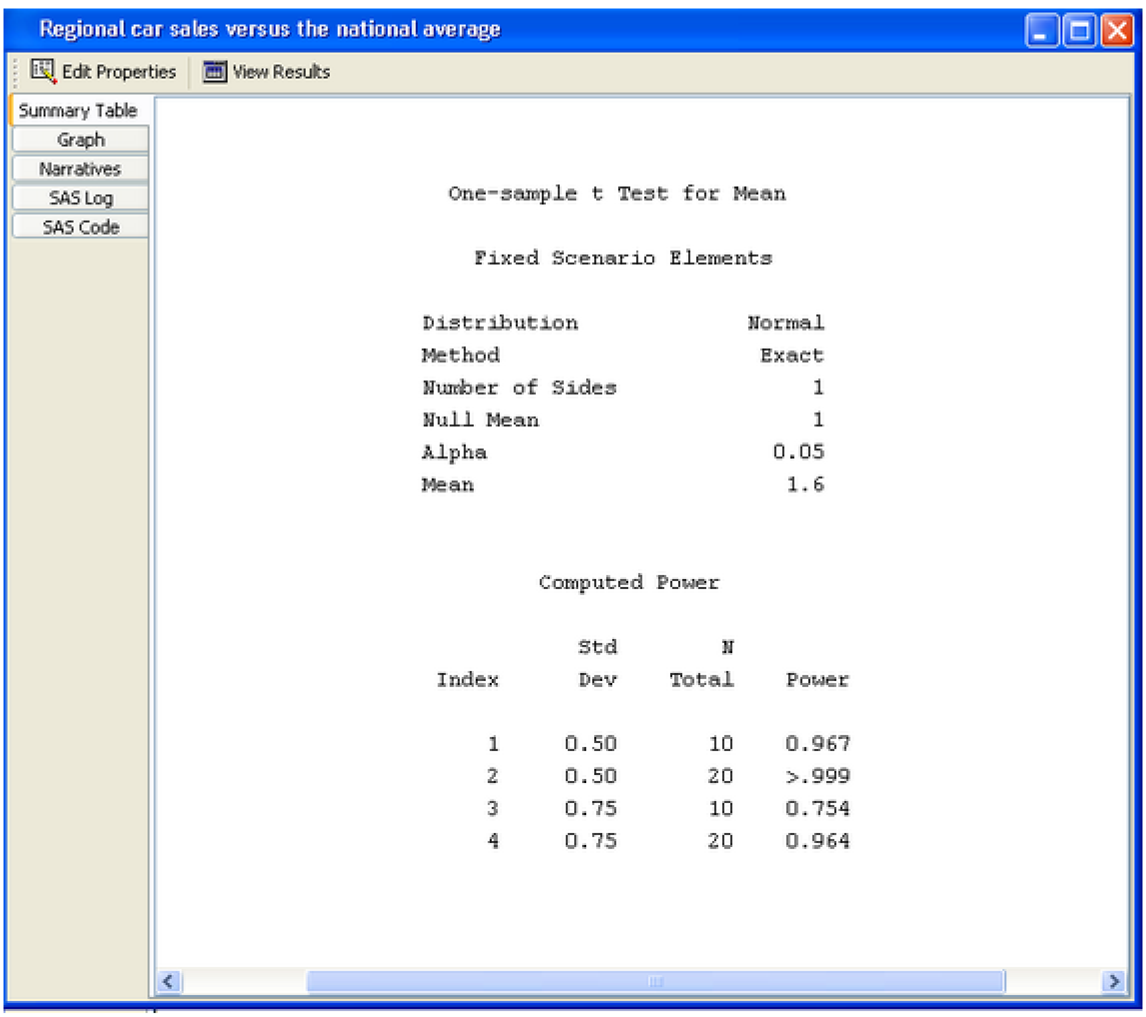
Viewing the Results

Results appear on the View Results page and are viewable in separate tabs. The tabs include **Summary Table**, **Graph**, **Narratives**, **SAS Log**, and **SAS Code** (located on the left side of the View Results page). The **Summary Table** and **Graph** tabs appear if you selected those options on the **Results** tab of the Edit Properties page. The other tabs always appear.

Summary Table

Click the **Summary Table** tab to view the summary table.

Figure 72.14 Summary Table Tab with Fixed Scenario Elements and Computed Power Tables



One-sample t Test for Mean

Fixed Scenario Elements

Distribution	Normal
Method	Exact
Number of Sides	1
Null Mean	1
Alpha	0.05
Mean	1.6

Computed Power

Index	Std Dev	N Total	Power
1	0.50	10	0.967
2	0.50	20	>.999
3	0.75	10	0.754
4	0.75	20	0.964

The Summary table consists of two subtables, as shown in Figure 72.14. The `Fixed Scenario Elements` table includes the parameters or options that have a single value for the analysis. The `Computed Power` table contains the input parameters that have been given more than one value, and it shows the computed quantity, power.

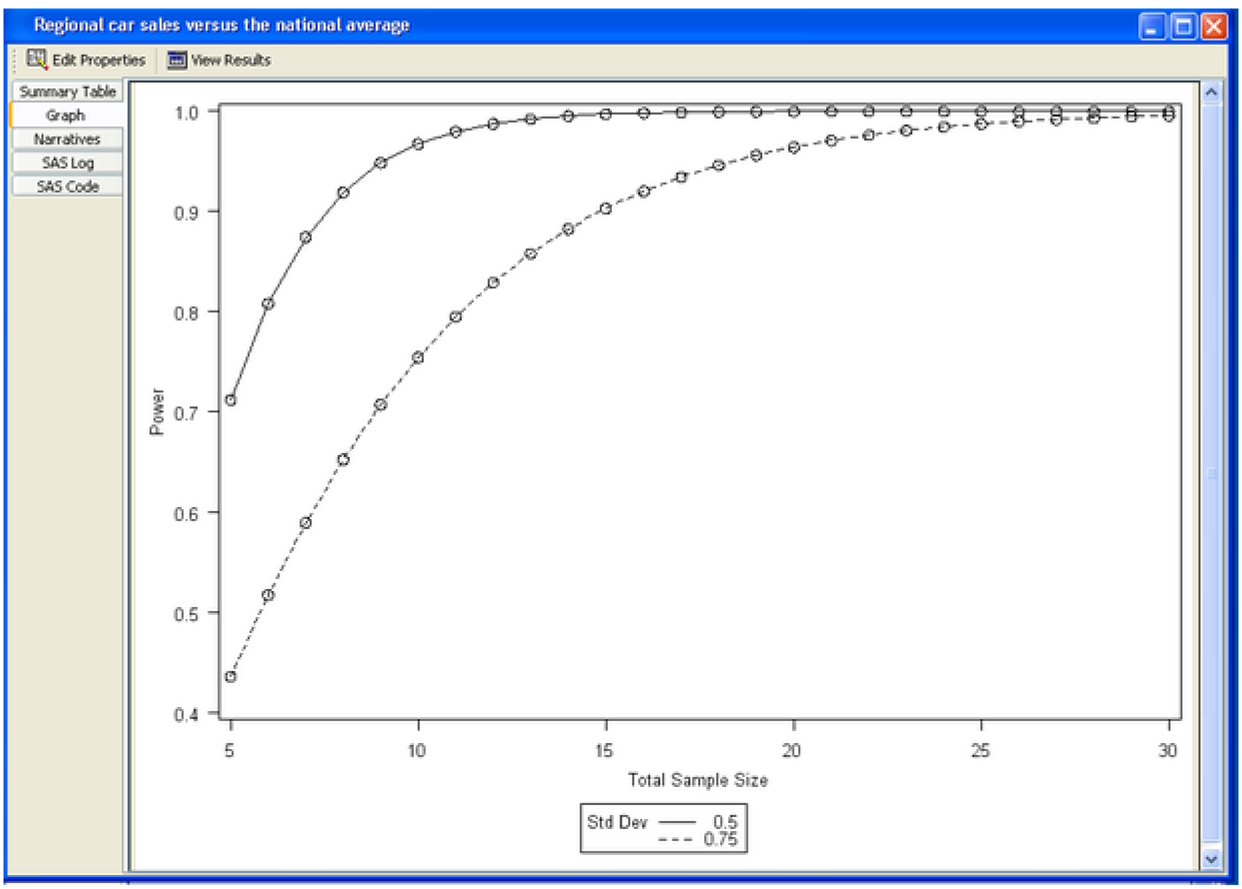
Thus, the `Computed Power` table contains four rows for the four combinations of standard deviation and sample size. From the table you can see that all four powers are high. The smallest value of power, 0.754, is associated with the largest standard deviation and the smallest sample size. In other words, the probability of rejecting the null hypothesis is greater than 75% in all four scenarios.

Power by Sample Size Graph

Click the **Graph** tab to view the power by sample size graph.

The power by sample size graph in Figure 72.15 contains one curve for each standard deviation. For a standard deviation of 0.5 (the upper curve), increasing sample size above 10 does not lead to much increase in power. If you are satisfied with a power of 0.75 or greater, 10 samples would be adequate for standard deviations between 0.5 and 0.75.

Figure 72.15 Graph Tab with Power by Sample Size Graph



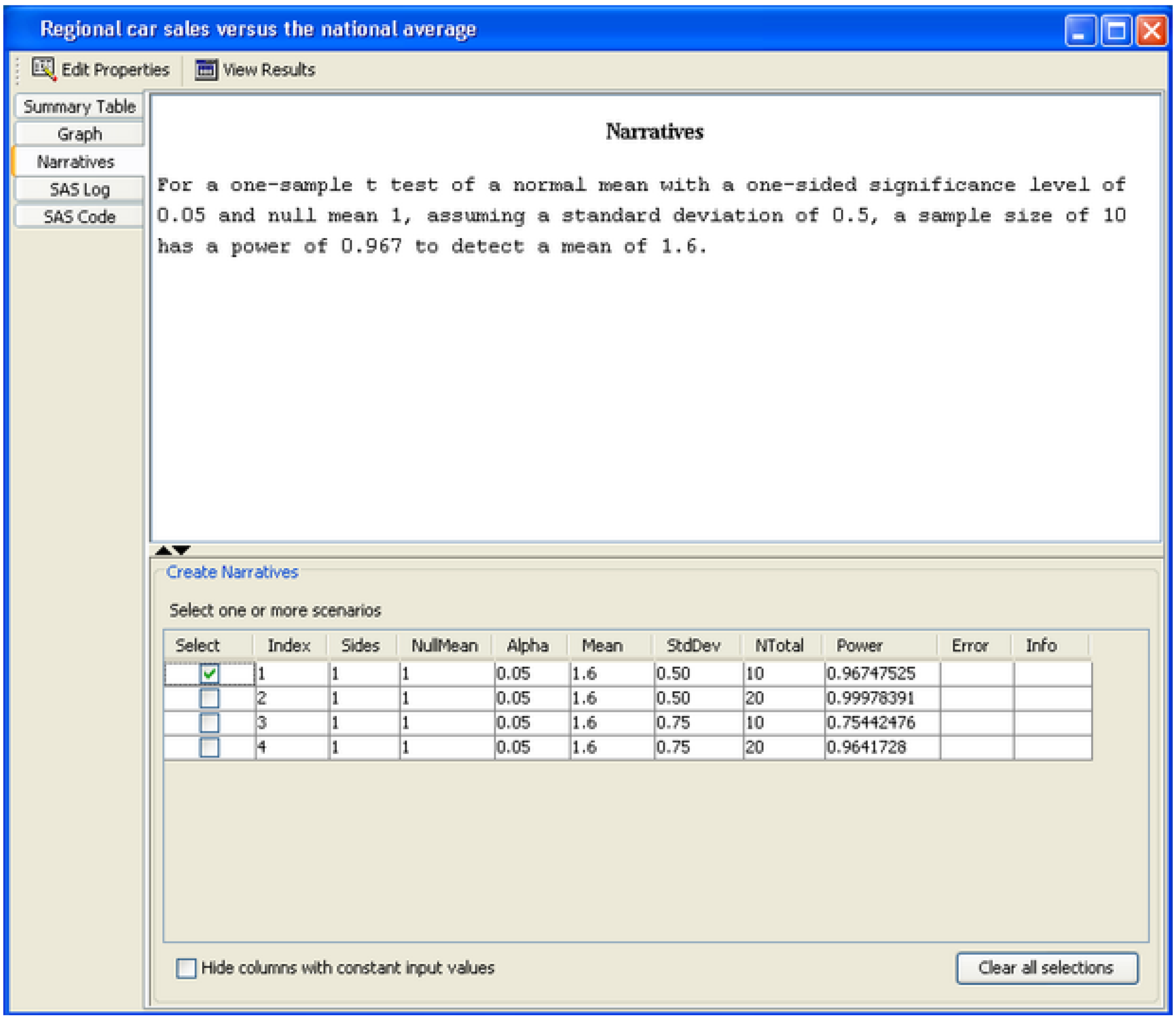
Narratives

Click the **Narratives** tab to display a facility for creating narratives.

Narratives are descriptions of the values that compose each scenario and include a statement about the computed power or sample size.

To create narratives, choose one or more scenarios in the table at the bottom of the tab. A narrative for each selected scenario is displayed in the top portion of the tab. See Figure 72.16.

Figure 72.16 Narrative Tab



For the example, select the first row in the table. The following narrative is displayed for the scenario with a standard deviation of 0.5 and a sample size of 10:

> For a one-sample *t* test of a normal mean with a one-sided significance level of 0.05 and null mean 1, assuming a standard deviation of 0.5, a sample size of 10 has a power of 0.967 to detect a mean of 1.6.

You can select several rows in the table. As you select each one, a corresponding narrative is created and displayed in the top portion of the table. Selecting a second scenario (the third row) produces the following output, where the narrative for the first row is followed by the narrative for the third row:

> For a one-sample *t* test of a normal mean with a one-sided significance level of 0.05 and null mean 1, assuming a standard deviation of 0.5, a sample size of 10 has a power of 0.967 to detect a mean of 1.6.
>
> For a one-sample *t* test of a normal mean with a one-sided significance level of 0.05 and null mean 1, assuming a standard deviation of 0.75, a sample size of 10 has a power of 0.754 to detect a mean of 1.6.

Other Results

Other results include the SAS log and the SAS code.

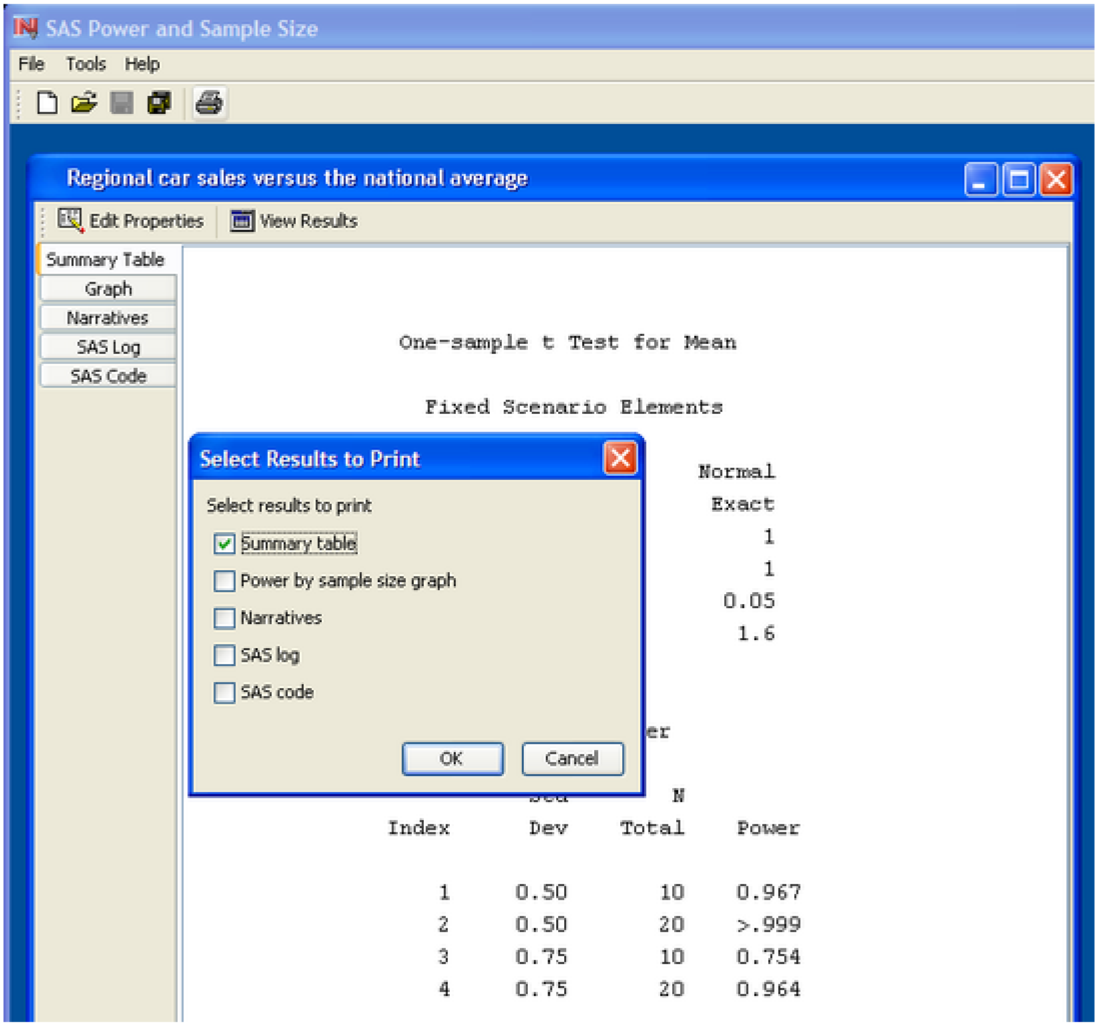
The SAS log that was produced when the **Calculate** button was last clicked appears on the **SAS Log** tab.

The SAS statements that produced the results appear on the **SAS Code** tab.

Printing Results

To print one or more results, select **File►Print** from the menu bar or click the **Print** toolbar icon. A window is displayed that lists all available results, as shown in Figure 72.17. Select the results that you want to print and click **OK**.

Figure 72.17 Print Selection Window



Changing Properties

If you want to change some values of the properties and rerun the analysis, change to the Edit Properties page and continue. The icons for selecting the Edit Properties and View Results pages are in the command bar just below the project window title.

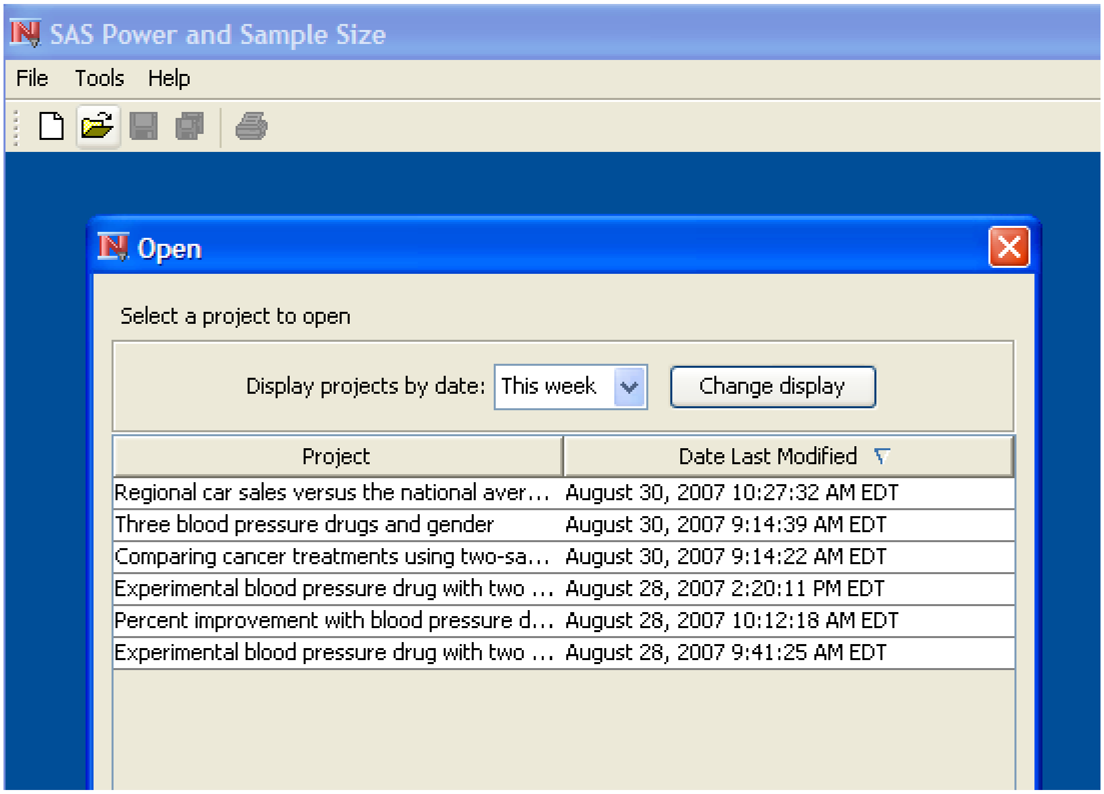
Closing the Project

When you are finished working with a project, close it by clicking the **X** in the upper right corner of the project window or selecting **File►Close** on the menu bar. If you have not saved the project, you will be asked if you want to save it before closing.

Opening a Project

You can reopen existing projects using the Open window. Select **File►Open** on the menu bar or click the **Open** toolbar icon.

Figure 72.18 Open Window Containing the Analysis Created in the Example



As shown in Figure 72.18, the analysis that you just completed is listed in the table. The label that you assigned to it, `Regional car sales versus the national average`, appears in the **Project** column of the table. The table also contains the date that the analysis was last modified. If you do not see the project that you are looking for, change the value of the **Display projects by date** box to `All` by selecting `All` from the drop-down list, and click the **Change display** button.

You can sort the projects in the table by clicking the header of the desired column. The sort direction is indicated by arrows displayed in the column header.

Select the project that you want to open and click **OK**. You can also double-click the project entry to open it.

Changing Values and Rerunning the Analysis

After viewing the graph, you might want to re-create the graph with a different range for sample sizes. On the **Results** tab of the Edit Properties page, click the **Customize** button for the power by sample size graph. The **Customize Graph** window is displayed.

On the **Value Ranges** tab of the window, change the Maximum value in the Sample Size table from `30` to `20`. Click **OK**.

Rerun the analysis by clicking **Calculate**. The View Results page is displayed again and the graph now has the new maximum value for the sample size axis.

How to Use: PSS Application

Overview

The PSS application is an application that resides on your desktop. It requires a connection to SAS software either on your desktop machine or a remote machine. You can set default values for several parameters and options as preferences. More detail on creating and editing projects is provided. Projects can be imported and exported.

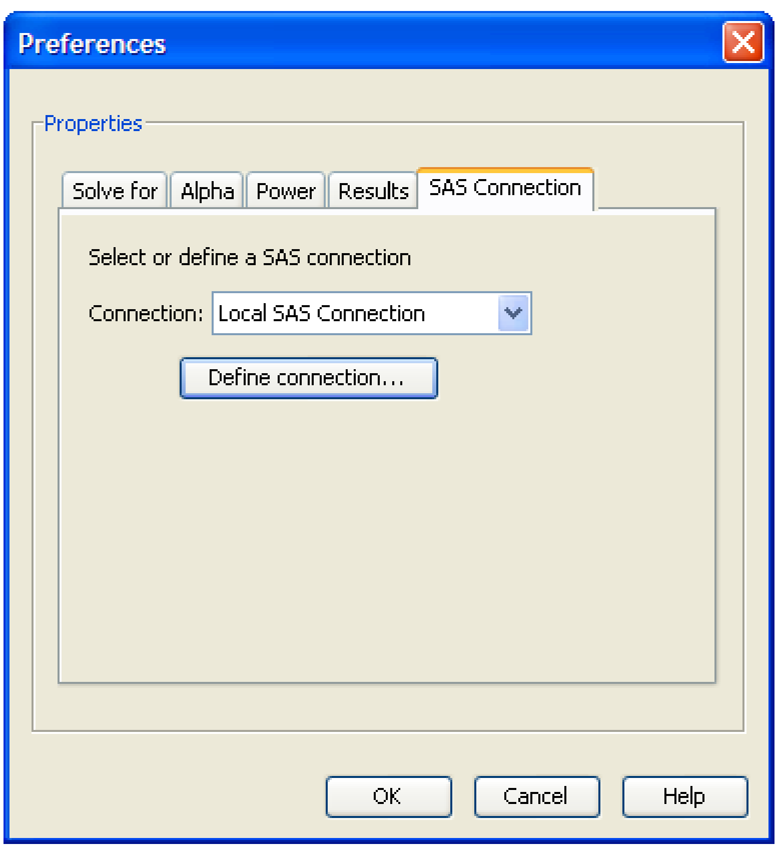
SAS Connections

Connections to SAS servers are defined in the Preferences window. To access the Preferences window, select **Tools▶Preferences** on the menu bar.

Click the **SAS Connection** tab to select or define a connection to a SAS server. A connection to a SAS server is required in order to calculate results. The server can be on your local (desktop) machine or on a remote machine.

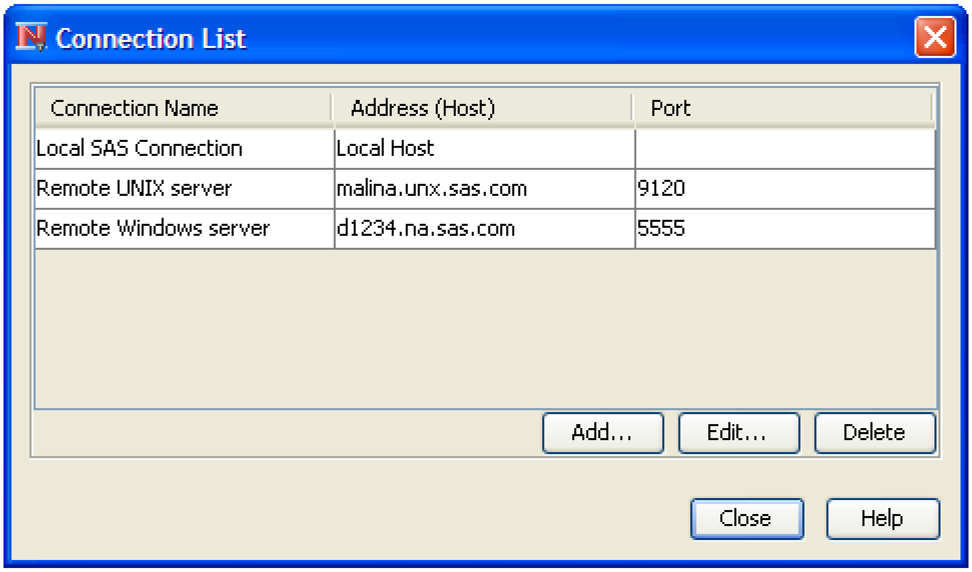
You can define several SAS connections and choose the one you want to use. To select a previously defined connection, choose it from the **Connection** list on the **SAS Connection** tab; see Figure 72.19.

Figure 72.19 SAS Connection Tab



To define a SAS connection, click the **Define connection** button. The Connection List window appears, as shown in Figure 72.20. To create a new connection, click **Add**. To edit an existing connection, select it in the Connection List and click **Edit**.

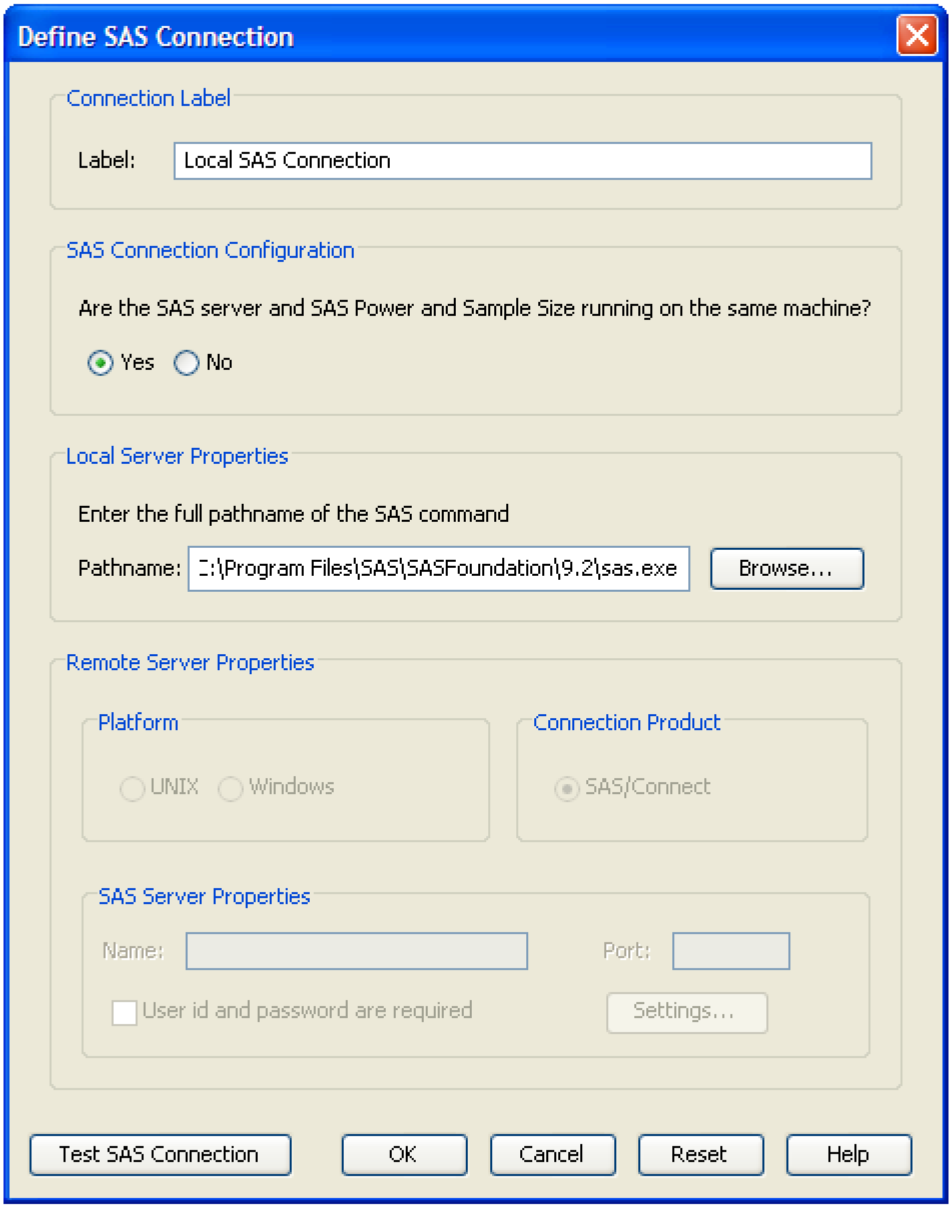
Figure 72.20 Connection List



Defining a SAS Connection

After you click the **Add** or **Edit** button, the Define SAS Connection window appears, as shown in Figure 72.21. If you clicked **Edit**, the previously defined information is available for editing.

Figure 72.21 Define Connection Window



Enter a descriptive label for the connection. The label is used to distinguish among the connections in the connections list.

Then, select **Yes** or **No** to specify whether the SAS connection is to the local machine (that is, the one on which PSS is running) or to a remote machine, respectively.

Defining a Local Connection

To define a connection to the local machine, enter the full path name of (or browse for) the SAS executable file (*sas.exe* on Microsoft Windows).

Test the SAS connection by clicking the **Test SAS Connection** button.

Defining a Remote Connection

To define a connection to a remote machine, select either the **UNIX** or **Windows** option to indicate that the remote SAS server is on a machine running the UNIX or Microsoft Windows operating systems, respectively. Then, specify the machine name and port number that the SAS/Connect spawner is using on the remote machine. Contact the SAS server administrator for this information.

If the remote machine is running Microsoft Windows, select the **User id and password are required** if authentication is required to access the SAS server (that is, if the SAS `-security` option is used). By default, authentication is required for SAS servers running on UNIX operating systems.

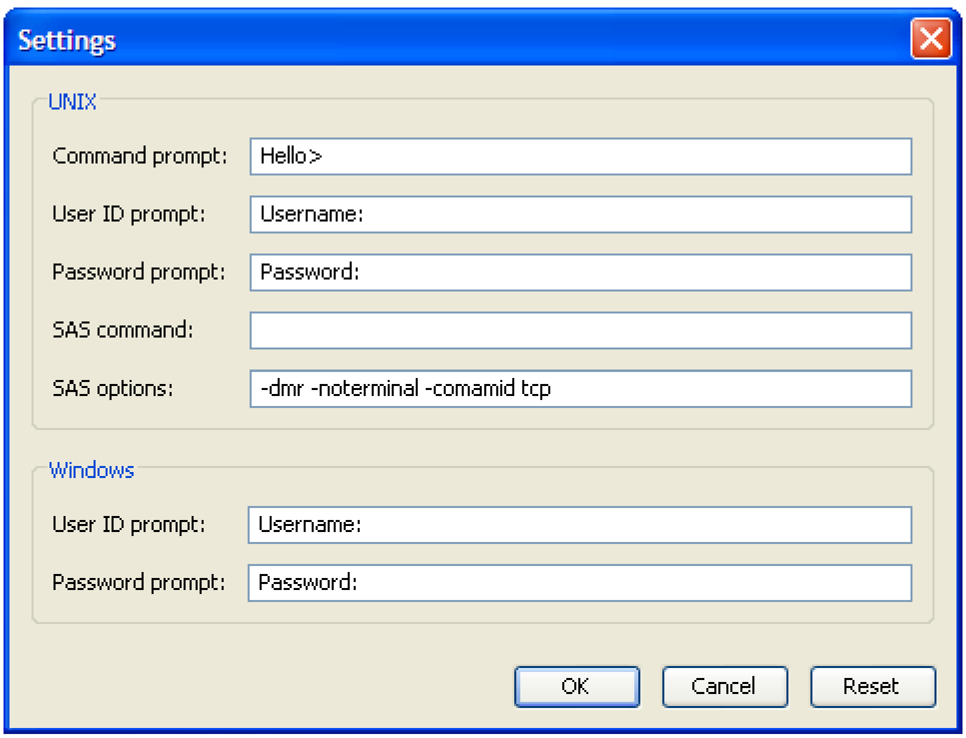
Test the SAS connection by clicking the **Test SAS Connection** button.

Additional Settings

Click the **Settings** button on the Define SAS Connection window to access some additional settings for a remote connection to a SAS server. For the most part these settings are prompts that PSS expects to receive from the SAS/CONNECT spawner on the remote machine, as shown in Figure 72.22.

If the remote SAS server is on a UNIX machine, you must specify the full pathname of the SAS command. Contact the SAS server administrator for this information.

Figure 72.22 Connection Settings Window

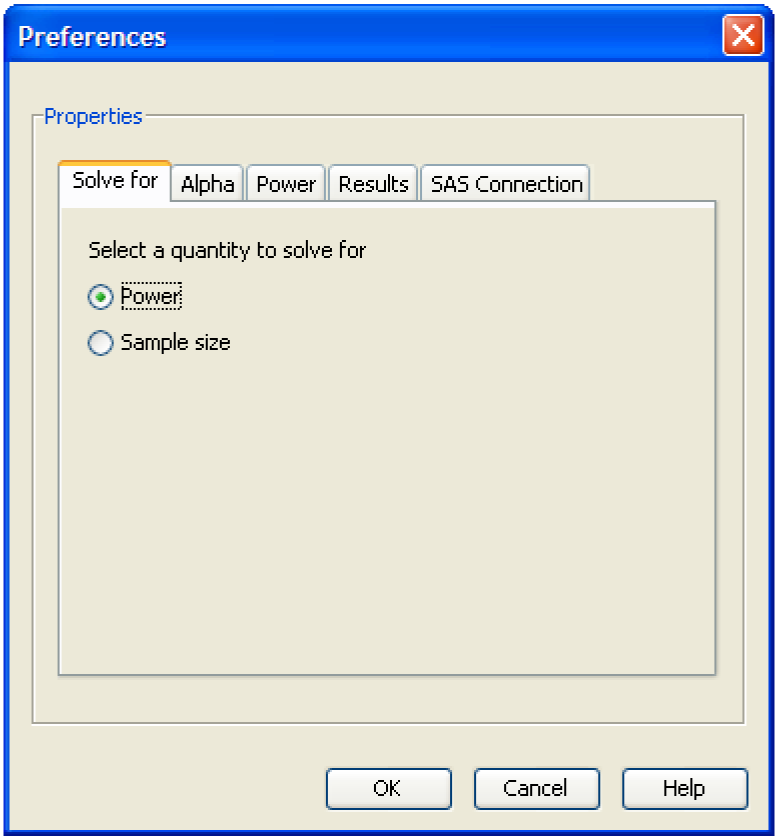


Setting Preferences

In the Preferences window you can set default values for options that are used by all analyses.

To access the Preferences window, select **Tools►Preferences** on the menu bar. Figure 72.23 shows the Preferences window.

Figure 72.23 Preferences Window



Preference values are used as the defaults for each newly opened project (that is, those that are opened from the New window). For a specific project, each of these default values can be overridden on the Edit Properties page.

Changes in preferences do not change the state of an existing analysis (that is, one that is accessed from the Open window).

Selecting the Quantity to Solve For

Click the **Solve For** tab to select **Power** or **Sample Size** as the default value to be solved for; see Figure 72.23. For confidence interval analyses, selecting **Power** is equivalent to selecting **Prob(Width)**.

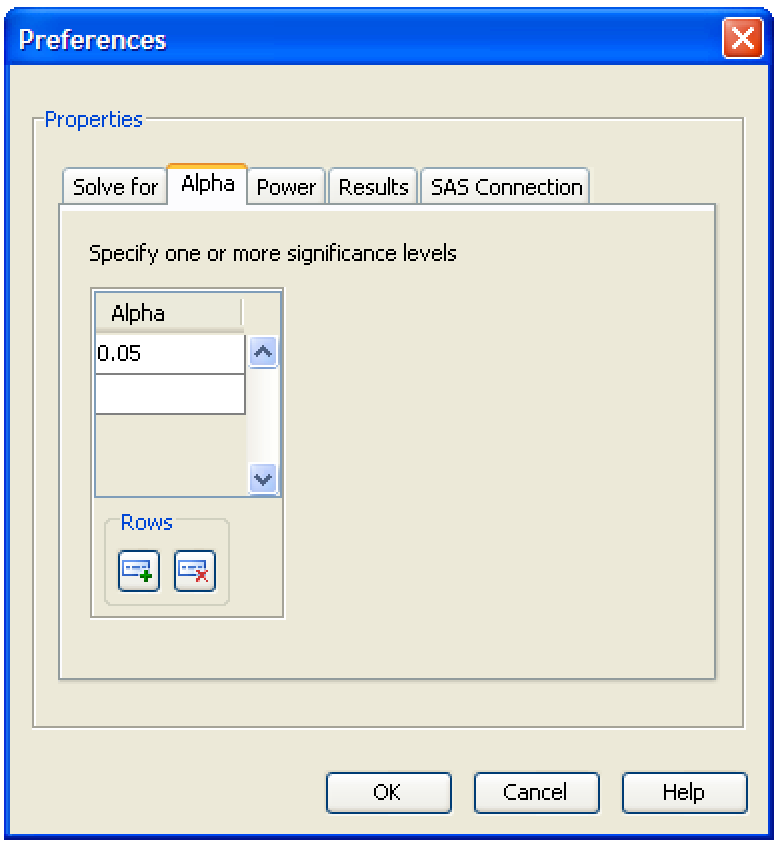
For analyses that offer both **Sample size per group** and **Total sample size**, the **Sample size** option on this page corresponds to total sample size.

Setting Alphas

Click the **Alpha** tab to enter one or more values for alpha. Alpha is the significance level (false positive probability). For confidence interval analyses, alpha values are transformed into confidence levels by (1 – alpha). For example, an alpha of 0.05 would represent a confidence level of 0.95.

To set default values of alpha, enter one or more values in the **Alpha** data entry table. See Figure 72.24. It is not necessary to have any default values for alpha. Add more rows to the table as needed using the  button at the bottom of the table.

Figure 72.24 Alpha Preference Tab

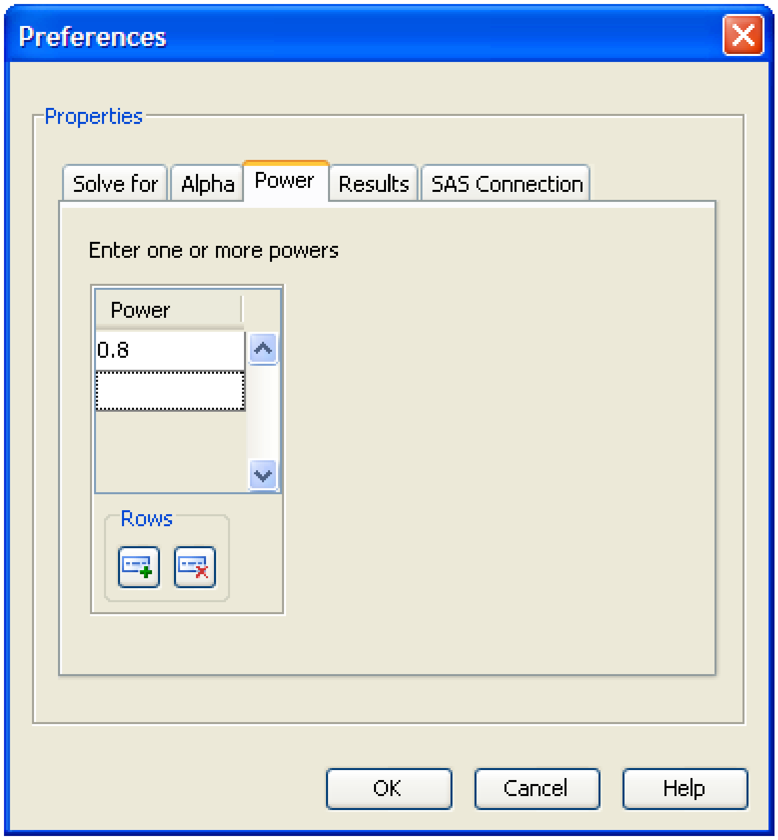


Setting Powers

Click the **Power** tab to enter one or more values for power. It is not necessary to have any default values for power. For confidence interval analyses, power values are treated as prob(width) values.

To set default values of power, enter one or more values in the **Power** data entry table; see Figure 72.25.

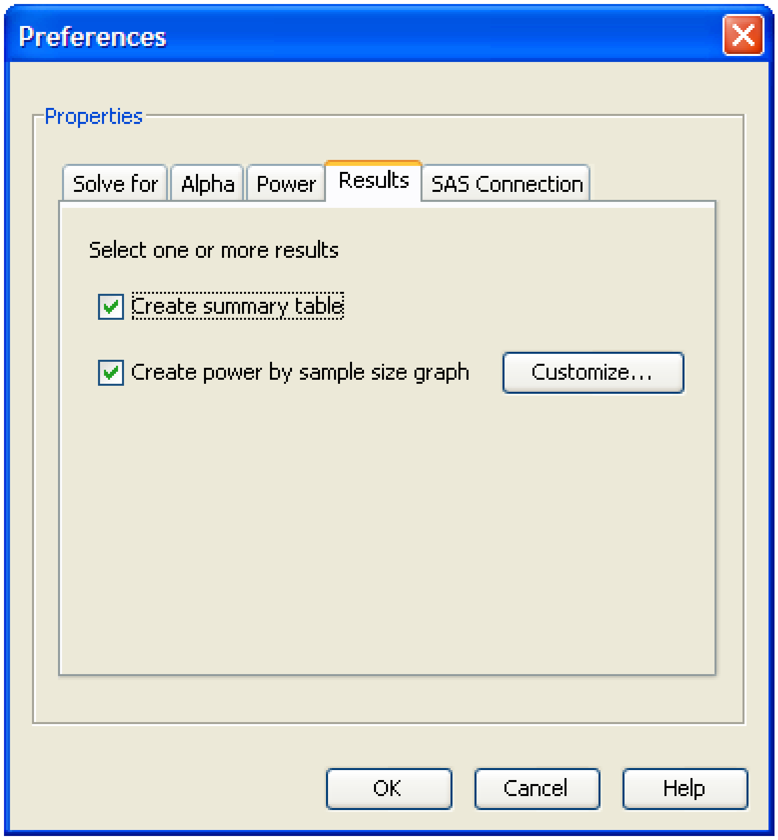
Figure 72.25 Power Preference Tab



Setting Results Options

Click the **Results** tab to make default selections for the summary table and the power by sample size graph options; see Figure 72.26.

Figure 72.26 Results Options Preferences Tab



The summary table consists of the input parameter values and the calculated quantity (power or sample size). Select the **Create summary table** check box to create the table by default.

To request that an analysis create a power by sample size graph by default, select the **Create power by sample size graph** check box.

Creating and Editing PSS Projects

A PSS project is an instance of an analysis. The first decision in using PSS is to choose the appropriate test or design. Select the **File►New** on the menu bar or click the **New** icon on the toolbar. The New window appears with a list of the available analyses. Select the type of analysis that you want from the list and click **OK**.

When the project is first opened, the Edit Properties page is displayed. It is described in the section "Editing Properties" on page 6174.

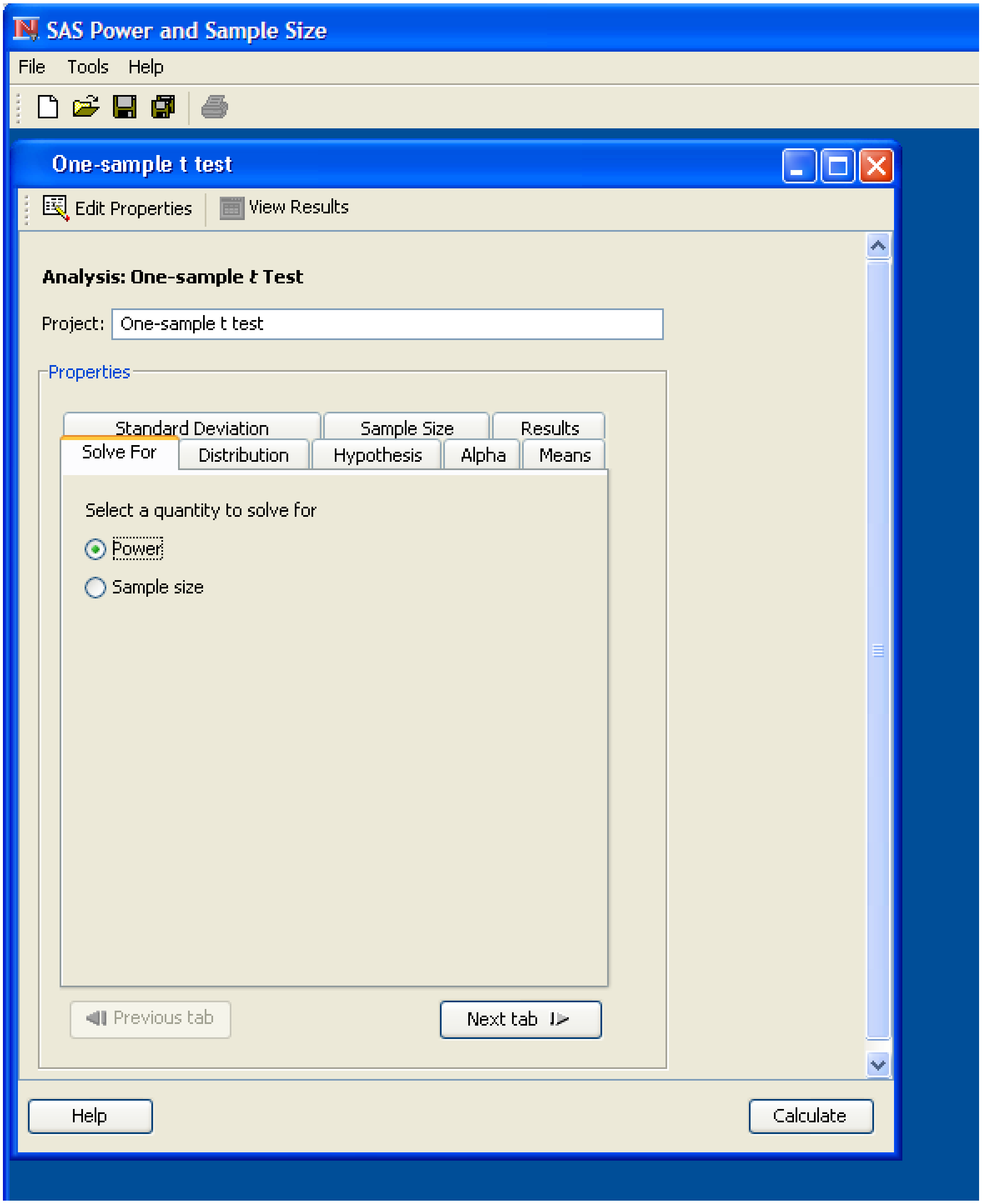
After the properties have been specified and the analysis is performed, the View Results page is displayed. See the section "Viewing the Results" on page 6178.

A project that has been saved and closed can be reopened from the Open window. Select **File►Open** on the menu bar or click the **Open** icon on the toolbar.

Editing Properties

The Edit Properties page consists of several analysis options and input parameters that are relevant to the particular analysis. These options and parameters are organized on several tabs, as shown in Figure 72.27.

Figure 72.27 Edit Properties Page

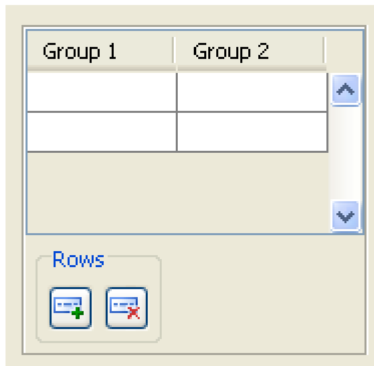


The Edit Properties page contains various controls by which you can enter values or select choices. In addition to the usual data entry controls such as text fields and check boxes, several specialized controls are present: data entry tables and the Alternate Forms control. More detailed descriptions follow.

Using Data Tables

Data entry tables are composed of data entry fields for one or more rows and columns. Figure 72.28 shows a two-row, two-column table.

Figure 72.28 Two-Column Data Entry Table with Controls



Type an appropriate value in each field. It is not necessary to type data in all rows or to delete empty rows. However, if a table has more than one column, the cells of a row must be completely filled or completely blank. Rows with values in some but not all cells are not allowed.

To append more rows, click the button beneath the table. To delete the last row of the table, click the button.

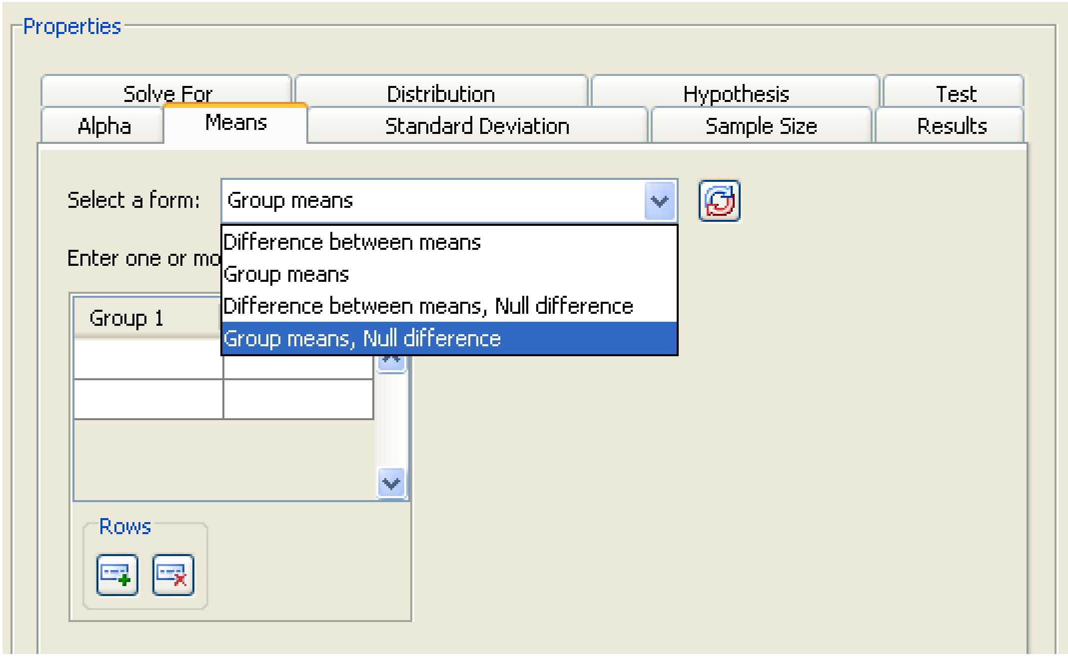
Also, you can display a pop-up menu to perform additional actions such as inserting and deleting rows. First, select the row to insert before or delete, then right-click to display the pop-menu and select the desired action.

Using Alternate Forms

For some input parameters, there are several ways in which data may be entered. For example, in the two-sample *t* test analysis, group means can be entered as either individual means or a difference between means.

The alternate forms are displayed in a drop-down list with an adjacent button, as shown in Figure 72.29. The button enables you to cycle through the alternatives, displaying each one in turn. To see what forms are available, you can open the drop-down list and select the one you want or you can click the button until the form that you want is displayed.

Figure 72.29 **Select a form** Drop-Down List and Button



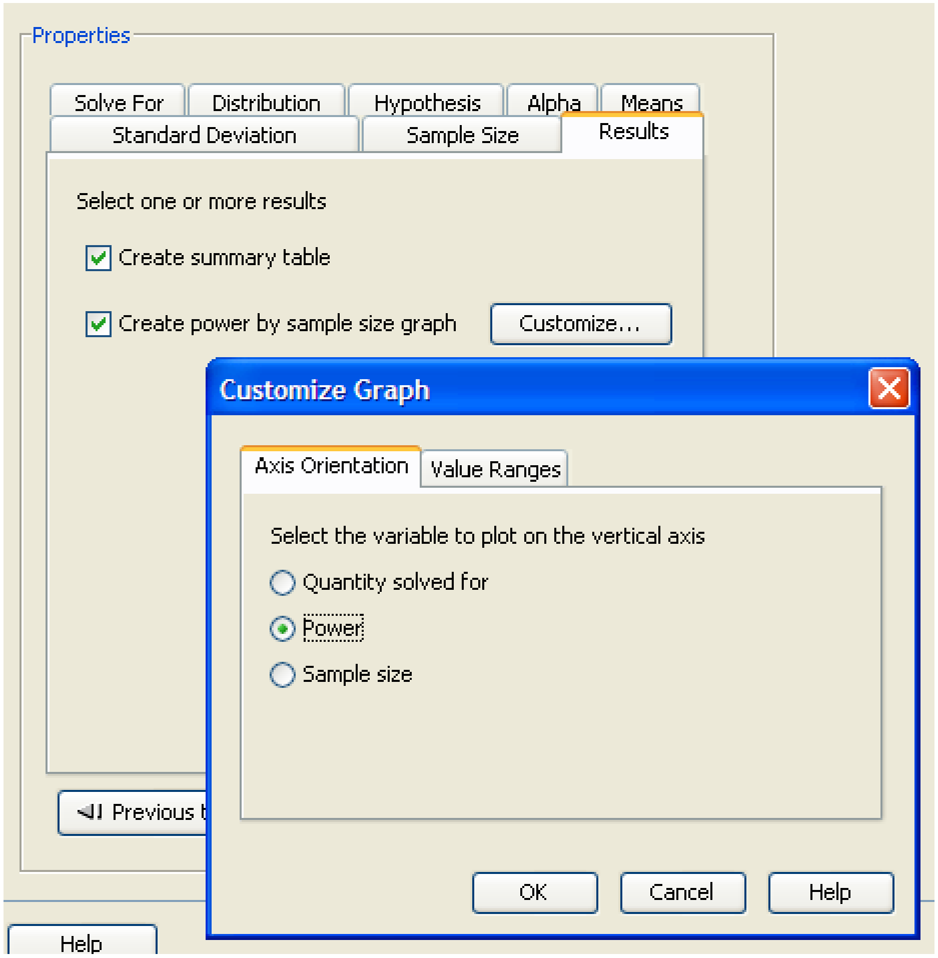
The alternate form last used for an analysis is saved and displayed as the default when a new instance of the analysis is opened.

Customizing Graphs

The Edit Properties page for all analyses contains a **Results** tab. You can choose to create a graph, and you can optionally choose to customize the graph by clicking the **Customize** button that is beside the **Create power and sample size graph** choice.

As shown in Figure 72.30, the Customize Graph window consists of an **Axis Orientation** tab and a **Value Ranges** tab. Use the **Axis Orientation** options to specify which axes you want used for power and for sample size. Use the **Value Ranges** settings to specify the axis range for the non-target quantity (that is, the power axis if you are solving for sample size or the sample size axis if you are solving for power).

Figure 72.30 Customize Graph Window



When specifying a value range, you can specify a minimum value and a maximum value. Also, you can select either the `Number of points` or the `Interval between points` choice for the axis and specify a value. All of these values are optional; specify only the ones you want.

Scenarios

A scenario is one instance of a complete set of values for an analysis. For example, if two alpha values and two total sample size values are specified with all other input parameters taking only a single value, there would be four scenarios—the four combinations of two alphas and two sample sizes.

Performing the Analysis

To perform the analysis, click **Calculate** at the lower right of the Edit Properties page. The input parameters are checked for validity, and the analysis is performed. The View Results page is then displayed.

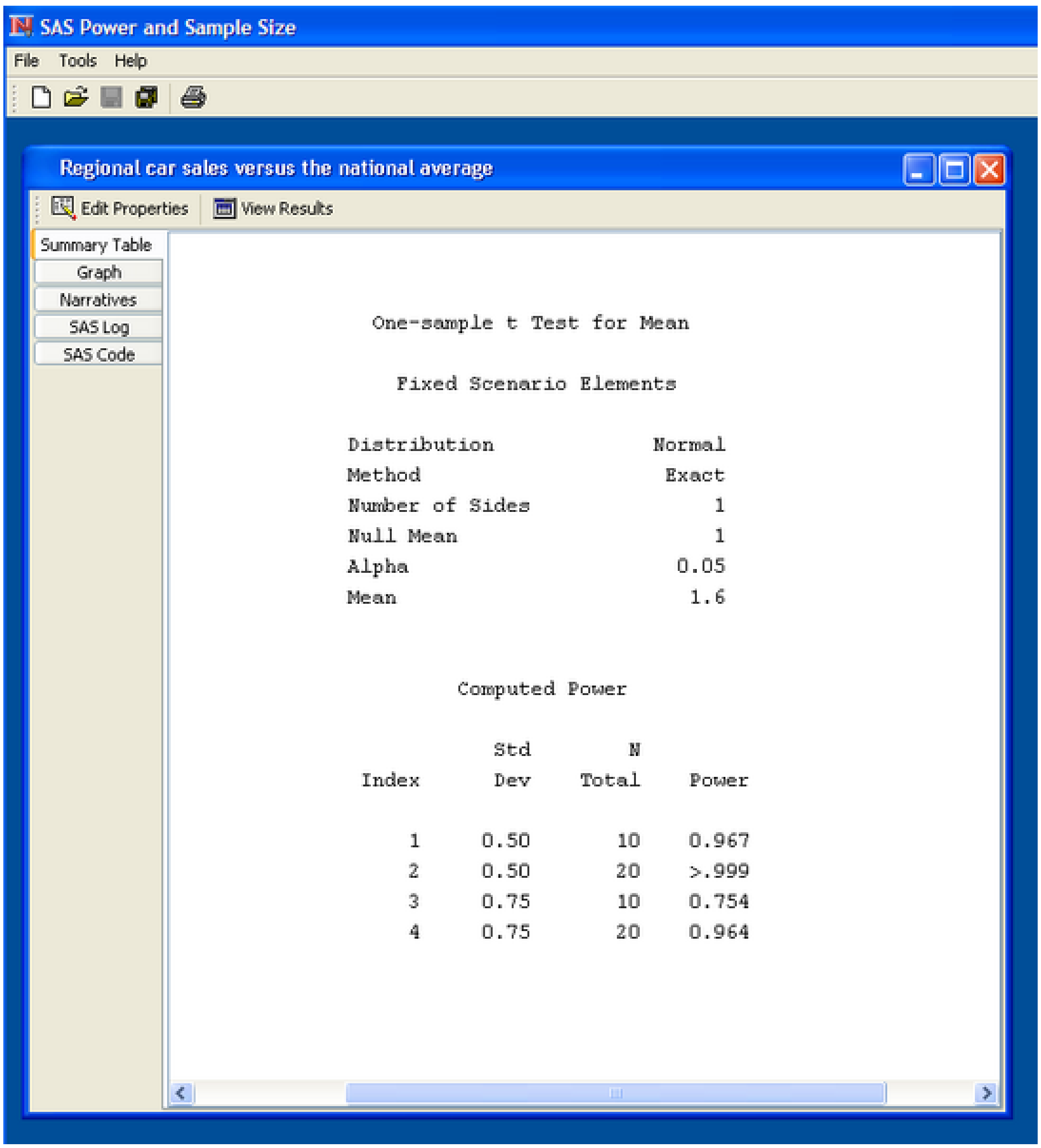
Viewing the Results

The results appear in separate tabs on the View Results Page. These tabs include **Summary Table**, **Graph**, **Narratives**, **SAS Log**, and **SAS Code**.

Viewing the Summary Table

Click the **Summary Table** tab to view the summary table. It consists of two subtables, as shown in Figure 72.31. The `Fixed Scenario Elements` table includes the options and parameter values that are constant for the analysis. The `Computed Power` table includes the calculated power or sample size values and the values for input parameters that have multiple values specified for the analysis.

Figure 72.31 View Results Page with Summary Table

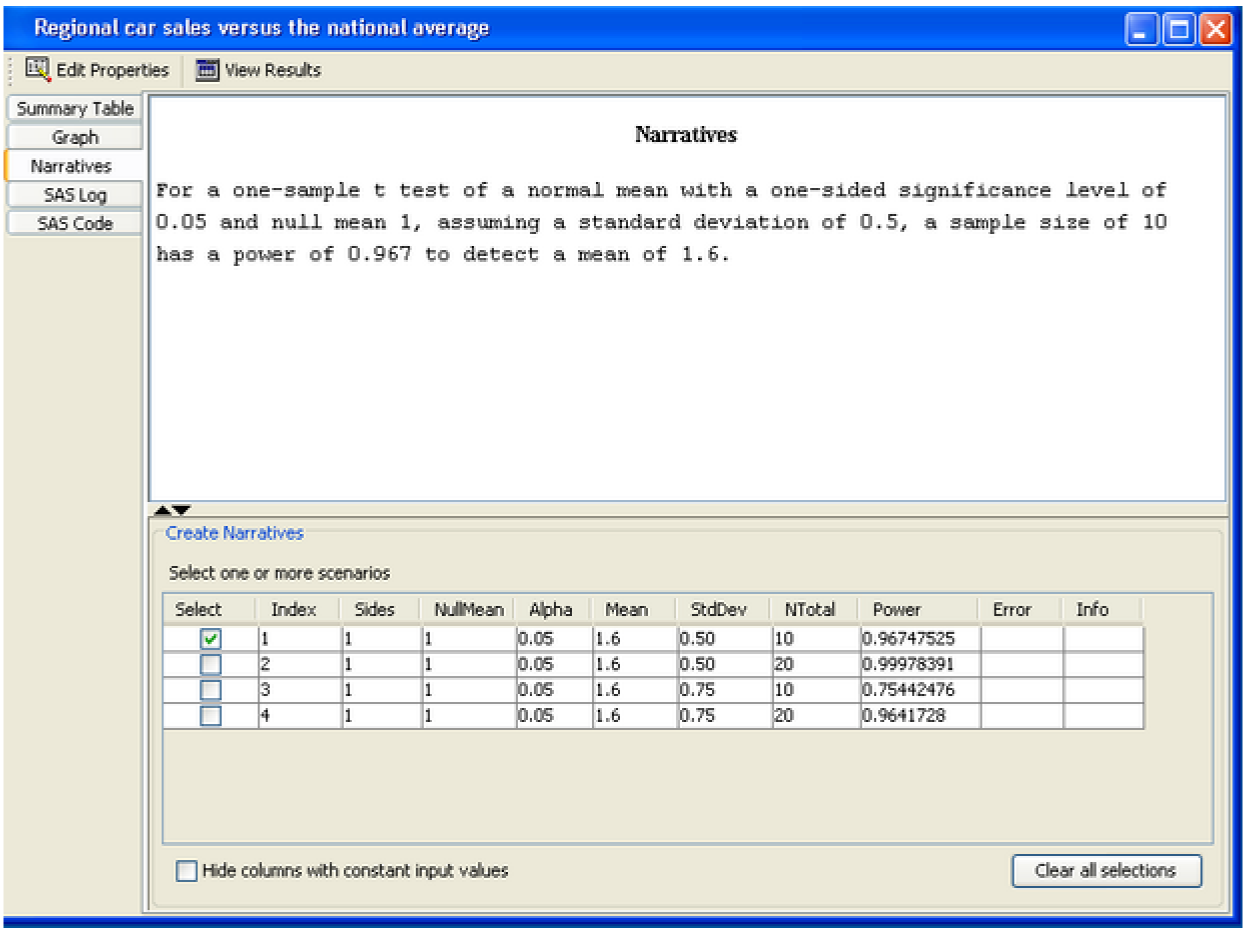


Creating Narratives

Click the **Narratives** tab to display a facility to create narratives. Narratives are descriptions of the input parameter values and calculated quantities in sentence or paragraph form. Each narrative corresponds to one calculated quantity value.

The **Narratives** tab is divided into a narrative selector panel and a narrative display panel. To create a narrative, select the row in the narrative selector panel that corresponds to it. You can select as many rows as you want. See Figure 72.32.

Figure 72.32 Narrative Selector and Display



The narrative selector table often contains columns whose values do not vary. For example, in Figure 72.32, the Sides, NullMean, Alpha, and Mean columns contain values that do not vary. You can hide these columns by selecting the **Hide columns with constant input values** check box.

Viewing the SAS Log and Code

Click the **SAS Code** tab to view the SAS statements that are used to generate the analysis results. Click the **SAS Log** tab to view the SAS log that corresponds to the analysis.

The SAS code differs slightly from the statements in the SAS log. Statements that are used to place the results in the location maintained by the application are not included. This is done to prevent you from overwriting the results stored by the application if you run the SAS code outside of the application.

Printing Results

To print one or more results, click the **Print** icon on the toolbar or select **File►Print** on the menu bar. The Select Results to Print window is displayed. You can choose to print one or more of the results by selecting the corresponding options here.

Saving the Project

To save a project, click the **Save** toolbar icon or select **File►Save** from the menu bar. Projects can be saved even if some of the information is invalid. Error checking is performed when the **Calculate** button is clicked.

Closing the Project

To close a project, click the **X** in the upper right corner of the project window or select **File►Close** from the menu bar.

Importing and Exporting Projects

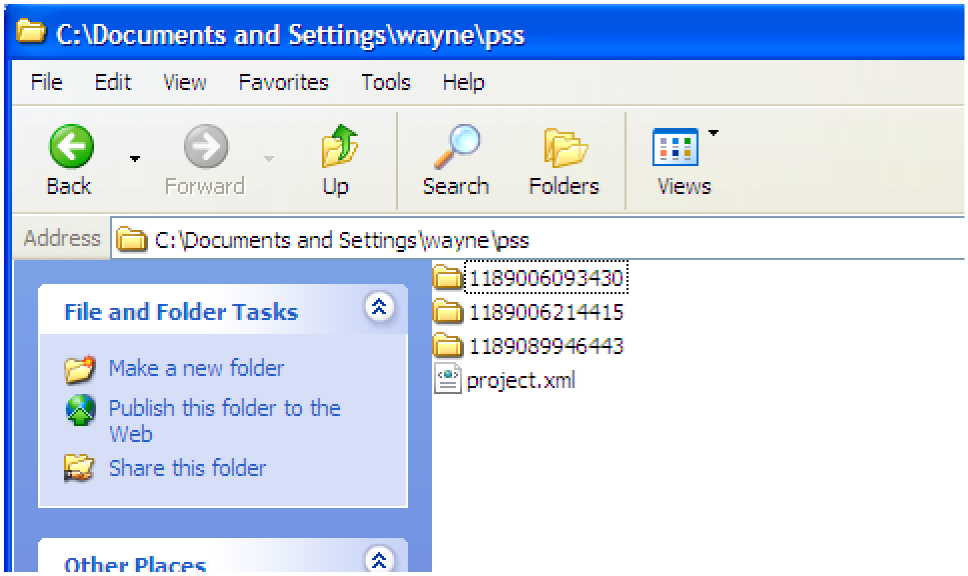
PSS projects can be imported from the same machine or a different machine. Also, the active project (the project that is open and on top of any other open projects) can be exported.

Importing Projects

A PSS project that was created on another machine or by another user can be imported and used. Also, importing projects is the recommended way of moving existing PSS projects that were created with PSS release 2.0 (a Web application) to PSS release 3.1 (a desktop application).

PSS files are stored in a folder entitled *pss*. The *pss* folder contains a *project.xml* file and individual folders for each project. See Figure 72.33.

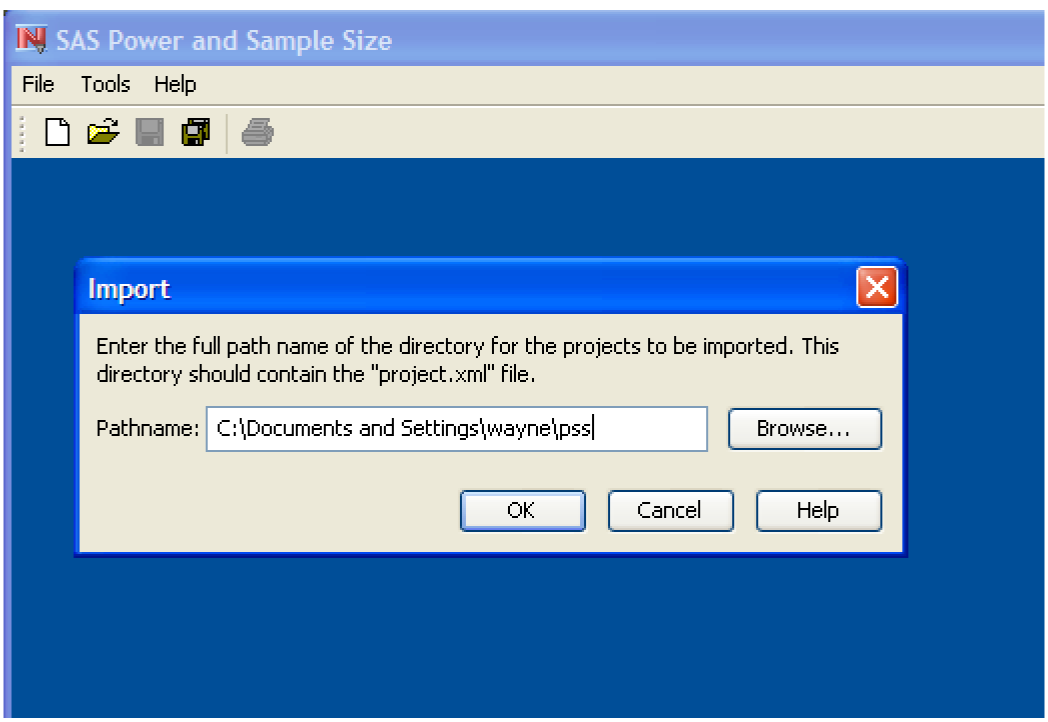
Figure 72.33 PSS Directory Structure



If PSS files are on another machine, they must first be copied to a temporary location on the desktop machine that is running PSS. The entire *pss* folder should be copied.

To import projects, select **File►Import** from the menu bar. Then, specify the full pathname of the *pss* folder.

Figure 72.34 Import Projects Window



To import PSS 2.0 files, you need to find the *pss* folder. The easiest way to do this is to search for the *project.xml* file. If you find several files with this name, you need to decide which one or more to import.

Exporting the Active Project

If you want to send a PSS project to someone, you can export the active project. The active project is the one that is open and that has focus (is displayed on top of any other open projects). Select **File►Export active project** and specify a temporary directory to hold the exported project.

The recipient must import the project using PSS.

Details: PSS Application

Software Requirements

PSS is available in SAS 9.2 or later for the following platforms: Microsoft Windows 7, Vista, and XP.

Two configurations are available for SAS connections: local and remote. With the local configuration, PSS and SAS must reside on the same machine. With the remote configuration, PSS and SAS can reside on different machines. SAS connections are defined and selected on the **SAS Connection** tab on the Preferences window. More information about SAS connections is found in the section "SAS Connections" on page 6166.

For both configurations, Base SAS and SAS/STAT software must be installed and SAS/GRAPH software is recommended.

For the remote configuration, SAS/CONNECT and SAS/IntrNet software must also be installed. For more information about configuring the remote SAS server, click **Help►Contents** on the menu bar and then click **Configuring a Remote SAS Server** under **Special Topics** in the table of contents.

Installation

SAS Power and Sample Size is installed separately from the SAS/STAT product. Contact your SAS site representative to have the application installed.

SAS Power and Sample Size is installed using the SAS Software Deployment Wizard. It is listed as an available product with, but separate from, Foundation SAS which contains the SAS/STAT and SAS/GRAPH products that are required for using the application.

Configuration

When you first run SAS Power and Sample Size 3.1 (PSS), you are asked to provide configuration information.

First, you are asked for the name of a directory to contain the your power and sample size projects. A folder named *pss* is created in the specified directory, and projects are stored in the *pss* folder. This directory cannot be the same as the one used by PSS 2.0. If it is, PSS requires that another folder name be provided.

Then, if the appropriate release of the SAS System is available on the desktop machine, you are asked whether a connection should be automatically created to it. If you respond `No`, then PSS informs you that a connection to the SAS server is necessary and asks if you want to select one now or later. A connection to a SAS server is not necessary to use the application until the **Calculate** button on the Edit Properties page of a project is clicked. More information about connections is available in the section "Setting Preferences" on page 6169.

Then, PSS displays a wizard to help you import existing PSS projects from either a previous release (PSS 2.0) or the current one (PSS 3.1). More information is available in the section "Importing Projects" on page 6180.

Example: Two-Sample *t* Test

Overview

The one-sample *t* test compares the mean of a sample to a given value. The two-sample *t* test compares the means of two samples. The paired *t* test compares the mean of the differences in the observations to a given number. PSS provides power and sample size computations for all of these types of *t* tests. For more information about power and sample size analysis for *t* tests, see Chapter 71, "The POWER Procedure."

The two-sample *t* test tests for differences or ratios between means for two groups. The groups are assumed to be independent. This example describes three examples using the two-sample *t* test: for equal variances, for unequal variances, and for mean ratios.

Test of Two Independent Means for Equal Variances

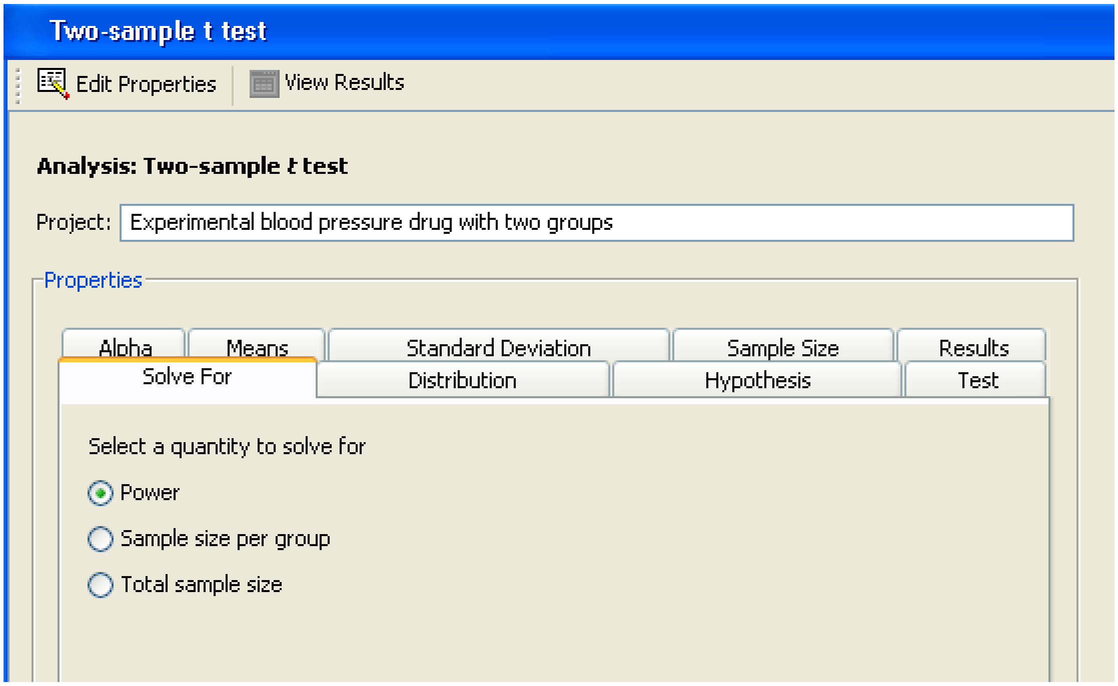
Suppose you are interested in testing whether an experimental drug produces a lower systolic blood pressure than a placebo does. Will 25 subjects per treatment group yield a satisfactory power for this test? From previous work, you expect that the blood pressure is 132 for the control group and 120 for the drug treatment group and that the standard deviation is 15 for both groups. You want to use a one-sided test with a significance level of 0.05. Because there are two independent groups and you are assuming that blood pressure is normally distributed, the two-sample *t* test is an appropriate analysis.

Start by creating a new project. Select **File►New**. In the New window, select **Two-sample t test** from the list. The Two-Sample *t* test project window appears, with the Edit Properties page displayed.

Editing Properties

On this page enter a name to describe the project and enter project properties. Click each tab on the Edit Properties page to enter the desired properties. You can also change tabs by clicking the **Next tab** or **Previous tab** buttons. See Figure 72.3.

Figure 72.35 Two-Sample *t* Test



Project Description

The description is used to identify this particular project in the Open and Delete windows. Type a description for your project in the **Project:** text box.

For this example, change the description to `Experimental blood pressure drug with two groups`, as shown in Figure 72.35.

Solve For

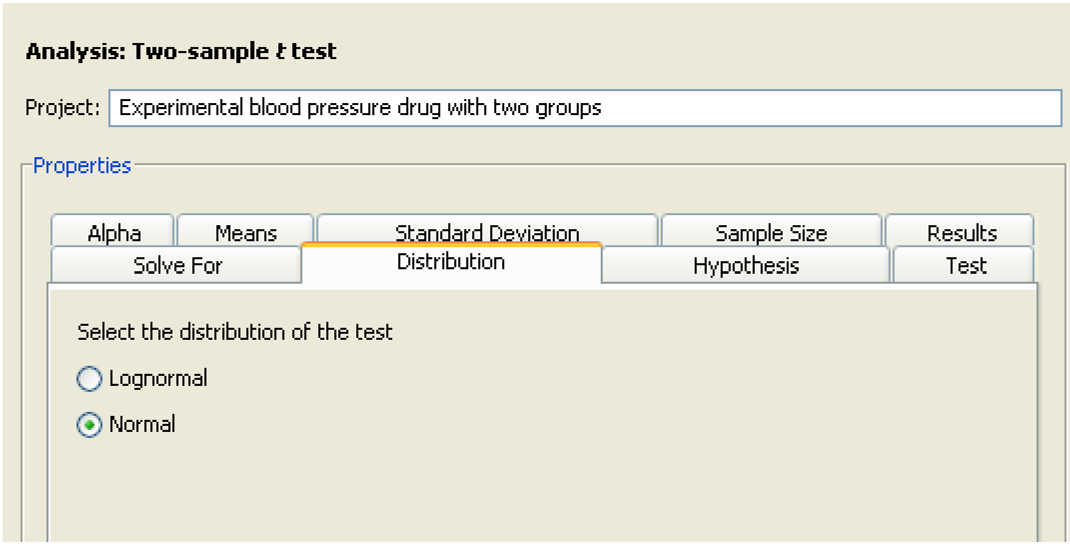
For the two-sample *t* test analysis, you can choose to solve for power, sample size per group, or total sample size. Specify the desired quantity type on the **Solve For** tab.

Click the **Solve For** tab and select the **Power** option as shown in Figure 72.35. For information about solving for sample size, see the section "Solving for Sample Size" on page 6204.

Distribution

Click the **Distribution** tab to select a distribution option that specifies the underlying distribution for the test statistic, as shown in Figure 72.36.

Figure 72.36 Distribution Tab

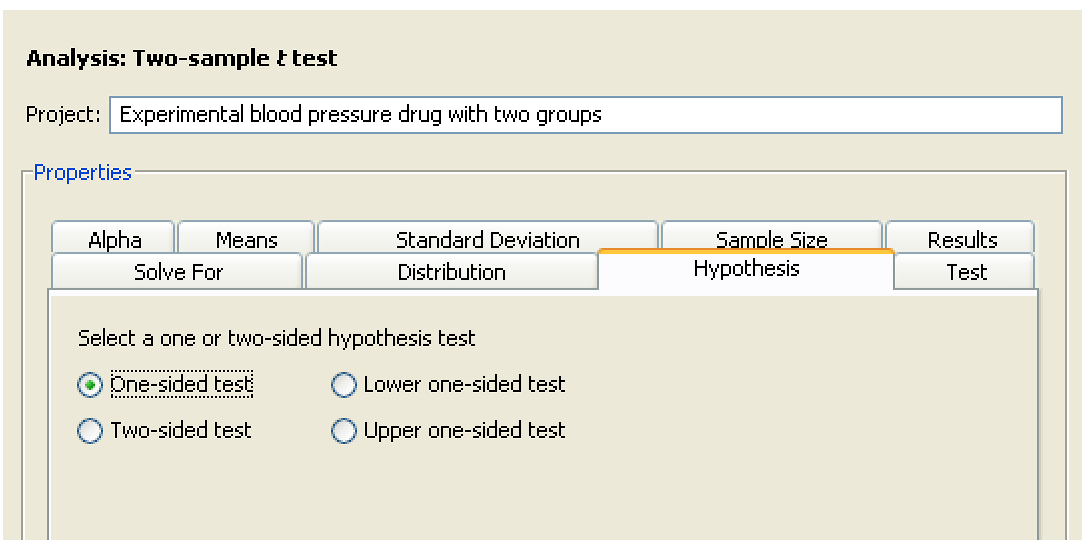


For this example, you are interested in means rather than mean ratios, so select the **Normal** option.

Hypothesis

Click the **Hypothesis** tab to select the type of test; see Figure 72.37.

Figure 72.37 Hypothesis Tab



You can choose either a one- or two-sided test. If you do not know the direction of the effect (that is, whether it is positive or negative), the two-sided test is appropriate. If you know the effect's direction, the one-sided test is appropriate. For the one-sided test, the alternative hypothesis is assumed to be in the same direction as the effect. If you specify a one-sided test and the effect is in the unexpected direction, the results of the analysis are invalid.

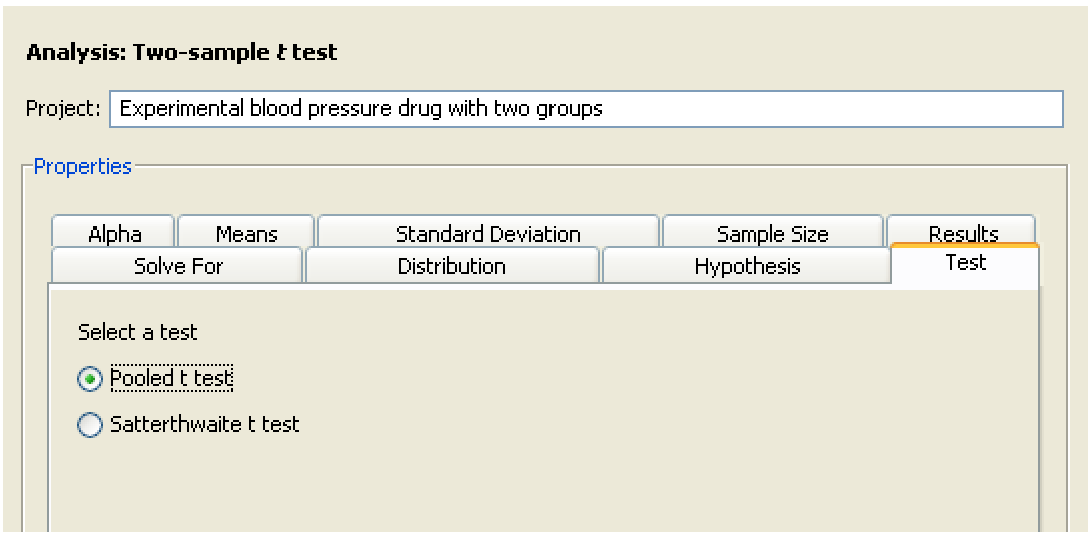
The **One-sided test** option assumes that you know the correct direction of the test. Select the **Lower one-sided test** and **Upper one-sided test** options to explicitly indicate the direction of the one-sided test.

Because you are interested only in whether the experimental drug lowers blood pressure, select the **One-sided test** option on the **Hypothesis** tab.

Test

Click the **Test** tab to select either the pooled *t* test or the Satterthwaite *t* test.

Figure 72.38 Test Tab

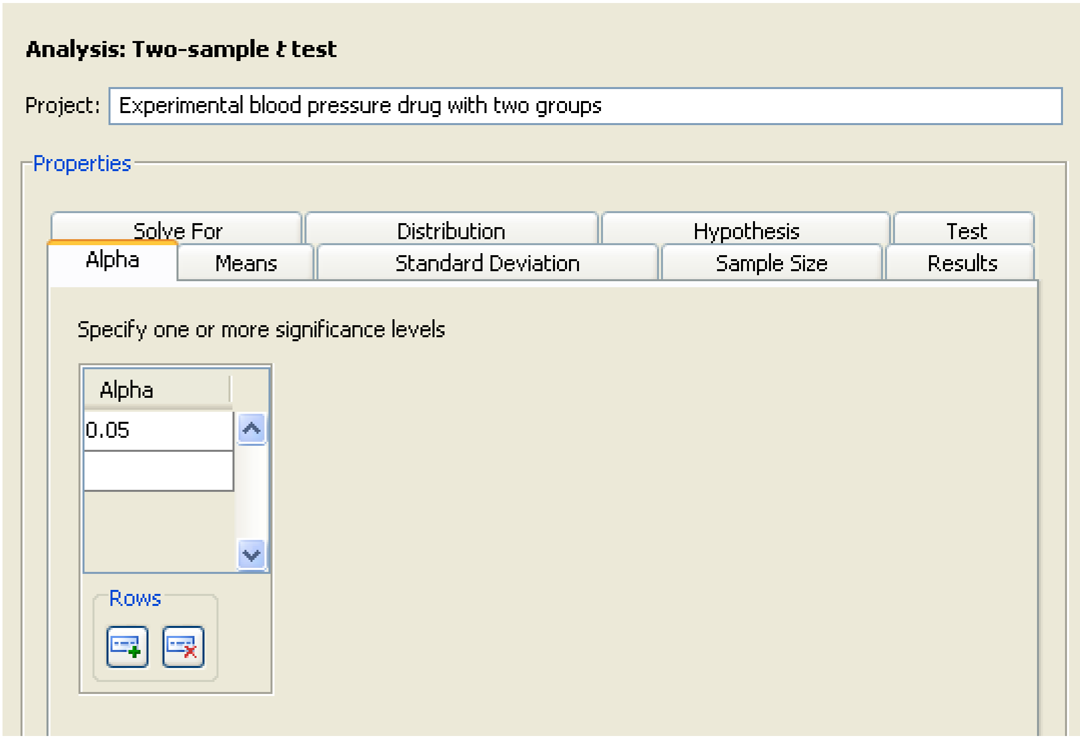


With the independent variances that the example uses, select **Pooled t test** option. The Satterthwaite *t* test is used with unequal variances; it is available only with the normal distribution.

Alpha

Click the **Alpha** tab to specify one or more significance levels, as shown in Figure 72.39.

Figure 72.39 Alpha Tab



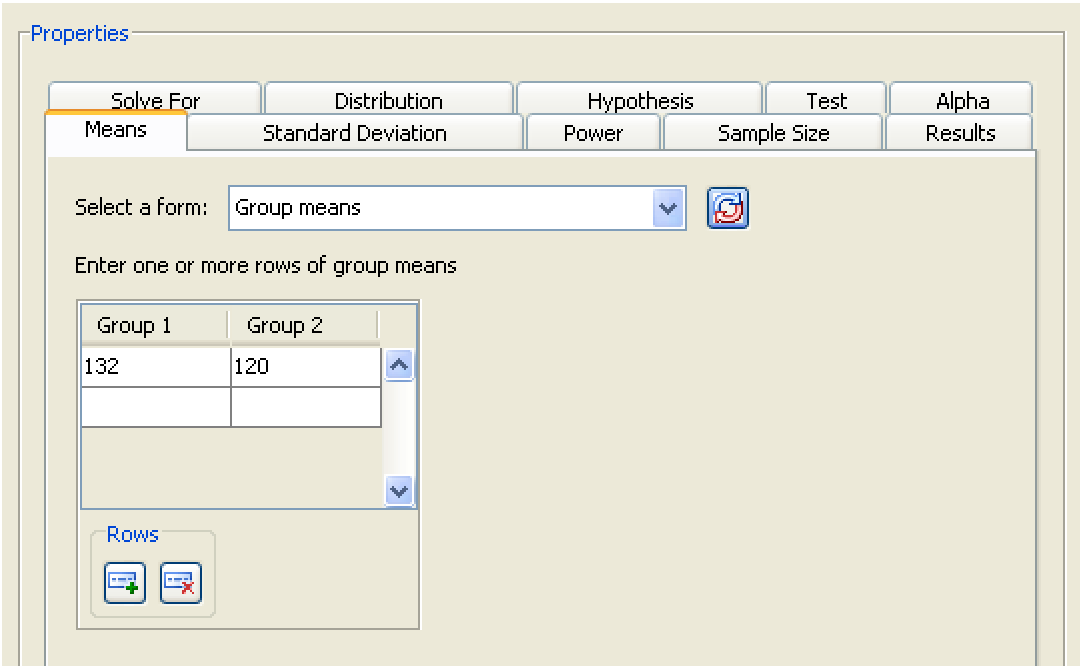
Alpha is the significance level (that is, the probability of falsely rejecting the null hypothesis). If you frequently use the same values for alpha, set them as defaults in the Preferences window. See the section "Setting Preferences" on page 6169 for more information about setting preferences.

Type the desired significance level of 0.05 in the first cell of the Alpha table (if it is not already the default value).

Means

Click the **Means** tab to select one of four possible ways to enter the means and the null mean difference, as shown in Figure 72.40.

Figure 72.40 Means Tab



Select one of the following forms from the **Select A Form** list. The four available forms are:

Difference between means
Enter the difference between the group means. The null mean difference is assumed to be 0.

Group means
Enter the means for each group. The null mean difference is assumed to be 0. The difference is formed by subtracting the mean for group 1 from the mean for group 2.

Difference between means, Null difference
Enter the difference between the group means and a null mean difference.

Group means, Null difference
Enter the means for each group and a null mean difference. The difference is formed by subtracting the mean for group 1 from the mean for group 2.

For this analysis, you can enter the means for the two groups either individually or as a difference. If your null mean difference is not zero, enter that value in the Null Mean table. (The Null Mean table is displayed only for the **Group means, Null Difference** and **Difference between means, Null difference** forms.)

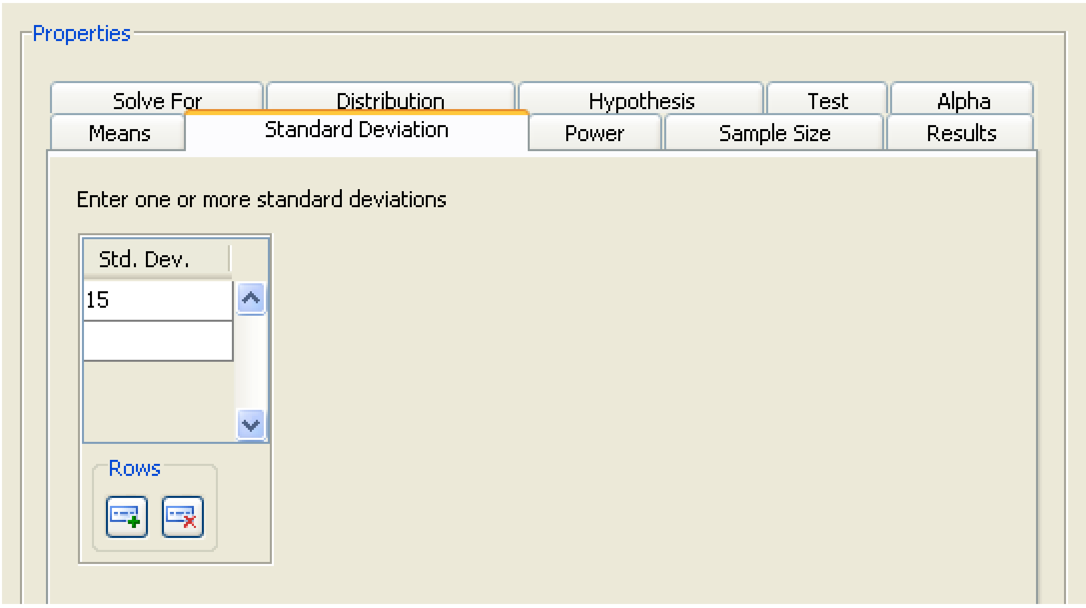
For this example, a null mean difference of 0 is reasonable, so select the **Group means** form from the list, as shown in Figure 72.40. Enter the control mean of `132` in the first row of the first column and the experimental mean of `120` in the first row of the second column.

Standard Deviation

Click the **Standard Deviation** tab to enter the standard deviation for the two groups. It is assumed to be equal for both groups.

For the example, enter a single value of `15`, as shown in Figure 72.41.

Figure 72.41 Standard Deviation Tab



Sample Size

Click the **Sample Size** tab to select one of three possible ways to enter the sample sizes, as shown in Figure 72.40.

Select one of the following forms from the **Select A Form** list:

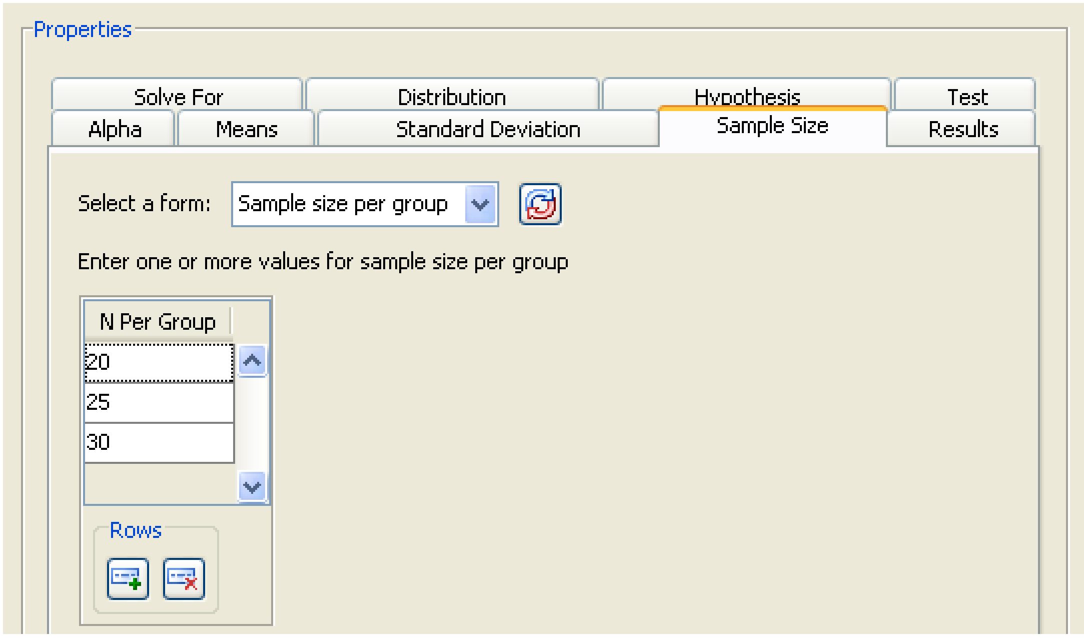
Sample size per group
Enter the sample size for one of the two groups. The group sizes are assumed to be equal.

Group sample sizes
Enter the sample size for each of the two groups. The group sizes can be equal or unequal.

Total N, Group weights
Enter the total sample size for the two groups and the relative sample sizes for each group. For more information about using relative sample sizes, see the section "Using Unequal Group Sizes" on page 6205.

Examine the alternatives by clicking the **Select a form** down arrow. For this example, select the **Sample size per group** form. You want to examine a curve of powers in the power by sample size graph, so enter the values `20`, `25`, and `30` in the Sample Size table, as shown in Figure 72.42. If you need to add more rows to the table, add them by clicking the button beneath the table.

Figure 72.42 Sample Size Tab



Summary of Properties

Table 72.2 contains the values of the input parameters for the example.

Table 72.2 Summary of Input Properties

Parameter	Value
Solve for	Power
Distribution	Normal
Hypothesis	One-sided test
Test	Pooled t test
Alpha	0.05
Means form	Group means
Means	132, 120
Standard deviation	15
Sample size form	Sample size per group
Sample size	20, 25, 30

Results

Click the **Results** tab to request desired results. Summary table and power by sample size graph options are available.

For the example, select the **Create summary table** and **Create power by sample size graph** check boxes.

Click **Calculate** to perform the analysis. If there are no errors in the input values, the View Results page appears. If there are errors in the input parameter values, you are prompted to correct them.

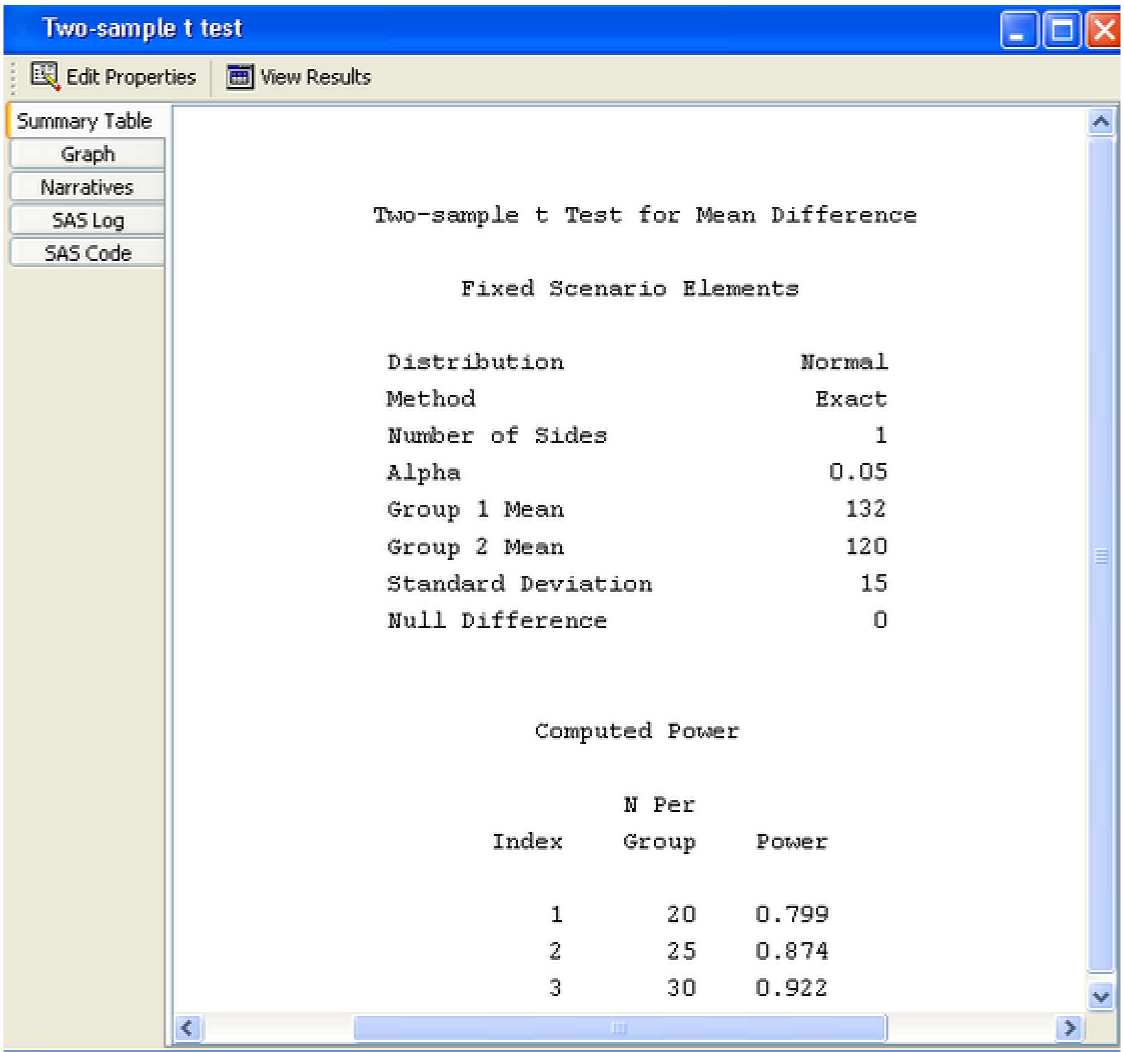
Viewing Results

The results are listed on separate tabs on the View Results page. Click the tab of each result that you want to view.

Summary Table

Click the **Summary Table** tab to view a table that includes the values of the input parameters and the computed quantity (in this example, power). See Figure 72.43.

Figure 72.43 Results Page with Summary Table

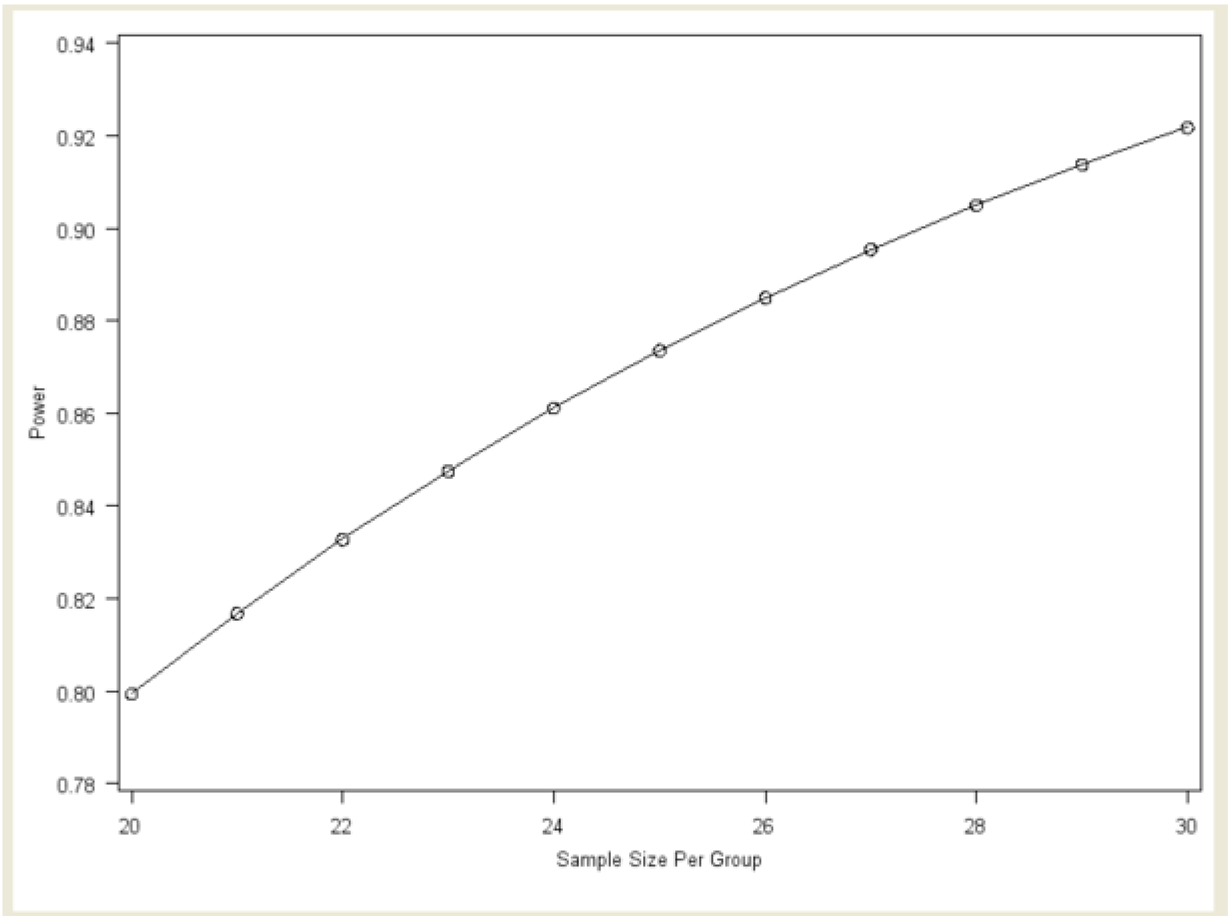


The table consists of two subtables: the `Fixed Scenario Elements` table that contains the input parameters that have only one value for the analysis, and the `Computed Power` table that contains the input parameters that have more than one value for the analysis and the corresponding power. Only the N per group parameter appears in the `Computed Power` table; all of the other input parameters have a single value. The computed power for a sample size per group of 25 is 0.874. Thus, you have a probability of 0.87 that the study will find the expected result if the assumptions and conjectured values are correct.

Power by Sample Size Graph

Click the **Graph** tab to view a power by sample size graph that displays power on the vertical axis and sample size per group on the horizontal axis. See Figure 72.44.

Figure 72.44 Power by Sample Size Graph

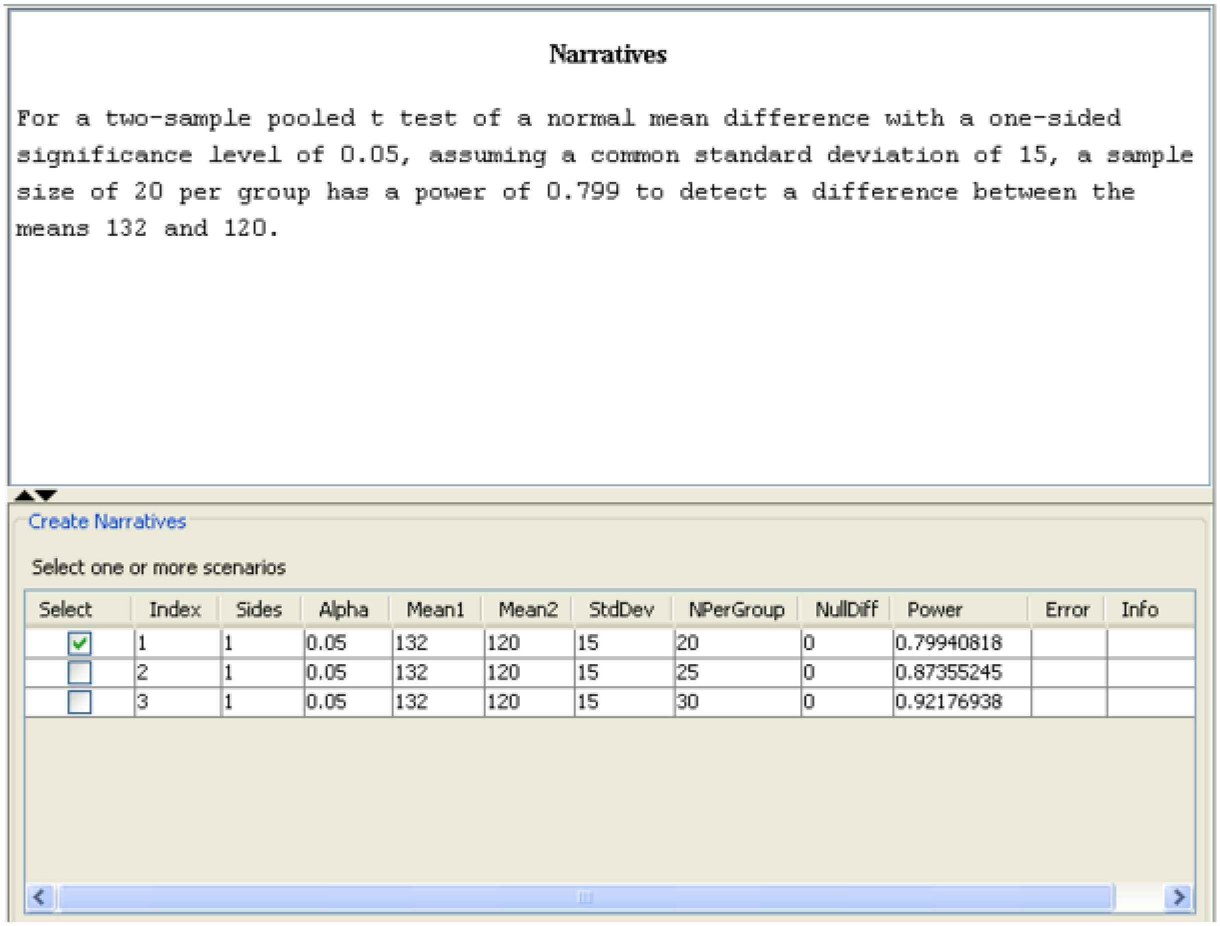


The range of values for the horizontal axis is 20 to 30, which were the smallest and largest values, respectively, that you entered on the **Sample Size** tab. You can customize the graph by specifying the values for the sample size axis (see the section "Customizing Graphs" on page 6176).

Narratives

Click the **Narratives** tab to create and display a sentence- or paragraph-length text summary of the input parameter values and the computed quantity for combinations of the input parameter values; see Figure 72.45.

Figure 72.45 Narrative Selector and Display



To create a narrative, selected the desired scenario (row) in the narrative selector table at the bottom of the **Narratives** tab.

In this example, select the narrative for the sample size per group of 20, which yields a power of 0.799. The following text summary is displayed:

```
For a two-sample pooled t test of a normal mean difference with a one-sided
significance level of 0.05, assuming a common standard deviation of
15, a sample size of 20 per group has a power of 0.799 to detect a
difference between the means 132 and 120.
```

To create other narratives, select the desired rows in the narrative selector table. If you also select the second row for the sample size of 25, another text summary is displayed below the first one:

```
For a two-sample pooled t test of a normal mean difference with a one-sided
significance level of 0.05, assuming a common standard deviation of
15, a sample size of 20 per group has a power of 0.799 to detect a
difference between the means 132 and 120.
```

```
For a two-sample pooled t test of a normal mean difference with a one-sided
significance level of 0.05, assuming a common standard deviation of
15, a sample size of 25 per group has a power of 0.874 to detect a
difference between the means 132 and 120.
```

To change some values of the analysis and rerun it, select the Edit Properties page, change the desired properties, and click the **Calculate** button again.

Test of Two Independent Means for Unequal Variances

In the preceding example, you assumed that the population standard deviations were equal. If you believe that the population standard deviations are not equal, use the same two-sample *t* test analysis as with the preceding example, but change the test option and enter group standard deviations.

You can use the previous example to demonstrate this test. If the project is not already open, open it by selecting **File►Open** on the menu bar, and then selecting the project that you have been using.

Make a copy of the project by selecting **File►Save As**. Enter a different project description, `Experimental blood pressure drug with two groups for unequal variances`. Click **OK**.

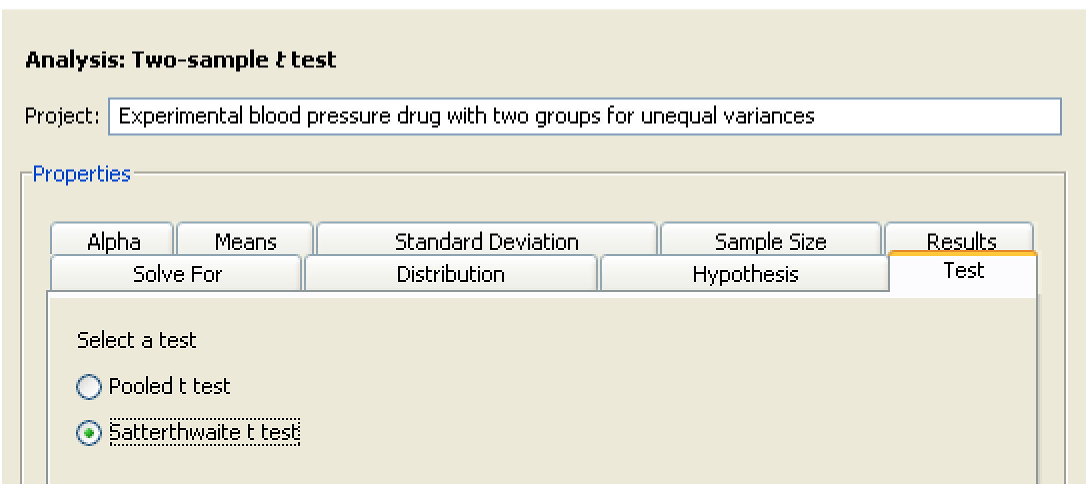
The copy of the project is opened, and the current project is closed.

Editing Properties

Test

On the **Test** tab of the copied project, change the test to **Satterthwaite t test**, as shown in Figure 72.46.

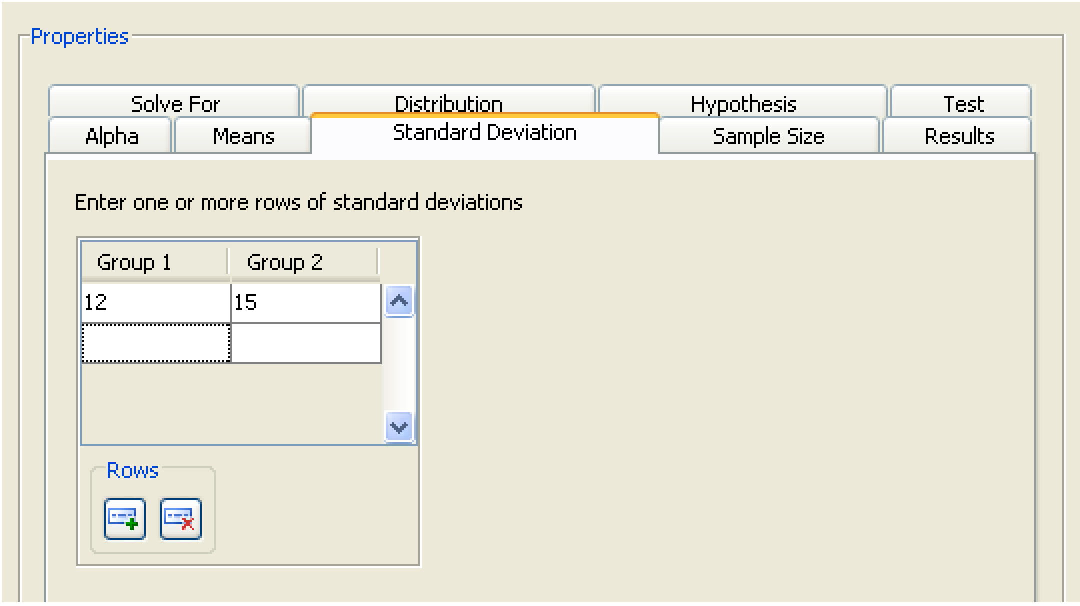
Figure 72.46 Satterthwaite *t* Test Option



Specifying Group Standard Deviations

Click the **Standard Deviation** tab and enter the group standard deviations of 12 and 15 on a single row, as shown in Figure 72.47.

Figure 72.47 Group Standard Deviations



Summary of Input Parameters

Table 72.3 contains the values of the input parameters for the example.

Table 72.3 Summary of Input Parameters

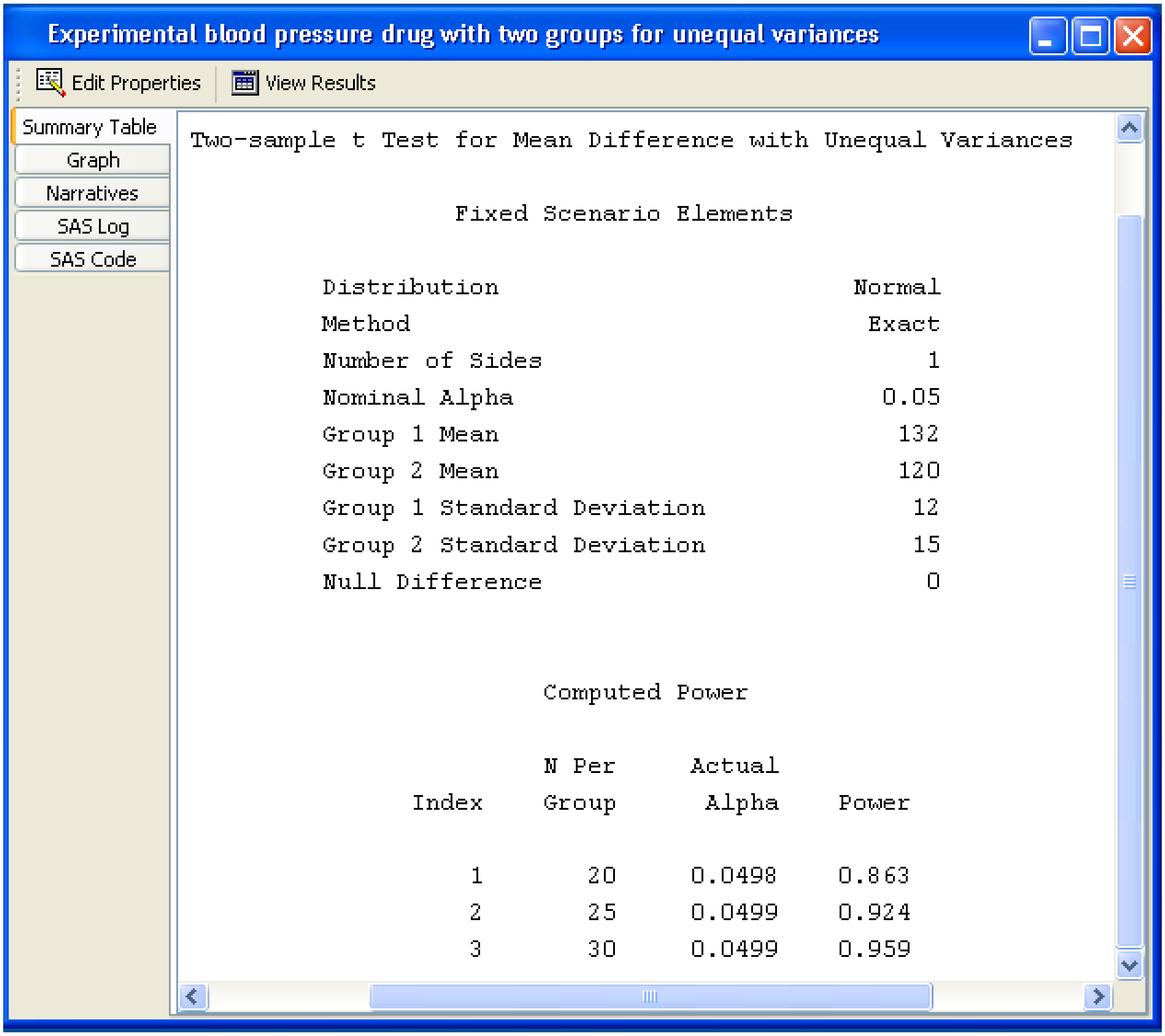
Parameter	**Value**
Distribution	Normal
Hypothesis	One-sided test
Test	Satterthwaite t test
Alpha	0.05
Means form	Group means
Means	132, 120
Standard deviation	12, 15
Sample size form	Sample size per group
Sample size	20, 25, 30

Click **Calculate** to run the analysis.

Viewing Results

The power for a sample size per group of 25 is 0.924, as shown in Figure 72.48. Notice that the actual alpha is 0.0499. This is because the Satterthwaite *t* test is (slightly) biased.

Figure 72.48 Satterthwaite Test Results



If you modified the previous example, when you select the **Narratives** tab, the following message is displayed:

```
Previously selected narratives have been cleared because one or more input
parameter values have changed.
```

In the previous analysis, you created narratives for two scenarios. Because this analysis uses group standard deviations, those selected narratives were cleared. The message would also have appeared if you had changed the number of scenarios.

Use the narrative selector table to create other narratives.

Test of Mean Ratios

Instead of comparing means for a control and drug treatment group, you might want to investigate whether the blood pressure of the treatment group is lowered by a given percentage of the control group, say 10 percent. That is, you expect the ratio of the treatment group to the control group to be 90% or less.

PSS provides a two-sample *t* test of a mean ratio when the data are lognormally distributed.

For mean ratios, the coefficient of variation (CV) is used instead of standard deviation. In this example, you can expect the CV to be between 0.5 and 0.6. You also want to compare an equally weighted sampling of groups with an overweighted sampling in which the control group contains twice as many subjects as the treatment group: 50 and 25, respectively.

Make a copy of the project by selecting **File►Save As**. Enter a different project description, `Percent improvement with blood pressure drug`.

The copy of the project is opened.

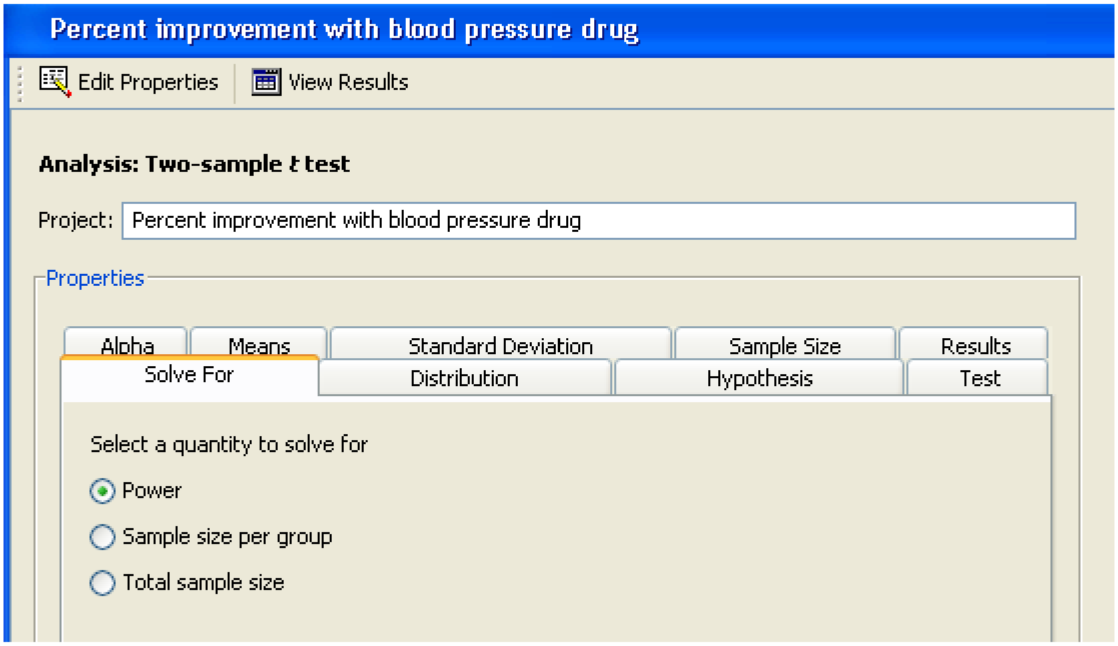
Editing Properties

Several of the input parameters for the test of mean ratios differ from the ones described in the section "Test of Two Independent Means for Equal Variances" on page 6183. Mean ratios and coefficients of variation are used instead of mean differences and standard deviations. These two parameters are discussed in detail in this section. For the input parameters and options that have been discussed previously in this example, only the values for this example are given.

Solve For Tab

Click the **Solve For** tab to select the **Power** option as the quantity to be solved for, as shown in Figure 72.49.

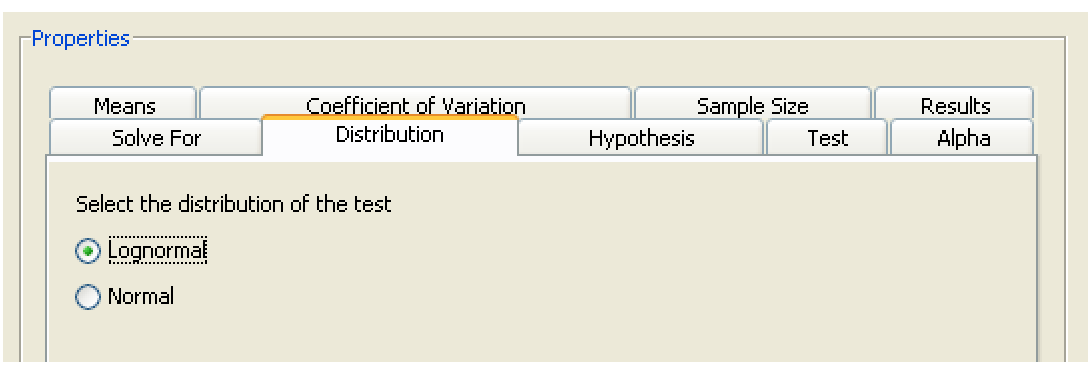
Figure 72.49 Project Description, Solve for Tab



Distribution

You are interested in mean ratios rather than means, so select the **Lognormal** option on the **Distribution** tab, as shown in Figure 72.50.

Figure 72.50 Distribution Tab with Lognormal Option



Hypothesis and Alpha

Click the **Hypothesis** tab and select the **One-sided test** option.

Click the **Alpha** tab and type 0.05 as the significance level in the first cell of the table, if it is not already there.

Means

Click the **Means** tab to select the input form for entering mean ratios. There are four alternate forms for entering means or mean ratios:

Mean ratio
: Enter the ratio of the two group means—that is, the treatment mean divided by the reference mean. The null ratio is assumed to be 1.

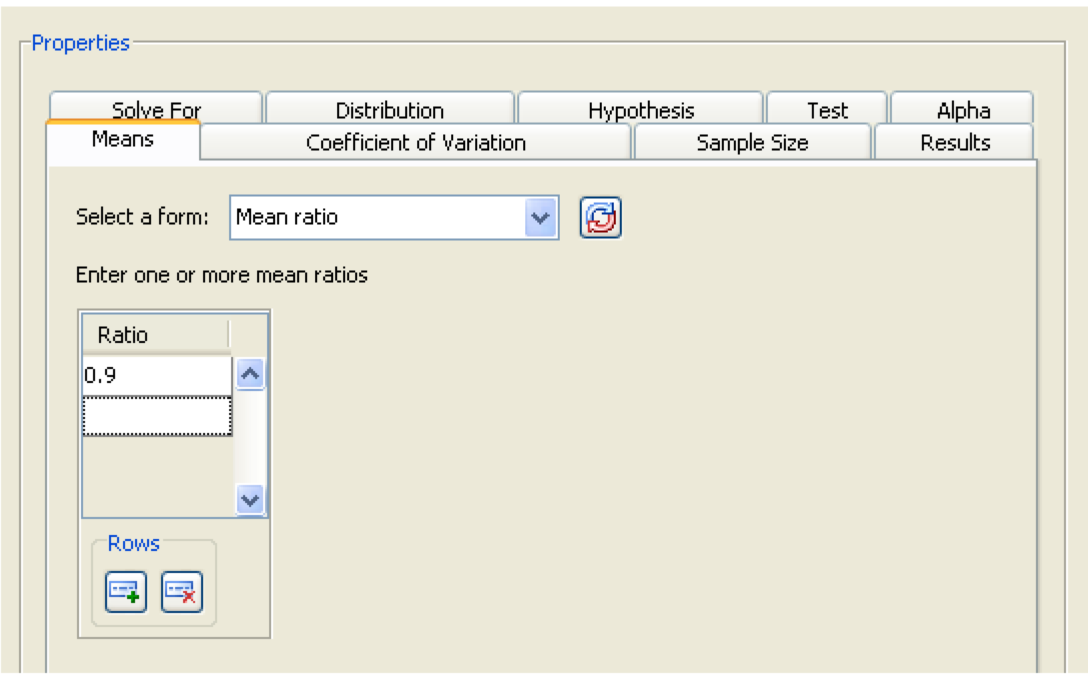
Group means
: Enter the means for each group. The ratio of the means is formed by dividing the mean for group 2 by the mean for group 1. The null ratio is assumed to be 1.

Mean ratio, Null ratio
: Enter the ratio of the two group means—that is, the treatment mean divided by the reference mean. Enter the null ratio.

Group means, Null ratio
: Enter the means for each group. The ratio of the means is formed by dividing the mean for group 2 by the mean for group 1. Enter the null ratio.

As shown in Figure 72.51, select the **Mean ratio** form which uses a default null ratio of 1. Enter a single mean ratio value of 0.9.

Figure 72.51 Means Tab with Mean Ration Form and Values

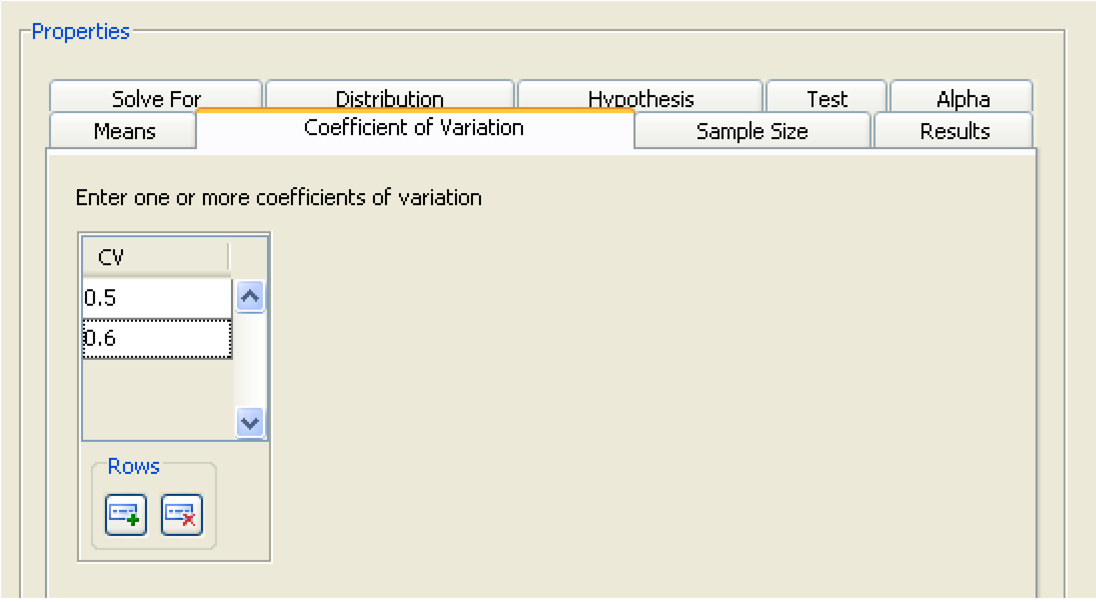


Coefficient of Variation

On the **Coefficient of Variation** tab, enter the coefficients of variation. They are assumed to be equal for the two groups.

For this example, enter 0.5 and 0.6, as shown in Figure 72.52.

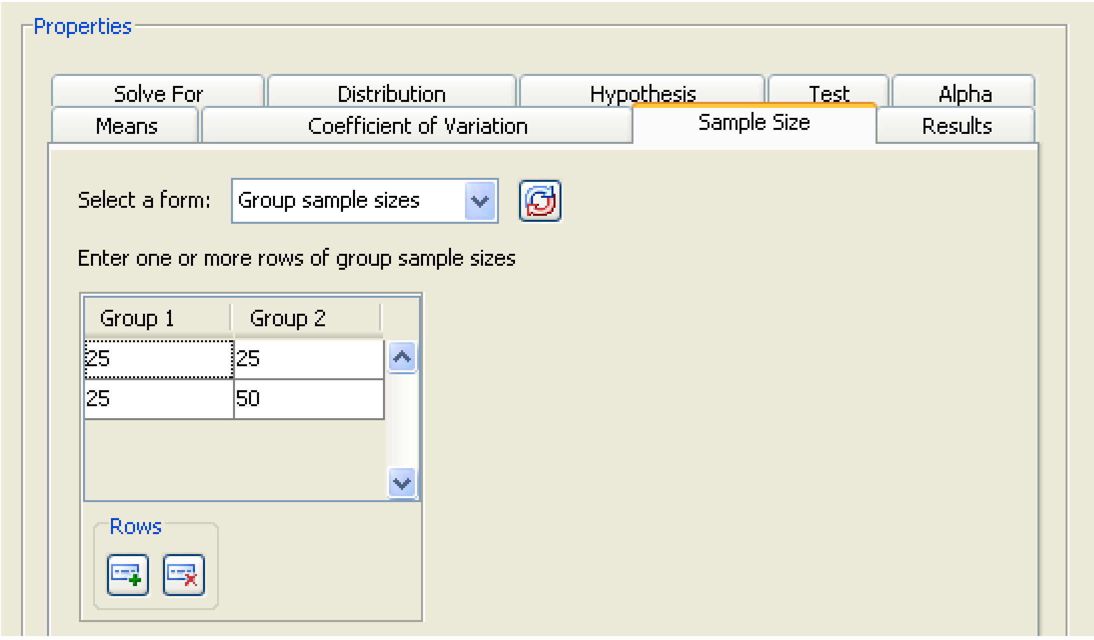
Figure 72.52 Coefficient of Variation Tab



Sample Size

On the **Sample Size** tab, select the **Group sample sizes** form and enter two sets of values: 25 and 25 in the first row and 25 and 50 in the second row, as shown in Figure 72.53.

Figure 72.53 Sample Sizes



Summary of Input Parameters

Table 72.4 contains the values of the input parameters for the example.

Table 72.4 Summary of Input Parameters

Parameter	**Value**
Hypothesis	One-sided test
Distribution	Lognormal
Alpha	0.05
Means form	Mean ratio
Mean ratio	0.9
Coefficients of variation	0.5, 0.6
Sample size form	Group sample sizes
Sample Size	(25, 25), (25, 50)

Results

On the **Results** tab, select the **Create summary table** and **Create power by sample size graph** check boxes.

Click **Calculate** to perform the analysis.

In this case, the following message is displayed:

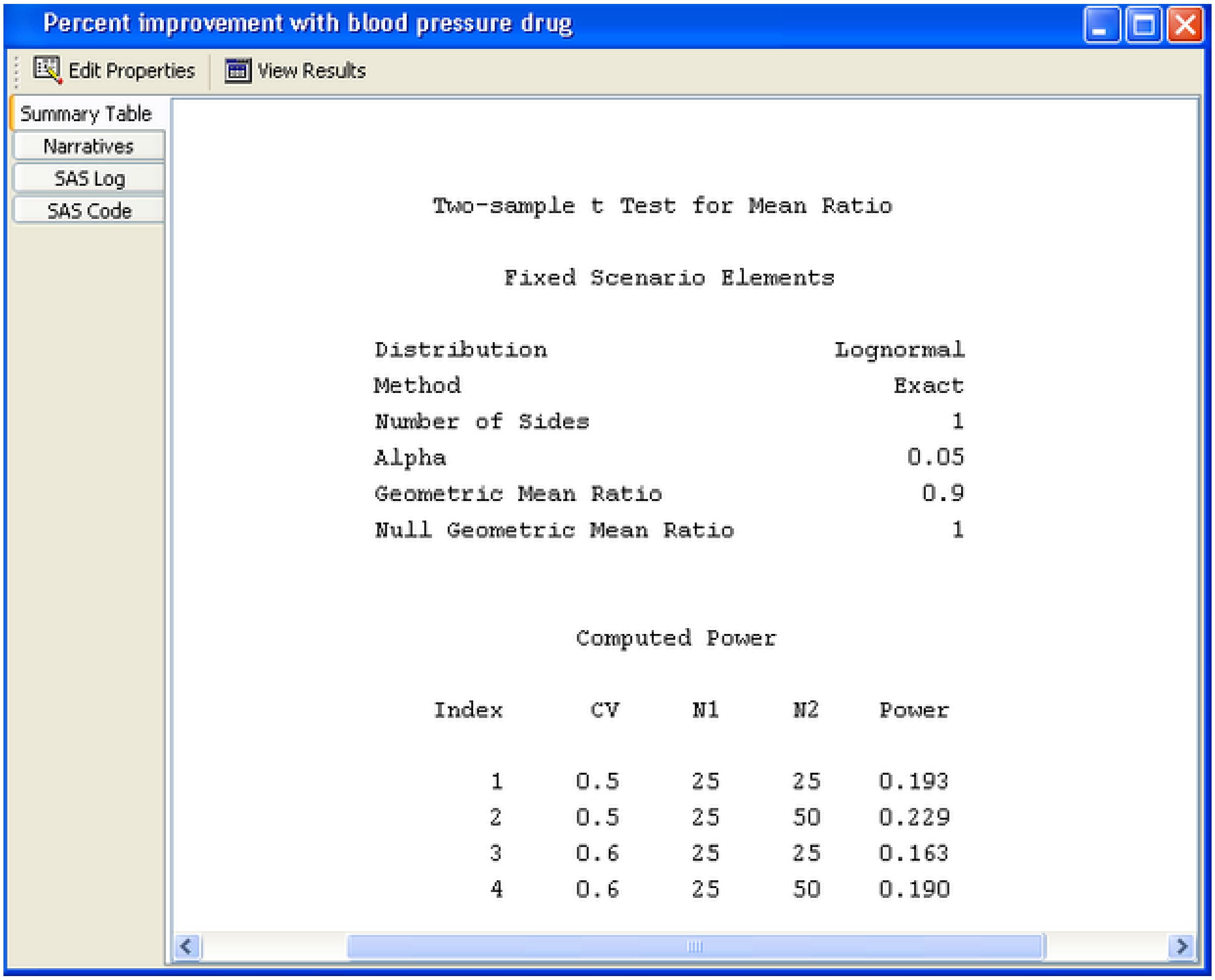
```
The power by sample size graph is not available when specifying sample
sizes for two groups.
```

If you want a power by sample size graph, you can choose to plot total sample size instead by using the `Total N, Group weights` sample size form on the **Sample Size** tab. For more information about using this input form, see the section "Using Unequal Group Sizes" on page 6205.

Viewing Results

The first thing that you notice from the summary table in Figure 72.54 is that the calculated powers are quite low—they range from 0.163 to 0.229. You have less than a 25% probability of detecting the difference that you are looking for. Clearly, this set of parameter values leads to insufficient power. To increase power, you might choose a larger sample size or a larger alpha.

Figure 72.54 Summary Table



You can also see that oversampling the control group improves power slightly, 0.229 versus 0.193 for the coefficient of variation of 0.5. However, this is a marginal increase that is probably not worth the added expense.

For the example, use larger sample sizes with equal cell sizes. Return to the Edit Properties page by clicking the **Edit Properties** icon near the top of the window.

Then, on the **Sample size** tab, change to the **Sample size per group** form. Specify sample sizes of 50, 100, 150, and 200, as shown in Figure 72.55.

Figure 72.55 Modified Sample Size Values

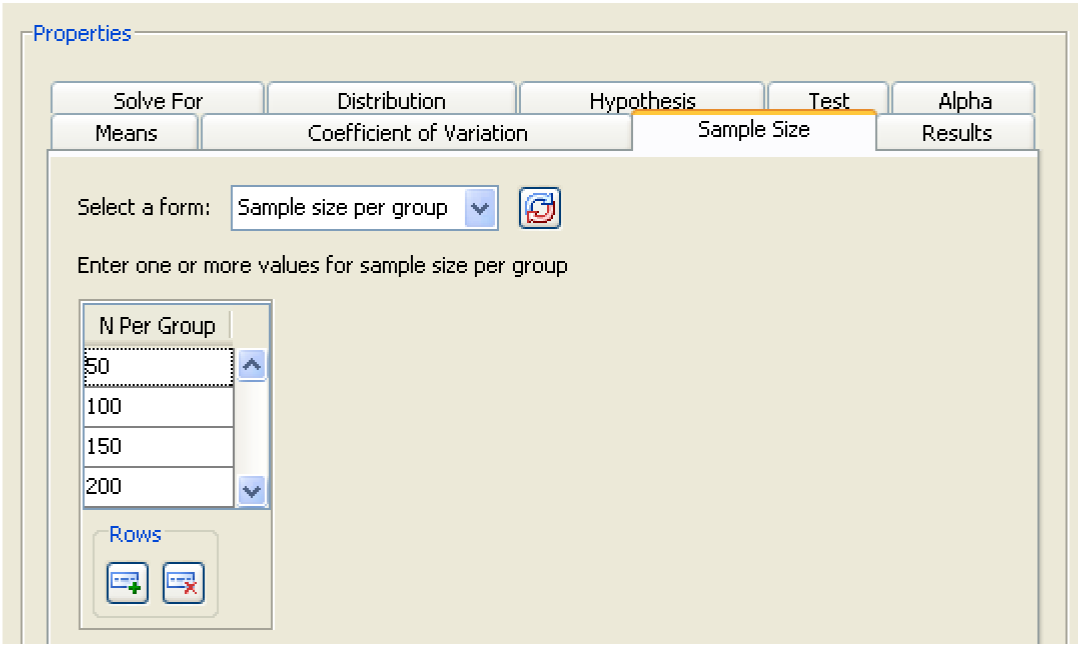


Table 72.5 contains the modified values of the input parameters for the example.

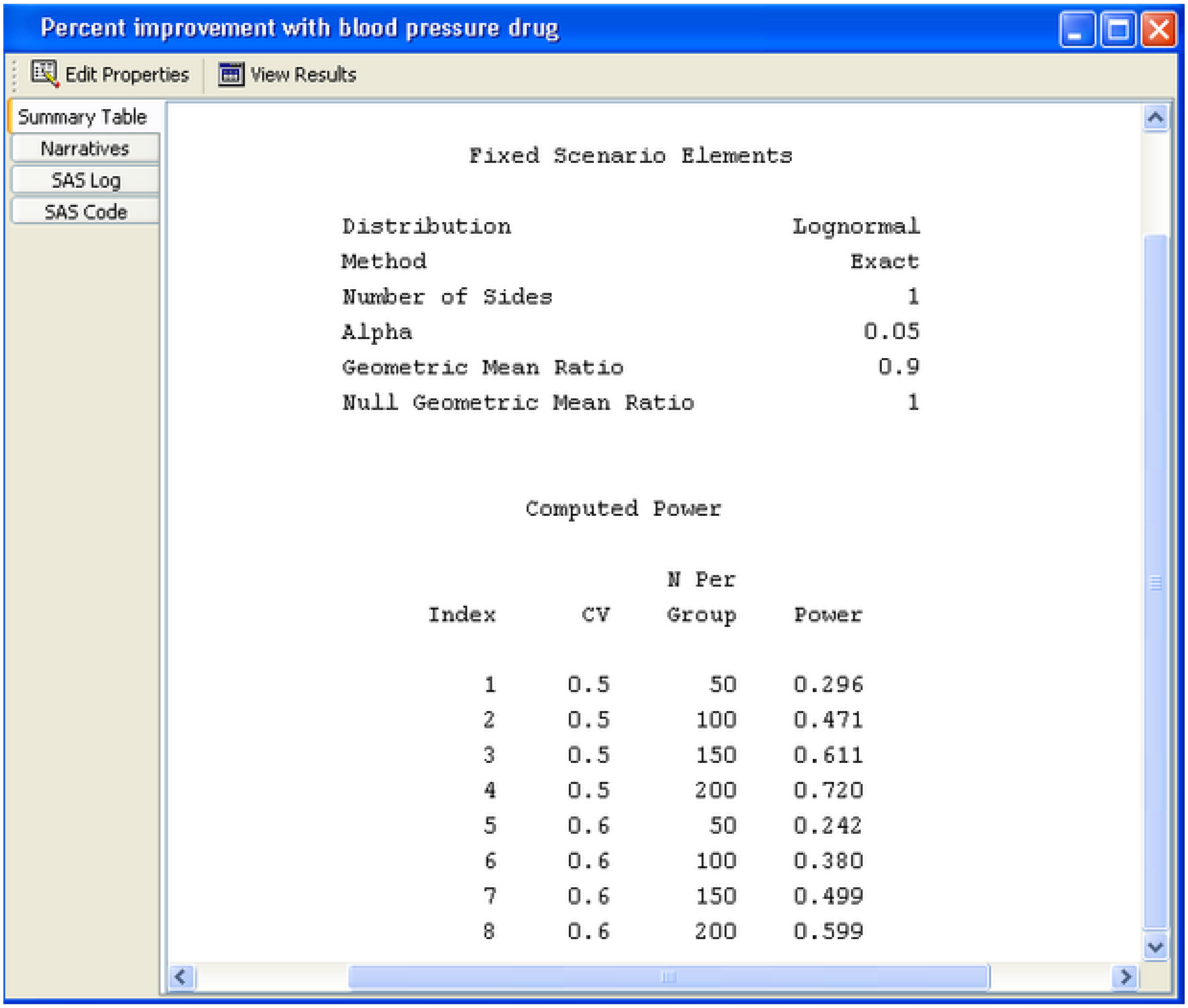
Table 72.5 Modified Summary of Input Parameters

Parameter	Value
Sample size form	Sample size per group
Sample size	50, 100, 150, 200

Rerun the analysis by clicking **Calculate**.

Figure 72.56 displays the summary table. The largest sample size of 200 (per group) yields a power of 0.72 for a coefficient of variation of 0.5, and 0.599 for one of 0.6. With a total of 400 subjects, you still have a 30% to 40% probability of not detecting the effect even if it exists.

Figure 72.56 Summary Table for Modified Sample Sizes



Fixed Scenario Elements

Distribution	Lognormal
Method	Exact
Number of Sides	1
Alpha	0.05
Geometric Mean Ratio	0.9
Null Geometric Mean Ratio	1

Computed Power

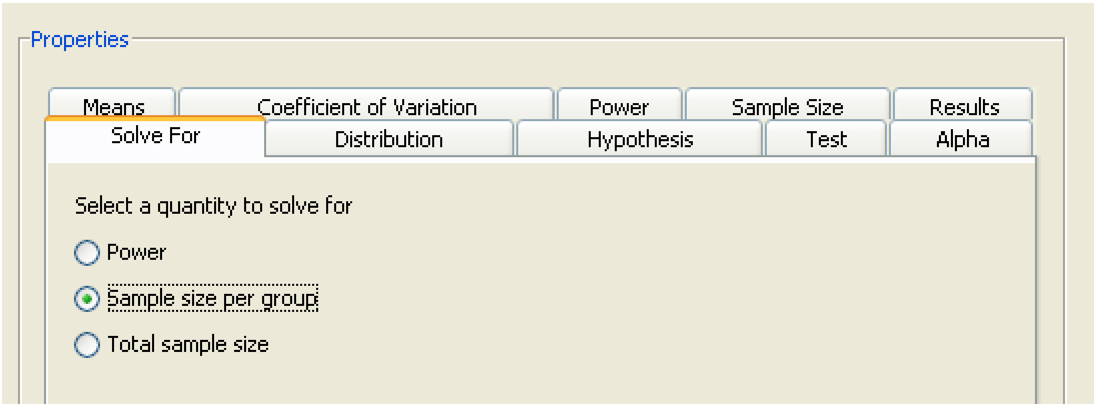
Index	CV	N Per Group	Power
1	0.5	50	0.296
2	0.5	100	0.471
3	0.5	150	0.611
4	0.5	200	0.720
5	0.6	50	0.242
6	0.6	100	0.380
7	0.6	150	0.499
8	0.6	200	0.599

Additional Topics

Solving for Sample Size

Several types of analysis enable you to solve for either total sample size or sample size per group. The sample size per group choice assumes equal group sizes. When solving for total sample size, the group sizes can be equal or unequal. Select the desired quantity on the **Solve For** tab. An example of these options is shown in Figure 72.57.

Figure 72.57 Solve For Tab with Sample Size Selected



For either of the two sample size options, you must specify one or more values for power on the **Power** tab. If you frequently use the same values for power, set them as the default in the Preferences window, which is accessed by **Tools►Preferences**. Changing preferences affects only projects that you create after the change; existing projects are not affected.

If you select total sample size, you must specify whether the group sizes are equal or unequal. Select the appropriate option on the **Sample Size** tab. For unequal group sizes, you must specify the relative sample sizes for the two groups. For information about providing relative sample sizes, see the section "Using Unequal Group Sizes" on page 6205.

Using Unequal Group Sizes

When solving for either power or total sample size, you might have unequal group sizes. If so, you must provide relative sample sizes for the groups. Weights must be greater than 0 but do not have to sum to 1.

Select the **Total N, Group weights** form on the **Sample Size** tab. Enter total sample sizes of 30 and 60 in the **Total N** table. Select the **Unequal group sizes** option and click **Enter Relative Sample Sizes**, as seen in Figure 72.58.

Figure 72.58 Sample Size Tab with Group Weights Form

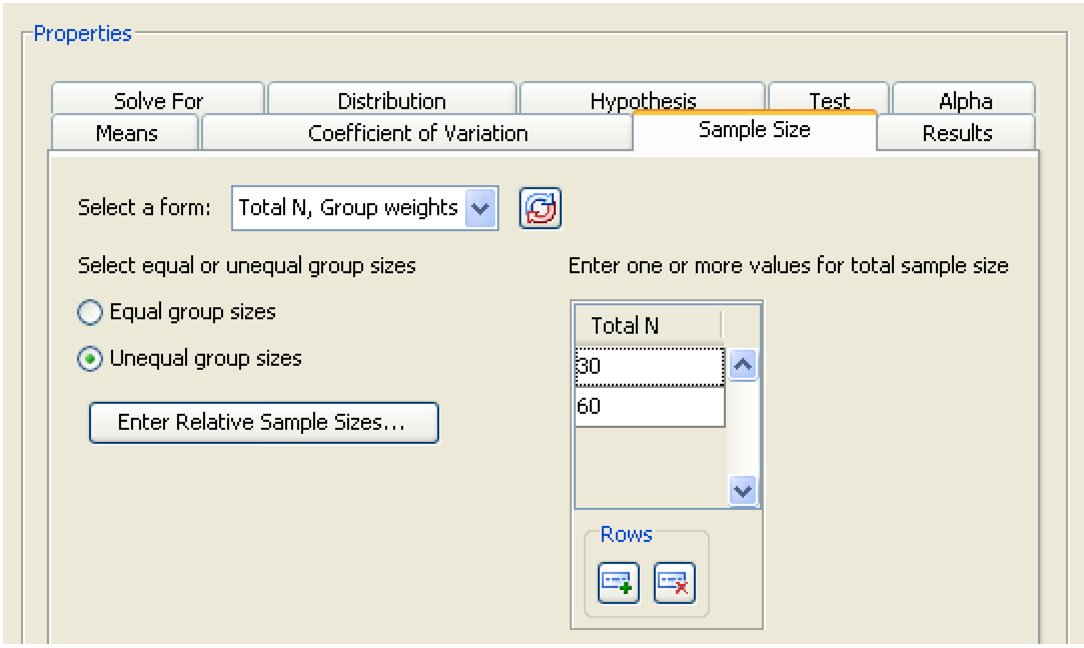
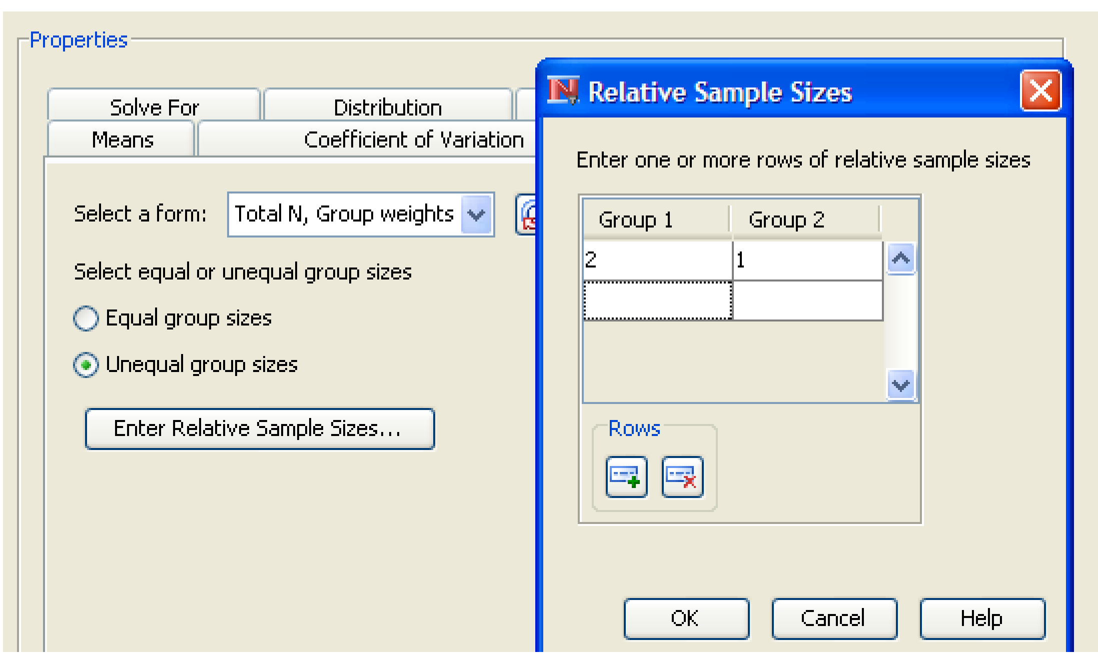


Figure 72.59 displays the window in which you can enter relative sample sizes. As an example, enter 2 for the first group and 1 for the second. In this case, you are sampling the drug treatment group twice as often as the control group.

Figure 72.59 Relative Sample Sizes Window



The weights control how the total sample size is divided between the two groups. In the example, the sample size for groups 1 and 2 is 20 and 10, respectively, for a total sample size of 30.

Click **OK** to save the values and return to the Edit Properties page.

Example: Analysis of Variance

Overview

PSS offers power and sample size calculations for analysis of variance in two tasks: one-way ANOVA and general linear univariate models. Optional contrasts are available in both tasks.

In the one-way ANOVA task, you can solve for sample size per group as well as total sample size. The contrast facility for the one-way ANOVA task enables you to select orthogonal polynomials as well as to specify contrast coefficients. For more information about power and sample size analysis for one-way ANOVA, see Chapter 71, "The POWER Procedure."

In the general linear univariate models task, you specify linear models for a single dependent variable. Type III tests and contrasts of fixed effects are included, and the model can include covariates. For more information about power and sample size analysis for linear univariate models, see Chapter 44, "The GLMPOWER Procedure."

The Example

Suppose you are interested in testing how two experimental drugs affect systolic blood pressure relative to a standard drug. You want to include both men and women in the study. You have a two-factor design: a drug factor with three levels and a gender factor with two levels. You choose a main-effects-only model because you do not expect a drug by gender interaction. You want to calculate the sample size that will produce a power of 0.9 using a significance level of 0.05. You believe that the error standard deviation is between 5 and 7 mm pressure. This is a two-way analysis of variance, so the general linear univariate models task is the appropriate one.

Editing Properties

Start by opening the New window (**File▶New**). In the **Analysis of Variance and Linear models** section of the New window, select **General linear univariate models**. The **General univariate linear models** project appears, with the Edit Properties page displayed.

Project Description

For the example, change the project description to `Three blood pressure drugs and gender`.

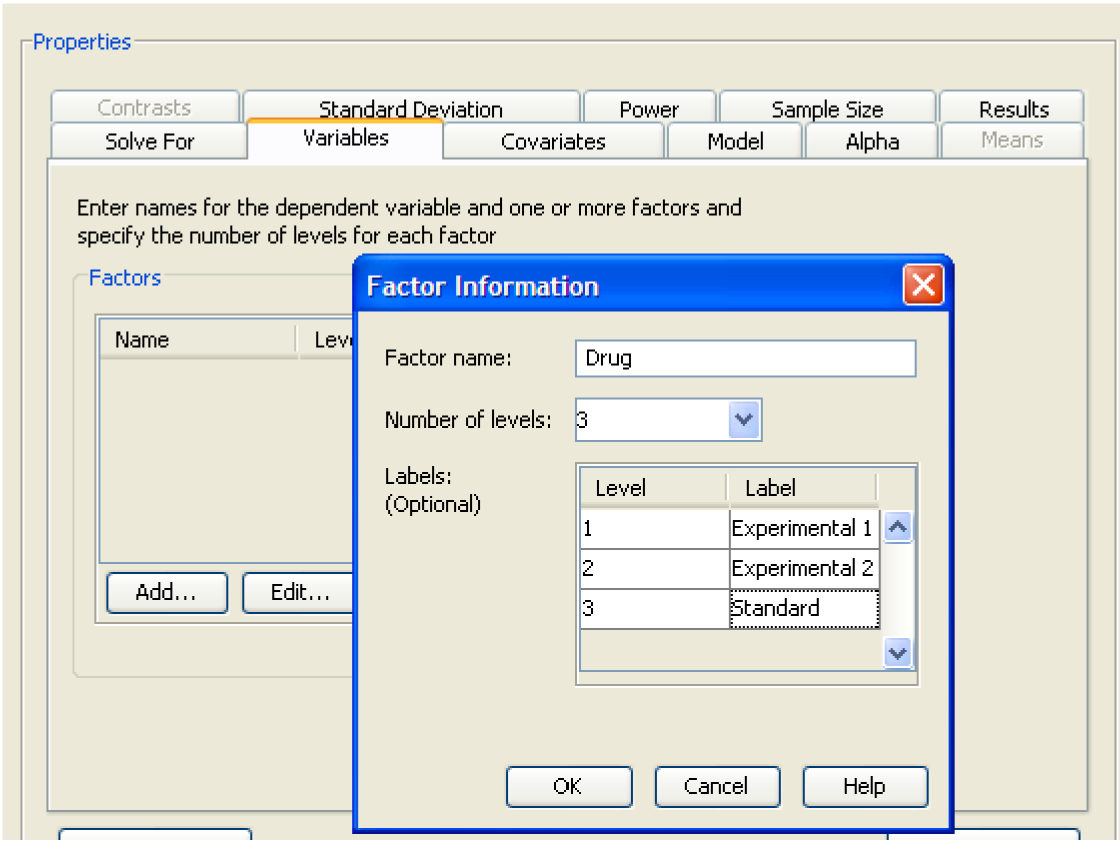
Solve For

Click the **Solve For** tab and select the **Sample size** option.

Variables

Click the **Variables** tab to enter the names of the factors in the design. Click the **Add** button. The Factor Definition window appears, as shown in Figure 72.60.

Figure 72.60 Factor Definition Window



Enter the name for the first factor, `Drug`, and enter the number of factor levels in the **Number of levels:** list box. There are three levels for this factor. Optionally, you can provide a label for each factor level. This label is used to identify factor levels on other tabs of the Edit Properties page. For this example enter the labels `Experimental 1`, `Experimental 2`, and `Standard` for the three levels of the `Drug` factor. Click **OK** when you are finished.

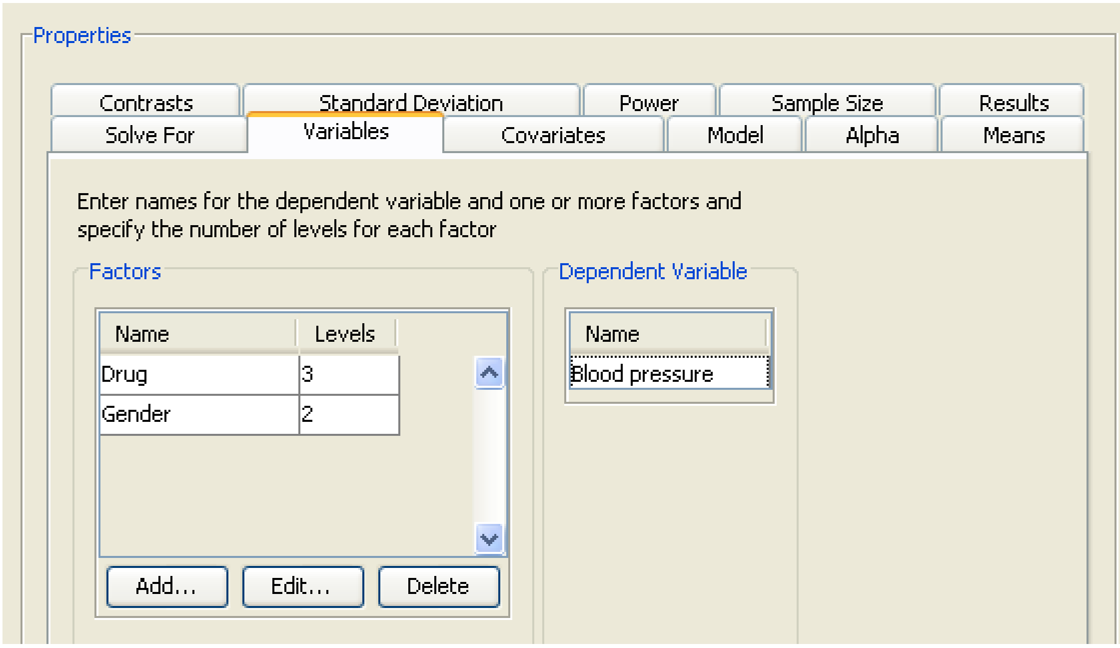
Click the **Add** button again and repeat the process for the second factor, `Gender` with two levels and labels `Female` and `Male`.

Factors can contain blanks and other special characters. Do not use an asterisk (*) because a factor name with an asterisk might be confused with an interaction effect. Factor names can be any length, but they must be distinct from one another in the first 32 characters.

On the **Variables** tab, you can also specify the name of the dependent variable; in this example, `Blood pressure` is used.

The completed **Variables** tab is shown in Figure 72.61.

Figure 72.61 Variables Tab with Factors and Number of Levels



Model

Click the **Model** tab, then choose from three model options:

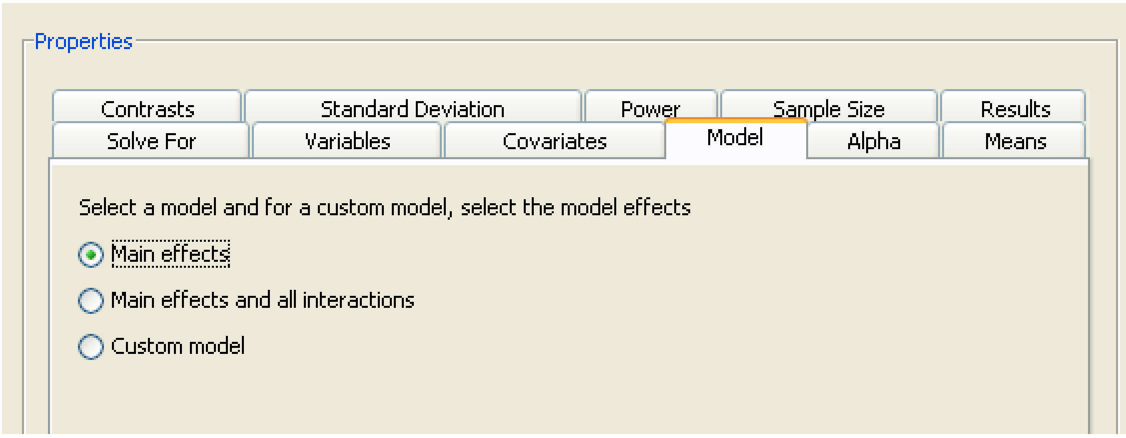
Main effects
: Only the main effects are included in the model.

Main effects and all interactions
: The main effects and all possible interactions are included in the model.

Custom model
: Selected effects are included in the model. The effects are selected in a model builder that is displayed when this model is selected. For more information about specifying a custom model, see the section "Specifying a Custom Model" on page 6220.

For this example, choose the default **Main effects** model, as shown in Figure 72.62.

Figure 72.62 Model Tab with Main Effects Selected



Alpha

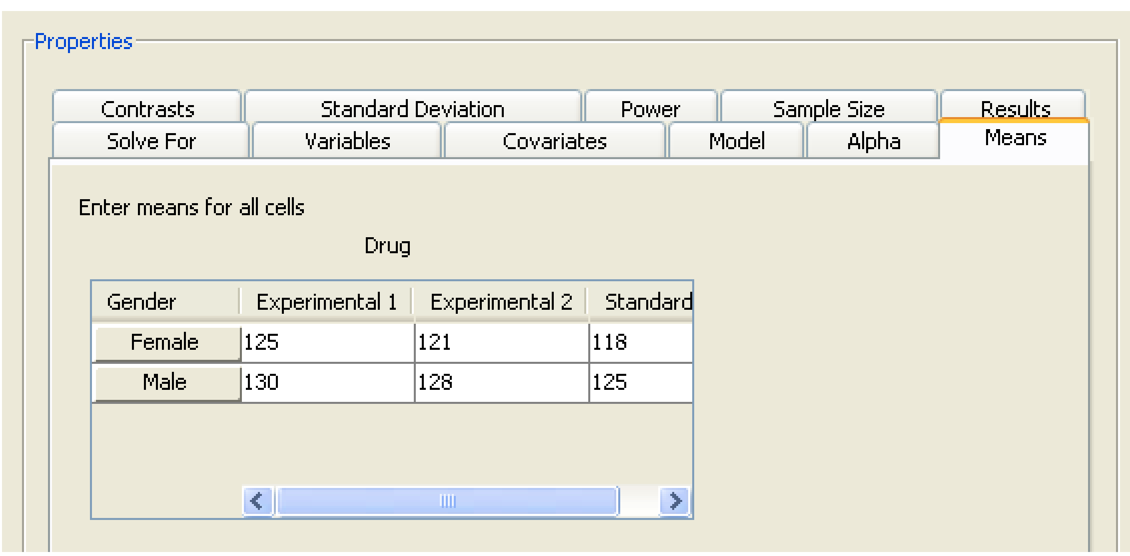
Click the **Alpha** tab to specify one or more significance levels. For the example, specify a single significance level of 0.05.

Alpha is the significance level (that is, the probability of falsely rejecting the null hypothesis). If you frequently use the same values for alpha, set them as the defaults in the Preferences window (**Tools►Preferences**).

Means

Click the **Means** tab to enter projected cell means for each cell of the design. The completed means for the example are shown in Figure 72.63.

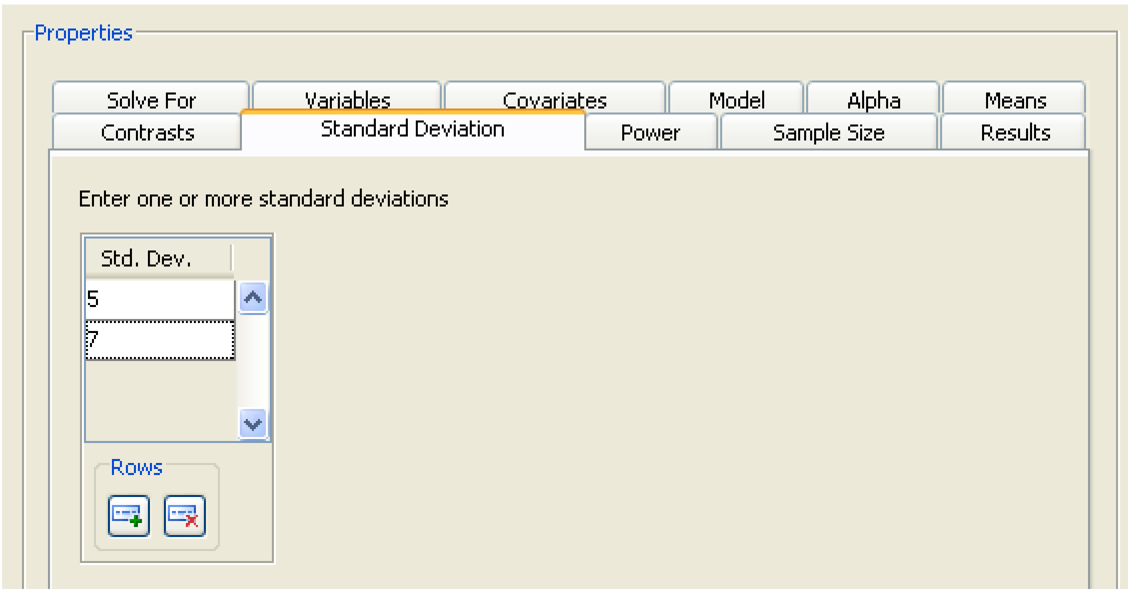
Figure 72.63 Means Tab with Cell Means



Standard Deviation

Click the **Standard Deviation** tab to specify one or more conjectured error standard deviations. The standard deviation is the same as the root mean squared error. For this example, enter two standard deviations, 5 and 7, as shown in Figure 72.64.

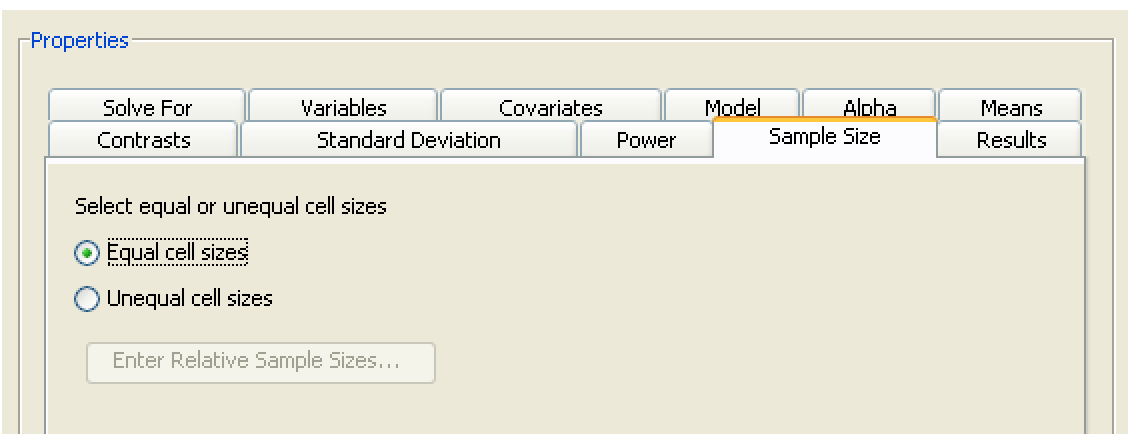
Figure 72.64 Standard Deviations Tab



Relative Sample Size

Click the **Sample Size** tab to select whether cell sample sizes are equal or unequal.

Figure 72.65 Sample Size Tab with Equal Cell Sample Sizes



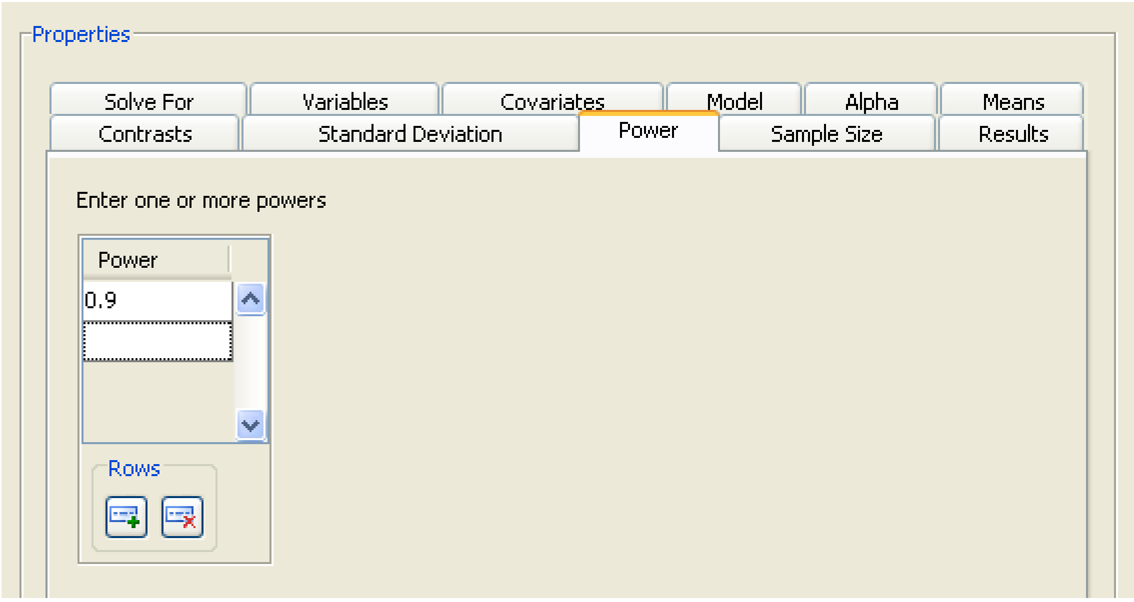
For the example, select the **Equal cell sizes** option, as shown in Figure 72.65.

When solving for sample size, it is necessary to specify whether the cell sample sizes are equal or unequal. If cell sizes are unequal, relative sample size weights must also be specified. For more information about providing sample size weights, see the section "Using Unequal Cell Sizes" on page 6217.

Power

Click the **Power** tab to specify one or more powers. For this example, enter a single power of 0.9, as shown in Figure 72.66.

Figure 72.66 Power Tab



Summary of Input Parameters

Table 72.6 contains the values of the input parameters for the example.

Table 72.6 Summary of Input Parameters

Parameter	Value
Model	Main effects
Alpha	0.05
Means	See Table 72.7
Standard deviation	5, 7
Relative sample sizes	Equal cell sizes
Power	0.9

Table 72.7 Cell Means

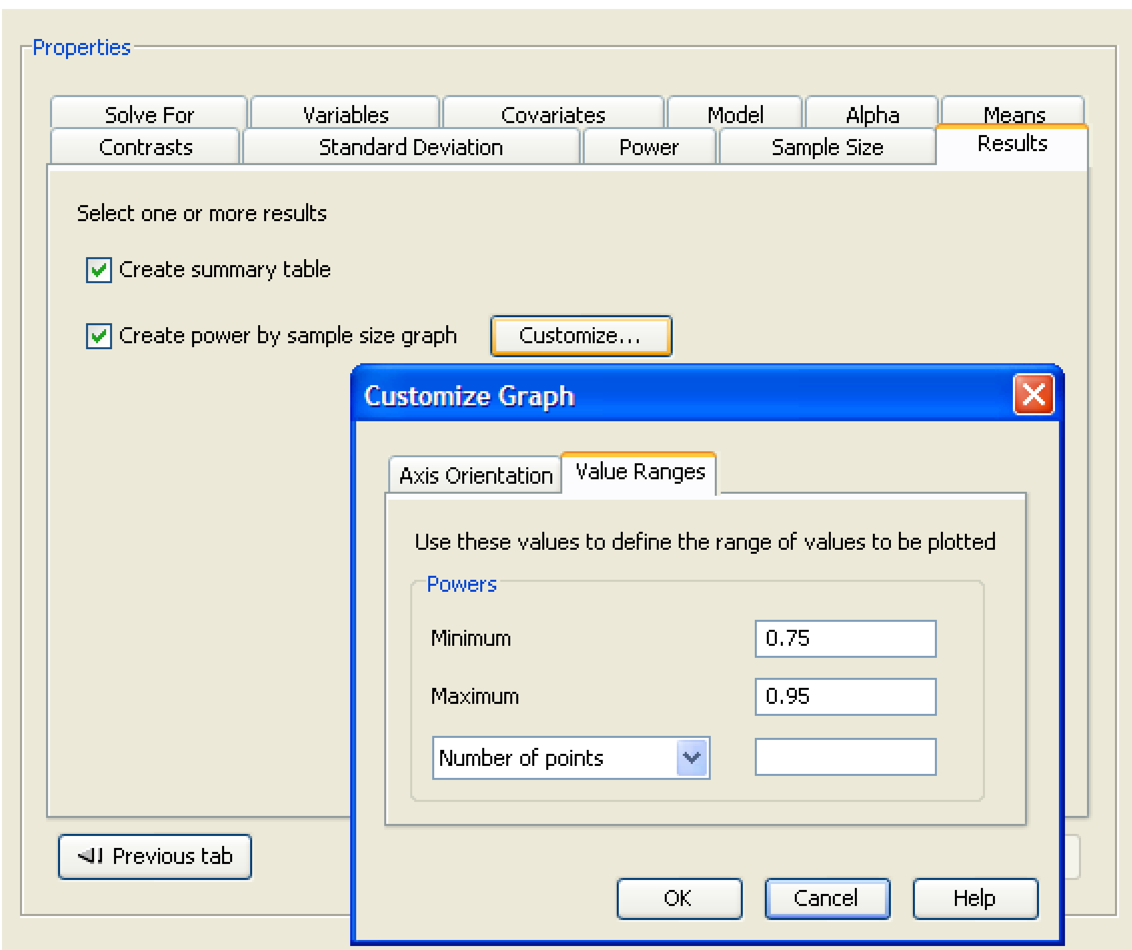
	Drug		
Gender	**Experimental 1**	**Experimental 2**	**Standard**
Female	125	121	118
Male	130	128	125

Results Options

Click the **Results** tab to select desired results. For the example, select both the **Create summary table** and **Create power by sample size graph** check boxes.

The graph consists of four points, one for each of the four scenarios that were created by combining the two factor main effects with the two standard deviations. This graph is not very informative, so specify a range of powers for the horizontal power axis. To change the power axis of the graph, click the **Customize** button beside the **Create power by sample size graph** check box to open the Customize Graph window.

Figure 72.67 Value Ranges on Customize Graph Window



Click the **Value Ranges** tab and enter a minimum power of 0.75 and a maximum power of 0.95, as shown in Figure 72.67. Click **OK** to close the window.

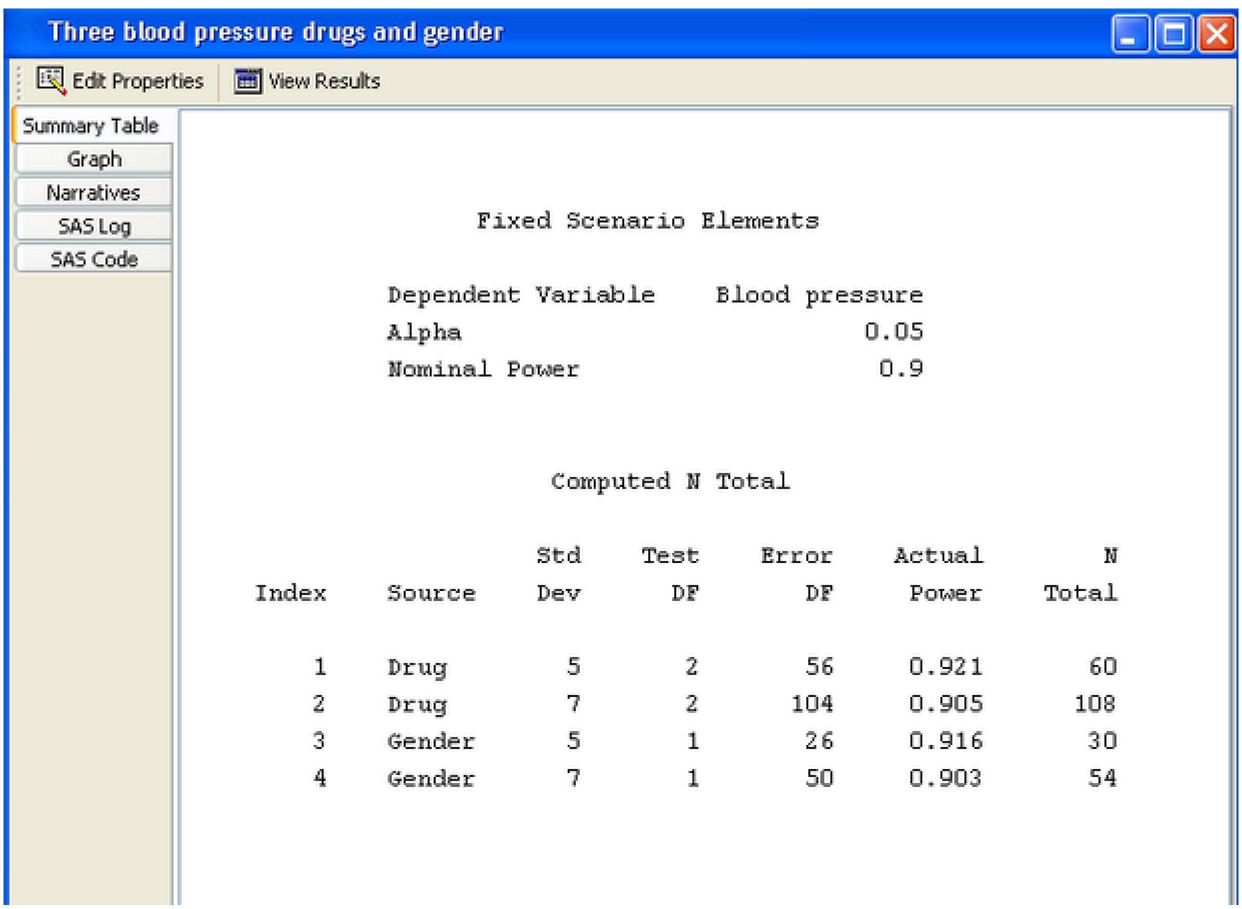
Now, click **Calculate** to perform the analysis.

Viewing Results

The results are displayed in separate tabs on the View Results page.

Click the **Summary Table** tab to view the summary table. In the `Computed N Total` table, sample sizes are listed for each combination of factor and standard deviation (Figure 72.68). You need a total sample size between 60 and 108 to yield a power of 0.9 for the `Drug` effect if the standard deviation is between 5 and 7. You need a sample size of half that for the `Gender` effect.

Figure 72.68 Summary Table



Fixed Scenario Elements

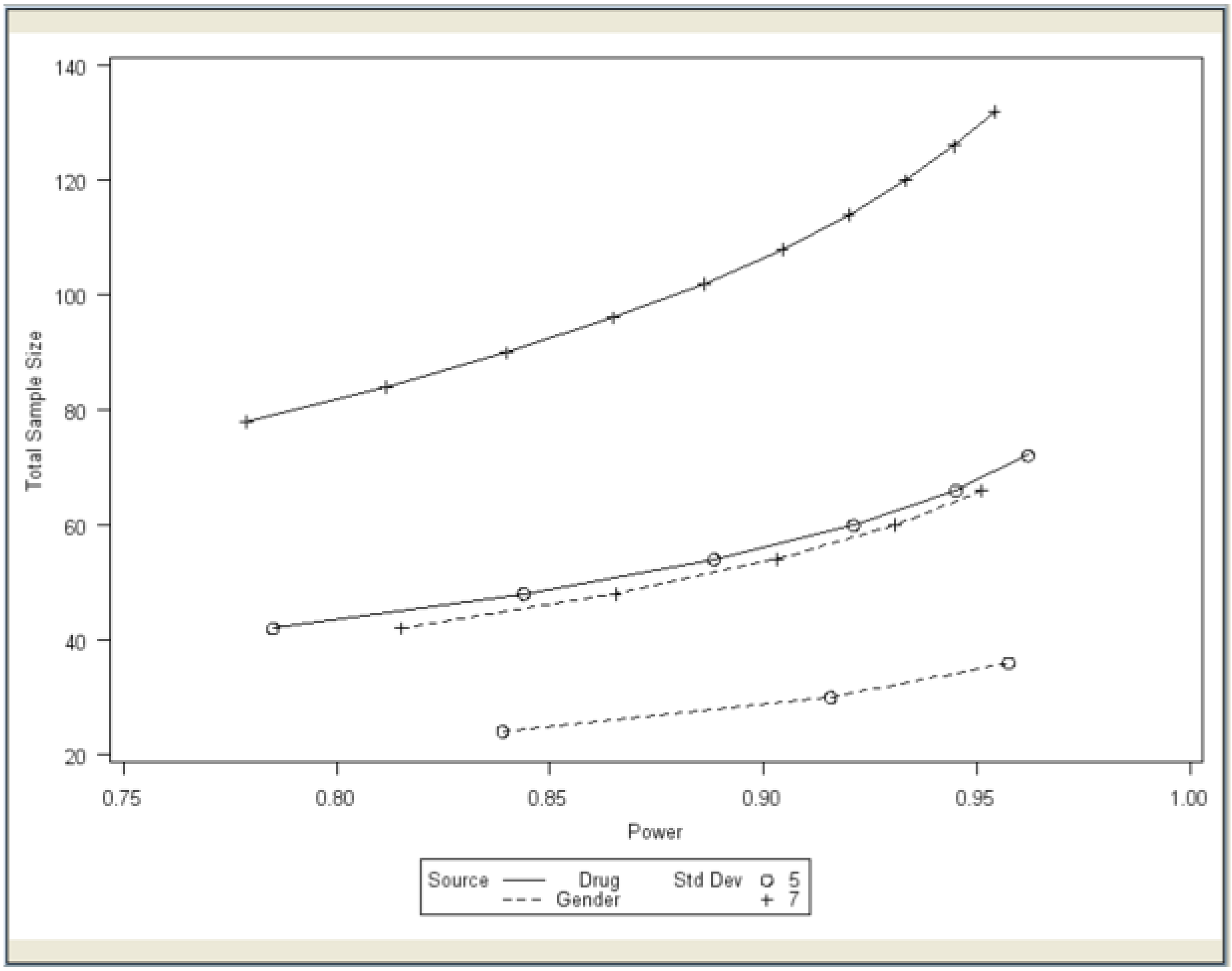
Dependent Variable	Blood pressure
Alpha	0.05
Nominal Power	0.9

Computed N Total

Index	Source	Std Dev	Test DF	Error DF	Actual Power	N Total
1	Drug	5	2	56	0.921	60
2	Drug	7	2	104	0.905	108
3	Gender	5	1	26	0.916	30
4	Gender	7	1	50	0.903	54

Click the **Graph** tab to view the power by sample size graph, as shown in Figure 72.69. One approximately linear curve is displayed for each standard deviation and factor combination.

Figure 72.69 Power by Sample Size Graph



Click the **Narratives** tab to create narratives of one or more scenarios. Select the first scenario, the Drug effect with the standard deviation of 5, in the narrative selector table. Note that the cell means are not included in the following narrative description:

```
For the usual F test of the Drug effect in the general linear univariate
model with fixed class effects [Blood pressure = Drug Gender] using a
significance level of 0.05, assuming the specified cell means and an
error standard deviation of 5, a total sample size of 60 assuming a
balanced design is required to obtain a power of at least 0.9.  The
actual power is 0.921.
```

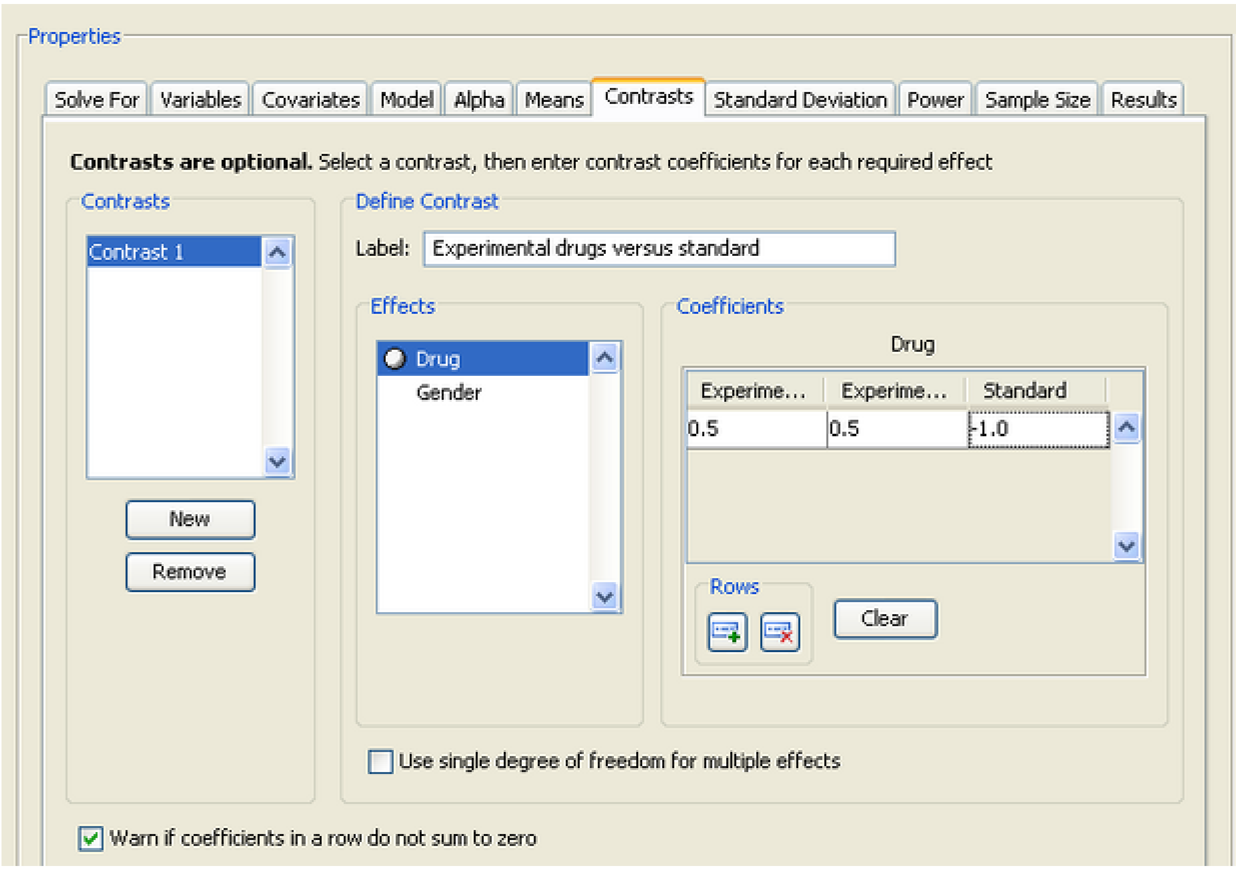
For more information about using the narrative facility, see the section "Creating Narratives" on page 6179.

Additional Topics

Adding Contrasts

Click the **Contrasts** tab to define one or more contrasts. Contrasts are optional. PSS allows contrasts to be added when using either a main effects model or a main effects and interactions model. At least two factors must have been specified in order to be able to enter contrasts. The contrast tab appears in Figure 72.70.

Figure 72.70 Contrast Tab with Coefficients



To create a contrast, click the **New** button. Then, select the newly created contrast (`Contrast 1`) from the list.

Specify a label for the contrast in the **Label** field. The label should be different from all of the factor names and all interactions in the model, as well as other contrast labels.

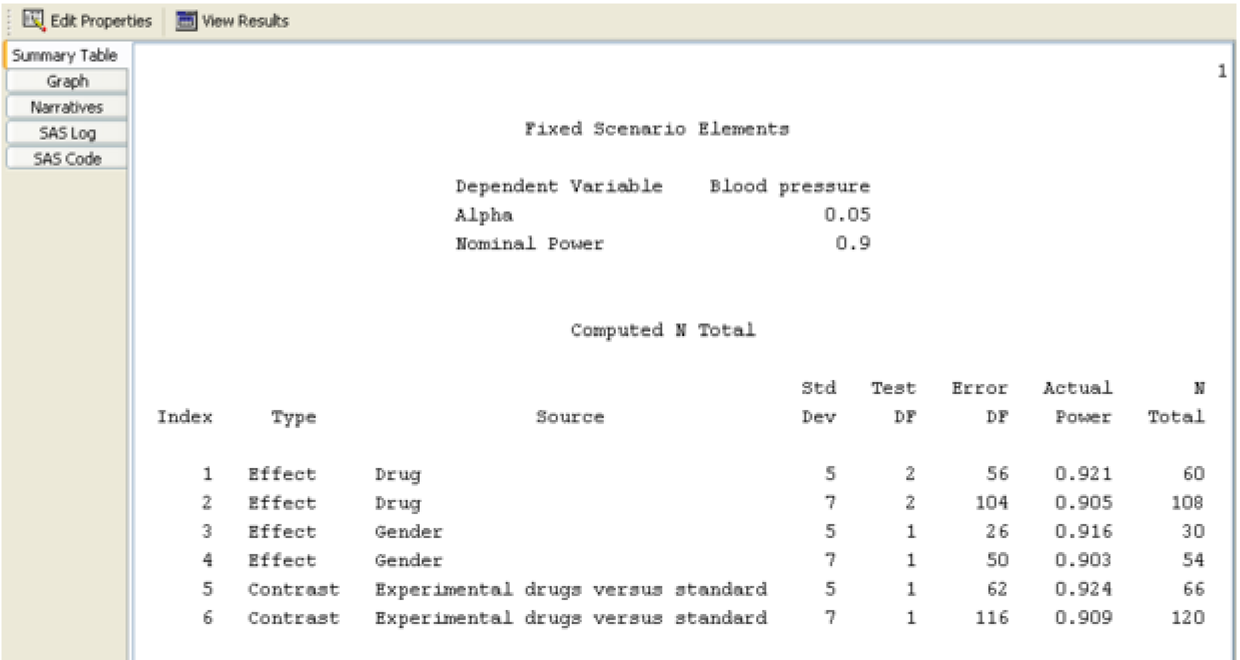
Then, for each term you want to include in the contrast, select the term in the **Effects** list and enter at least two coefficients per term. It is not necessary to enter zeros; blanks are considered to be zeros.

To clear all of the contrast coefficients for a term, click the **Clear** button. To remove a previously defined contrast, select it from the **Contrasts** list and click the **Remove** button.

In this example, you are interested in comparing the two experimental drugs to the standard drug. As shown in Figure 72.70, the contrast coefficients are 0.5, 0.5, and –1 for the three levels of the Drug effect.

Figure 72.71 shows the two scenarios for the contrast at the bottom of the `Computed N Total` table. The two scenarios also appear in the graph but the graph is not shown here.

Figure 72.71 Computed N Total Table for the Contrast



Fixed Scenario Elements

Dependent Variable	Blood pressure
Alpha	0.05
Nominal Power	0.9

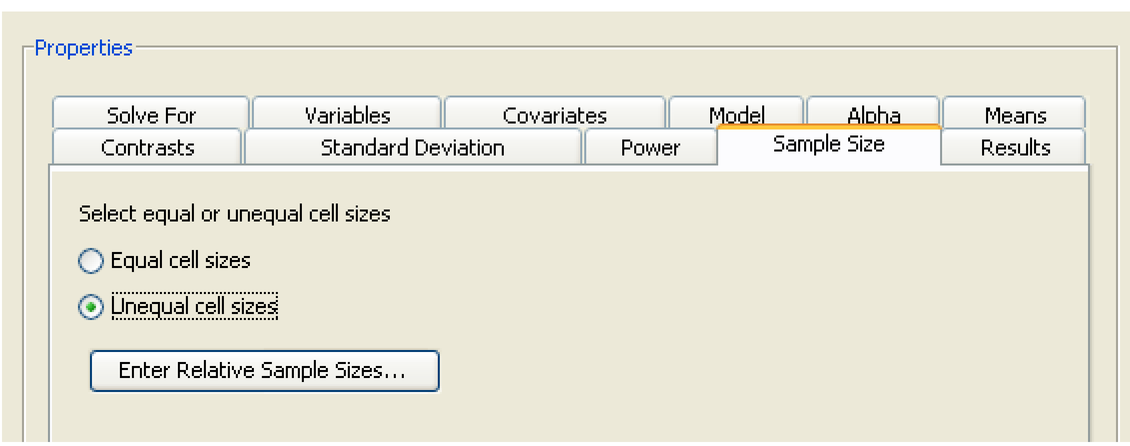
Computed N Total

Index	Type	Source	Std Dev	Test DF	Error DF	Actual Power	N Total
1	Effect	Drug	5	2	56	0.921	60
2	Effect	Drug	7	2	104	0.905	108
3	Effect	Gender	5	1	26	0.916	30
4	Effect	Gender	7	1	50	0.903	54
5	Contrast	Experimental drugs versus standard	5	1	62	0.924	66
6	Contrast	Experimental drugs versus standard	7	1	116	0.909	120

Using Unequal Cell Sizes

Click the **Sample Size** tab to select the equal or unequal cell sizes option.

Figure 72.72 Sample Size Tab



For the example, select the **Unequal cell sizes** option, as seen in Figure 72.72, and then click the **Enter Relative Sample Sizes** button.

Figure 72.73 shows the window in which you can enter relative sample sizes. As an example, enter the sample size weights from Table 72.8.

Table 72.8 Sample Size Weights

	Drug		
Gender	**Experimental 1**	**Experimental 2**	**Standard**
Males	1	1	2
Females	1	1	2

If you have unequal cell sizes, you must enter relative sample size weights for the cells. Weights do not have to sum to 1 across the cells. Some weights can be zero, but enough weights must be greater than zero so that the effects and contrasts are estimable.

In this case, you want the sample size of the standard group to be twice that of each of the two experimental groups. Click **OK** to save the values and return to the Edit Properties page.

Figure 72.73 Relative Sample Sizes Window

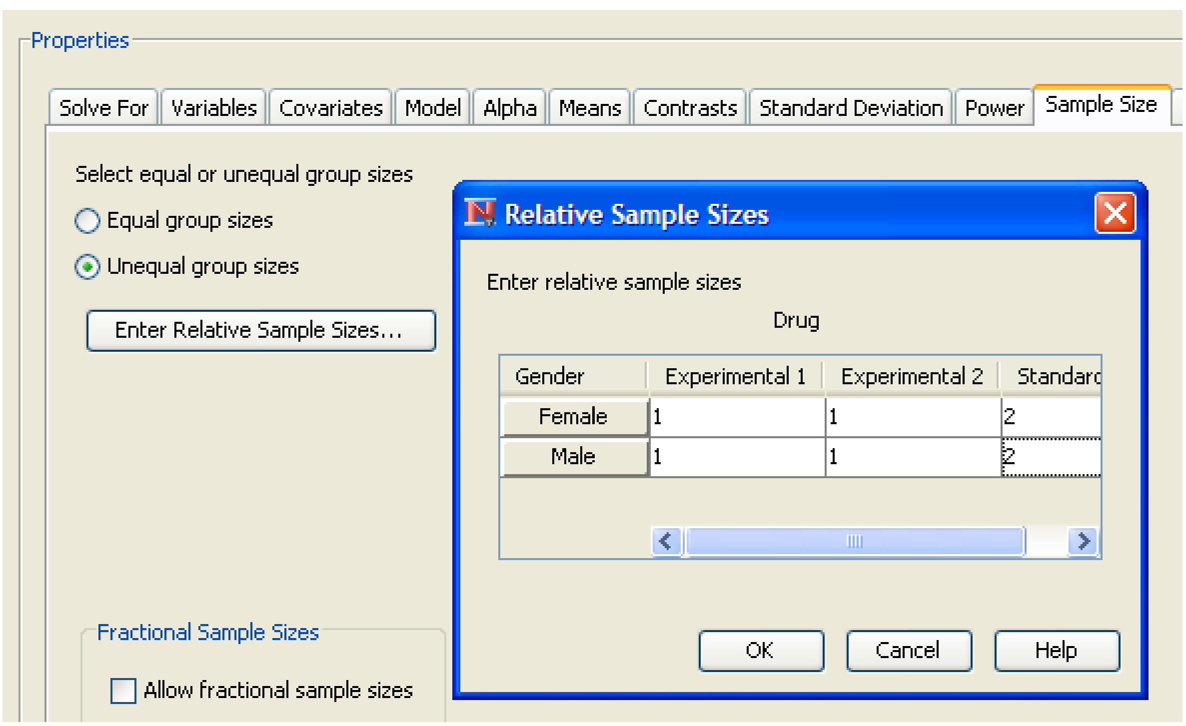


Figure 72.74 shows the summary table for the Drug by Gender example.

Figure 72.74 Summary Table for Unbalanced Design Example

1

Fixed Scenario Elements

Dependent Variable	Blood pressure
Weight Variable	_Weight_
Alpha	0.05
Nominal Power	0.9

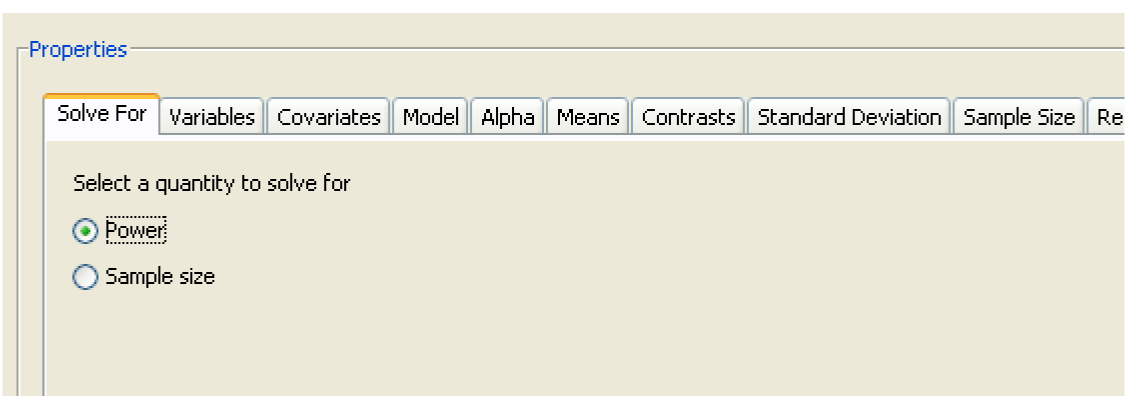
Computed N Total

Index	Type	Source	Std Dev	Test DF	Error DF	Actual Power	N Total
1	Effect	Drug	5	2	52	0.910	56
2	Effect	Drug	7	2	100	0.902	104
3	Effect	Gender	5	1	28	0.944	32
4	Effect	Gender	7	1	52	0.926	56
5	Contrast	Experimental drugs versus standard	5	1	52	0.911	56
6	Contrast	Experimental drugs versus standard	7	1	100	0.901	104

Solving for Power

In addition to solving for sample size, you can also solve for power. Figure 72.75 shows the two options. Click the **Solve For** tab to select the **Power** option.

Figure 72.75 Solve For Tab with Power Option Selected



When solving for power, you must provide sample size information. For the general linear univariate model analysis, you provide this information by using one of two alternate forms. To choose the desired alternate form, select the desired form from the **Select a form** list box on the **Sample Size** tab. The alternate forms are:

Sample size per cell
: Enter the sample size for a cell. Cell sizes are assumed to be equal. Sample size is reported in the summary table as total sample size.

Total N, Cell weights
: Enter the total sample size and specify whether cell sizes are to be equal or unequal. Select the **Equal cell sizes** or **Unequal cell sizes** option. For unequal cell sizes, you also enter cell weights. Click the **Enter Relative Sample Sizes** button to display a window that is used to enter the data. For more information about using unequal cell sizes, see the section "Using Unequal Cell Sizes" on page 6217.

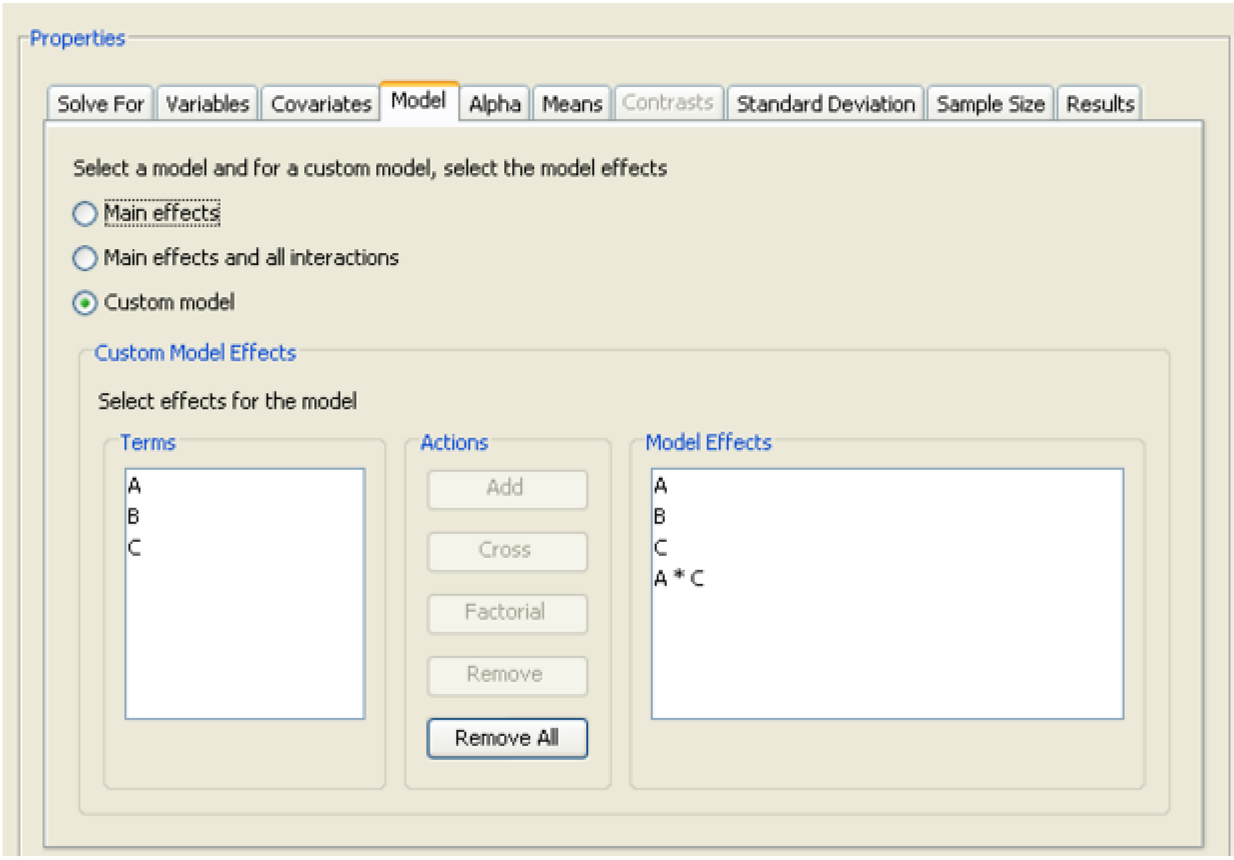
Specifying a Custom Model

Click the **Model** tab to select from three types of models: a **Main effects** model, a **Main effects and all interactions** model, and a **Custom model**.

To specify a custom model, select the **Custom model** option; then a model building facility is displayed.

The facility displays a list of the factors on the left. Construct the desired model using the **Add**, **Cross**, and **Factorial** buttons. The example shown in Figure 72.76 has the three main effects and one of the four possible interactions.

Figure 72.76 Model Tab with Custom Model Builder Displayed



Add the three main effects (A, B, C) by selecting them in the **Terms** list and clicking the **Add** button. Add the A*B interaction by selecting the A and B factors in the **Terms** list and clicking the **Cross** button.

To create the complete factorial design of several factors, select the factors in the **Terms** list, then click the **Factorial** button. All possible main effects and interactions are added to the **Model Effects** list.

To remove effects, select them in the **Model Effects** list and click the **Remove** button. Clicking the **Remove All** button removes all effects in the model.

Including Covariates

Click the **Covariates** tab to enter covariate information.

Figure 72.77 Covariates Tab with Proportional Reduction in Variance Form

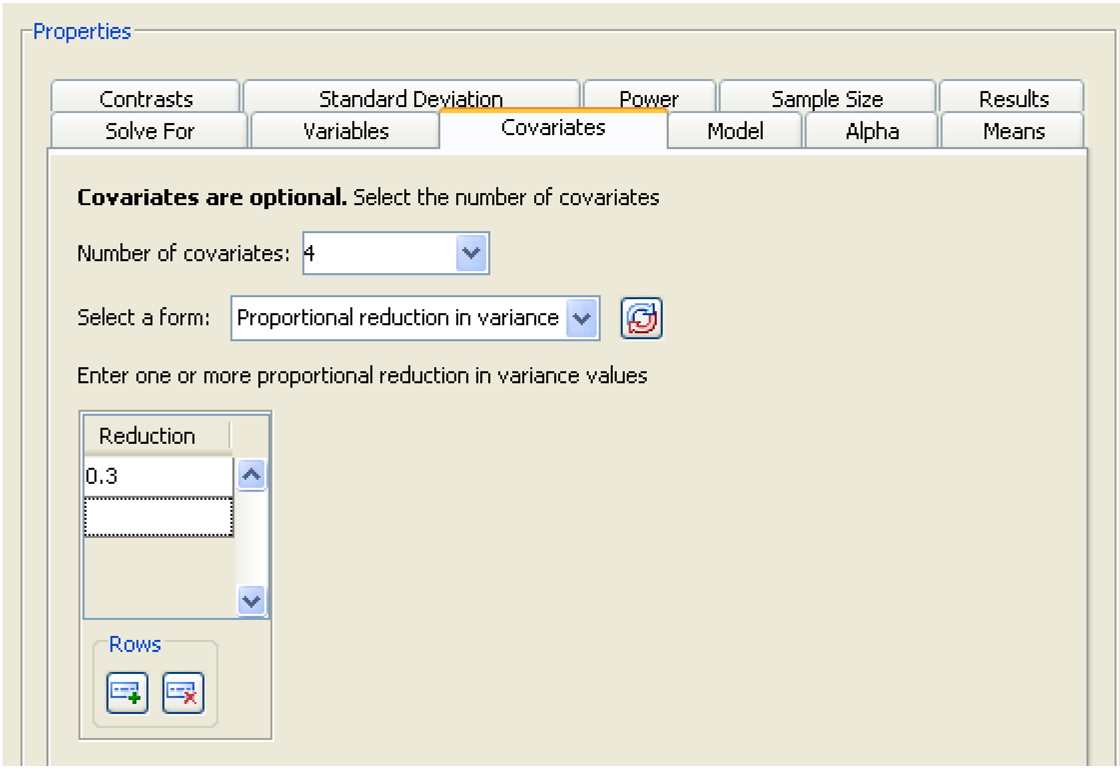


Figure 72.77 illustrates four covariates and a proportional reduction in variation of 0.3. The results for the analysis are not shown.

Covariates are optional. If you have covariates, include the total number of degrees of freedom for all covariates. To do this, add the number of continuous covariates and the sum of the degrees of freedom of the classification covariates, and enter this total in the **Number of Covariates** list box. For example, with two continuous covariates and a single classification covariate factor with three levels, the total would be $2 + (3 - 1) = 4$.

Also, you must enter the correlation between the dependent variable and the set of covariates. Two alternate forms are available: **Multiple correlation** and **Proportional reduction in variance**. Select the desired form and enter one or more values.

The multiple correlation is between the set of covariates and the dependent variable. Proportional reduction in variation is how much the variance of the dependent variable is reduced by the inclusion of the covariates, expressed as a proportion between 0 and 1.

Example: Two-Sample Survival Rank Tests

Overview

Survival analysis often involves the comparison of survival curves. PSS provides sample size and power calculations for two-sample survival rank analyses. Several rank tests are available: Gehan, log-rank, and Tarone-Ware. There are also several ways to specify the survival functions. For more information about power and sample size analysis for survival rank tests, see Chapter 71, "The POWER Procedure."

The Example

Suppose you want to compare survival rates for an existing cancer treatment and a new treatment. You intend to use a log-rank test to compare the overall survival curves for the two treatments. You want to determine a sample size to achieve a power of 0.8 for a two-sided test using a balanced design, with a significance level of 0.05.

The survival curve of patients for the existing treatment is known to be approximately exponential with a median survival time of five years. You think that the proposed treatment will yield a survival curve described by the times and probabilities listed in Table 72.9. Patients are to be accrued uniformly over two years and followed for three years.

Table 72.9 Survival Probabilities for Proposed Treatment

Time	Probability
1	0.95
2	0.90
3	0.75
4	0.70
5	0.60

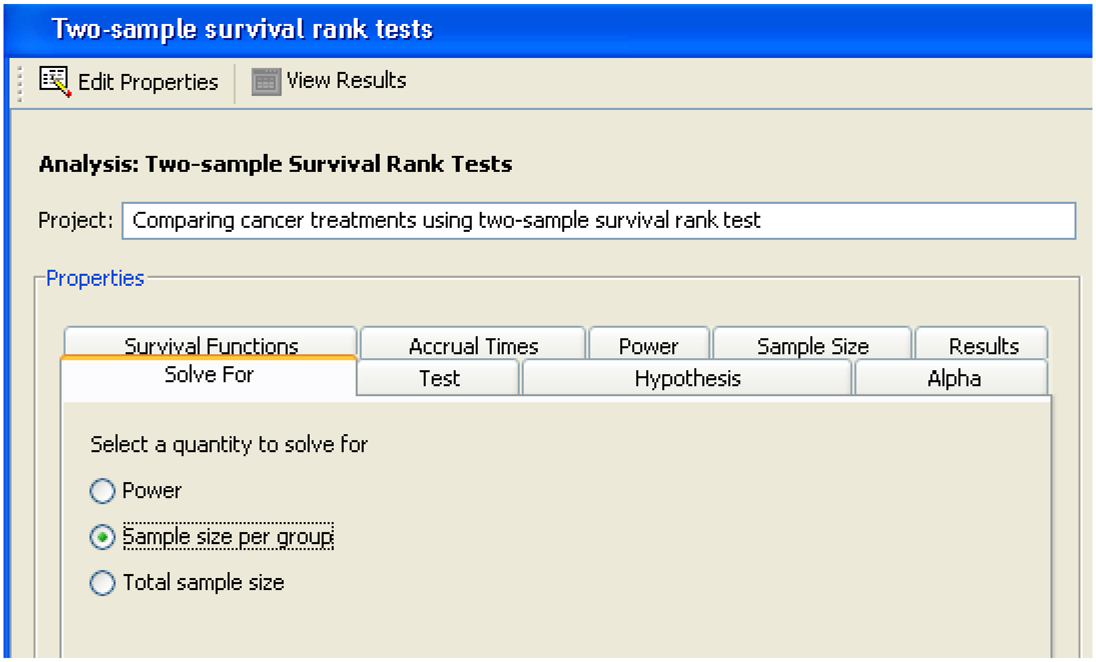
To create a new survival analysis project, select **File►New**, Then, under the **Survival Analysis** section, select **Two-sample survival rank tests** and click **OK**. The **Two-sample survival rank tests** project appears with the Edit Properties page displayed.

Editing Properties

Project Description

For the example, change the project description to `Comparing cancer treatments using two-sample survival rank test`.

Figure 72.78 Project Description and Solve For Tab



Solve For

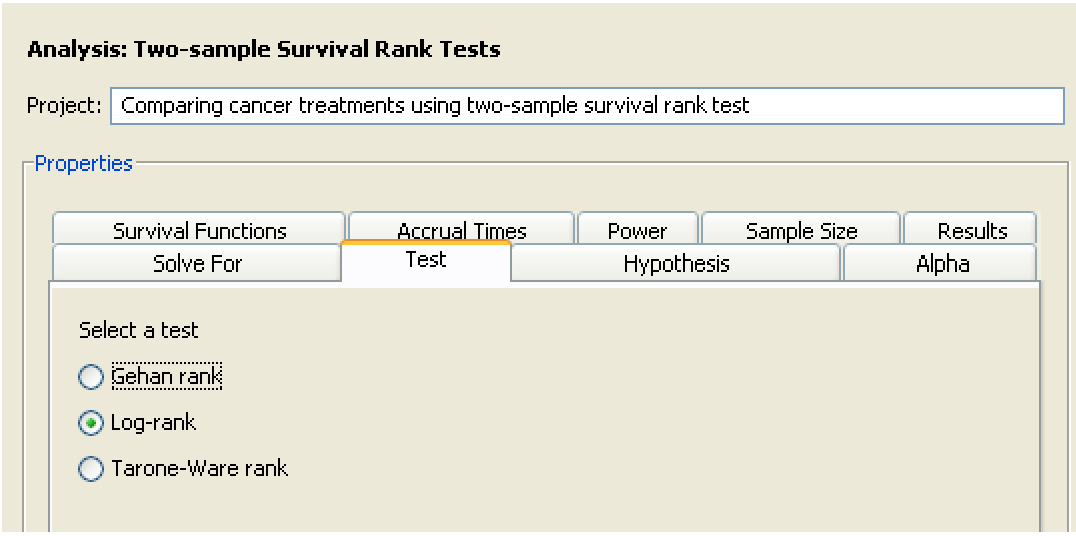
Click the **Solve For** tab to select the quantity to solve for. For this example, select the **Sample size per group** option, as shown in Figure 72.78. For information about calculating total sample size, see the section "Solving for Sample Size" on page 6204.

In this analysis you can solve for power, sample size per group, or total sample size.

Test

Click the **Test** tab to select a rank test. For this example, select the **Log-rank** option, as shown in Figure 72.79.

Figure 72.79 Test Tab

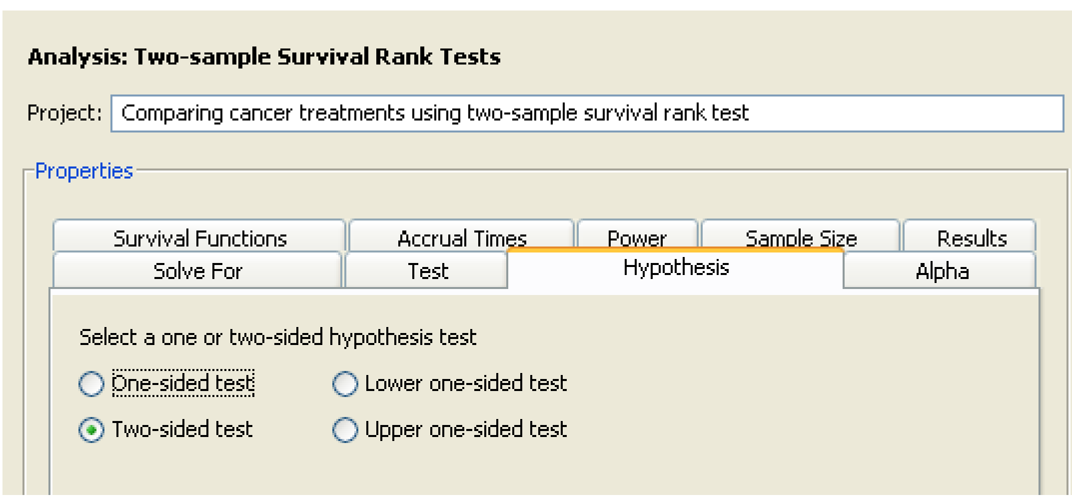


Several rank tests are available: Gehan, log-rank, and Tarone-Ware. The Gehan test is most sensitive to survival differences near the beginning of the study period, the log-rank test is uniformly sensitive throughout the study period, and the Tarone-Ware test is somewhere in between.

Hypothesis

Click the **Hypothesis** tab to select a one- or two-sided test. For the example, select the **Two-sided test** option, as shown in Figure 72.80.

Figure 72.80 Hypothesis Tab

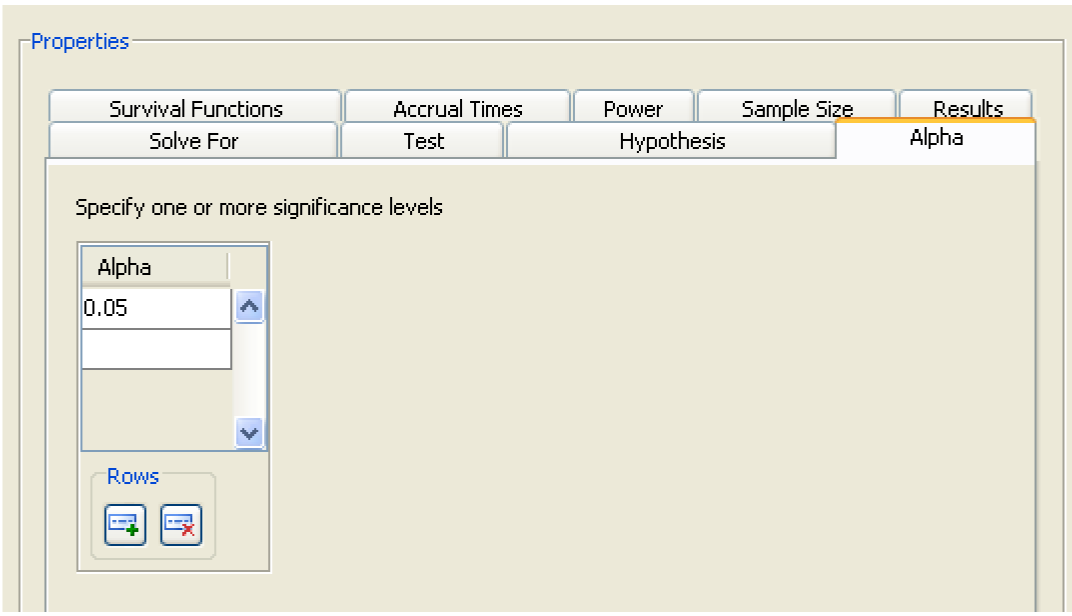


You can choose either a one- or two-sided test. For the one-sided test, the alternative hypothesis is assumed to be in the same direction as the effect. If you do not know the direction of the effect (that is, whether it is positive or negative), the two-sided test is appropriate. If you know the effect's direction, the one-sided test is appropriate. If you specify a one-sided test and the effect is in the unexpected direction, the results of the analysis are invalid.

Alpha

Click the **Alpha** tab to enter one or more values for the significance level. For the example, enter the desired significance level of 0.05 in the first cell of the Alpha table, as shown in Figure 72.81, if it is not already the default value.

Figure 72.81 Alpha Tab

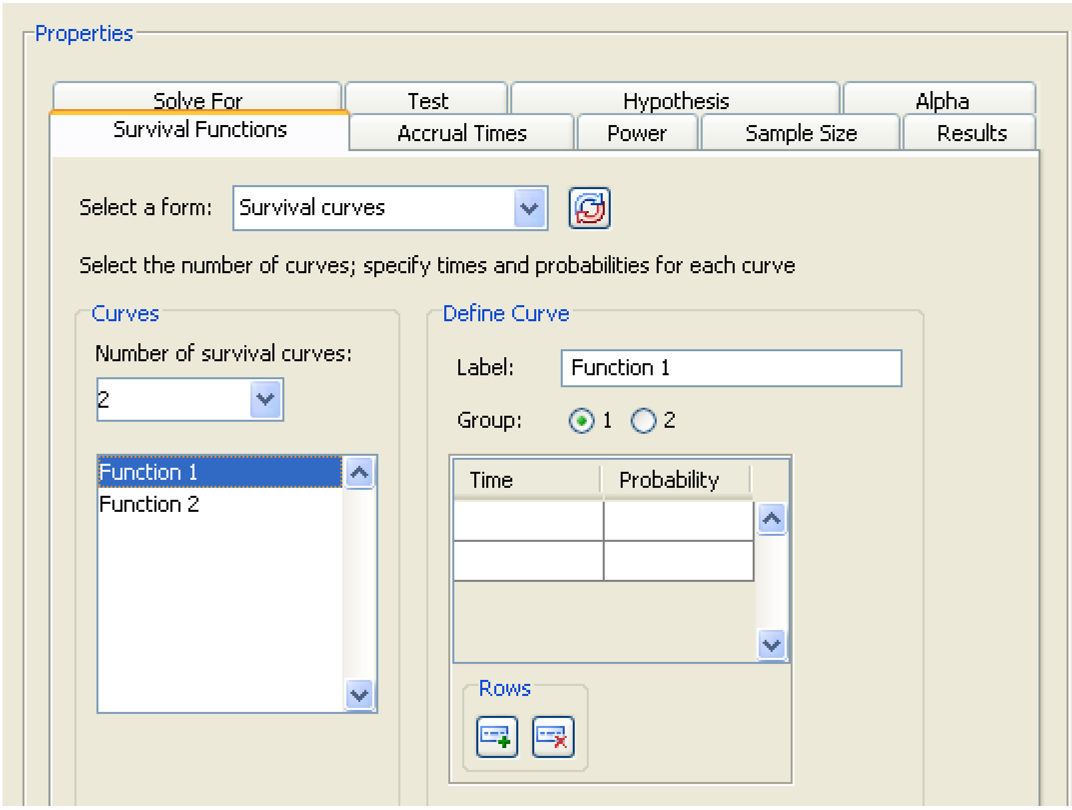


The significance level is the probability of falsely rejecting the null hypothesis. If you frequently use the same values for alpha, set them as the defaults in the Preferences window.

Survival Functions

Click the **Survival Functions** tab to select the input form for the survival functions.

Figure 72.82 Survival Functions Tab with Number of Curves



Examine the input alternatives available in the **Select a form** list. There are four alternate forms for entering survival functions. The first three apply only to exponential curves; the fourth applies to both piecewise linear and exponential curves.

Group median survival times
: Enter median survival times for the two groups.

Group hazards
: Enter hazards for the two groups.

Hazards, Hazard ratios
: Enter hazards for the reference group and hazard ratios.

Survival curves
: Enter survival probabilities and their associated times for each of several curves. Select or enter the number of curves from the drop-down list; at least two curves are required. Then, for each curve, select it in the left-hand list, select the Group 1 or Group 2 option, and then define the survival curve by entering pairs of times and probabilities. Enter a time and probability pair only if the probability is less than that of the previous pair.

For information about using the other forms, see the section "Using the Other Survival Curve Forms" on page 6236.

For each survival curve, select the curve in the left-hand list. Then, enter a descriptive label and select which group it is for. The labels should be unique. Finally, enter pairs of survival times and probabilities.

When you enter probabilities, enter a time and probability pair only when the probability for a survival curve changes. For example, if the probability for curve 1 at time 1 and 2 is 0.9 and at time 3 is 0.8, enter 0.9 for time 1 and 0.8 for time 3.

To specify an exponential survival curve, enter a single time and probability pair. In the example, the exponential curve for the existing treatment is defined by a probability of 0.5 at time 5.

The units of time for the survival curves must correspond to the units for the accrual, follow-up, and total times, which are described in the section "Accrual Times" on page 6229.

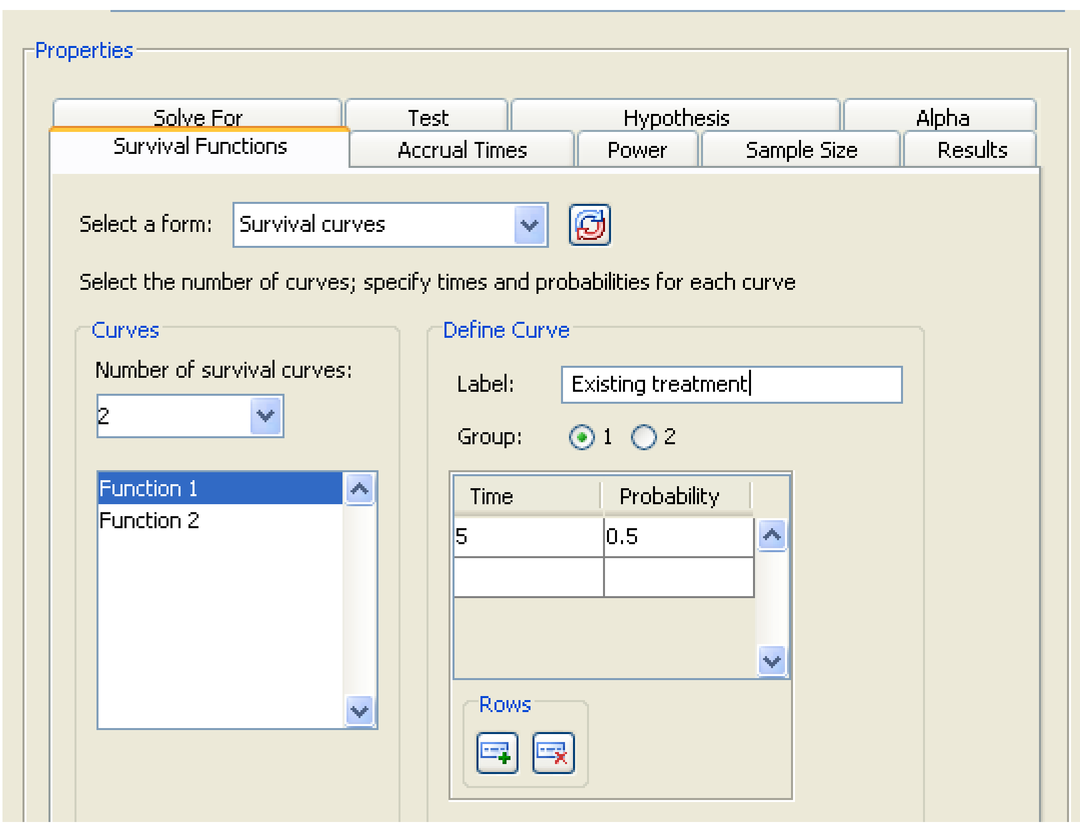
You can also compare several survival curves. For example, if you have two scenarios, A and B, for group 1's curve and two scenarios, C and D, for group 2's curve, then specify probabilities for the four curves and assign A and B to group 1 and C and D to group 2.

For the example, select the **Survival curves** form, as shown in Figure 72.82. Enter the value, 2, in the **Number of survival curves** list box.

For the example enter the following values:

- For the first survival curve, enter a label of `Existing treatment` and select the **Group 1** option. For the first curve, enter a time of 5 and a probability of 0.5. Figure 72.83 shows the resulting values.

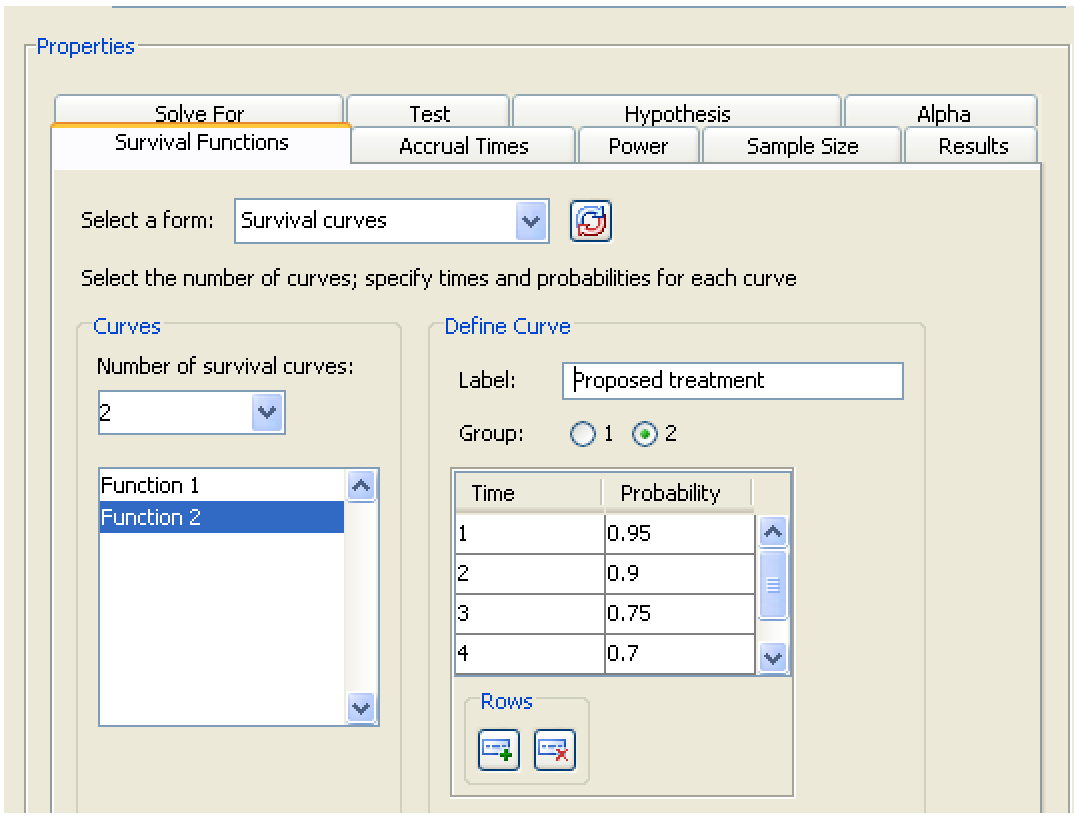
Figure 72.83 Survival Times and Probabilities for Curve 1



- For the second curve select `Function 2` in the selection list on the left side of the tab. Enter a label of `Proposed treatment` and select the **Group 2** option. Then, enter time values of 1 through 5 and the corresponding probabilities of 0.95, 0.9, 0.75, 0.7, and 0.6. To add rows to the table, click the  button beneath the table.

Figure 72.84 shows these values; the last row of the time and probability table is not displayed.

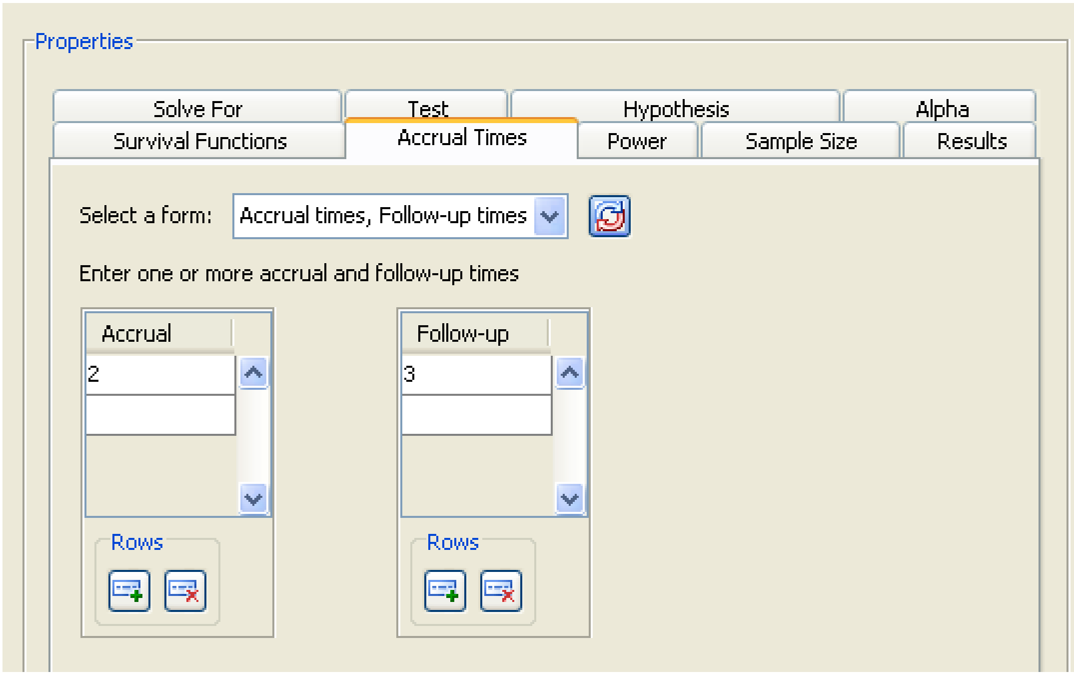
Figure 72.84 Survival Times and Probabilities for Curve 2



Accrual Times

Click the **Accrual times** tab to select an input form for accrual times and to enter the times.

Figure 72.85 Accrual Times Tab



Examine the alternatives available in the **Select a form** list.

Accrual time is the period during which subjects are brought into the study. Follow-up time is the period during which subjects are observed after all subjects have been included in the study. Total time is the sum of accrual and follow-up time. The units of time for the accrual, follow-up, and total times must correspond to the units you used specified for the survival curves.

When you enter survival curves, the sum of the accrual and follow-up times must be less than the largest time for each survival curve. This does not apply to survival curves represented by a single time, which represent exponential curves.

On the **Accrual Times** tab, there are three alternate forms for entering accrual and follow-up times:

Accrual times, Follow-up times
Enter accrual and follow-up times.

Accrual times, Total times
Enter accrual and total times.

Follow-up times, Total times
Enter follow-up and total times.

For the example, select the **Accrual times, Follow-up times** form. Then enter a single value of `2` in the Accrual table and a value of `3` in the Follow-up table, as shown in Figure 72.85.

Power

Click the **Power** tab to enter one or more power values. For the example, enter a single value of `0.8`.

When you calculate sample size, it is necessary to specify one or more powers.

Summary of Input Parameters

Table 72.10 contains the values of the input parameters for the example.

Table 72.10 Summary of Input Parameters

Parameter	Value
Solve for	Sample size per group
Test	Log-rank
Hypothesis	Two-sided test
Alpha	0.05
Survival function form	Survival curves
Survival curves	See Table 72.11 and Table 72.12
Accrual and follow-up times form	Accrual time, Follow-up times
Accrual times	2
Follow-up times	3
Power	0.8

Table 72.11 and Table 72.12 contain times and probabilities for the two survival curves, respectively.

Table 72.11 Survival Times and Probabilities for Existing Treatment (Survival Curve 1)

Time	Probability
5	0.5

Table 72.12 Survival Times and Probabilities for Proposed Treatment (Survival Curve 2)

Time	Probability
1	0.95
2	0.90
3	0.75
4	0.70
5	0.60

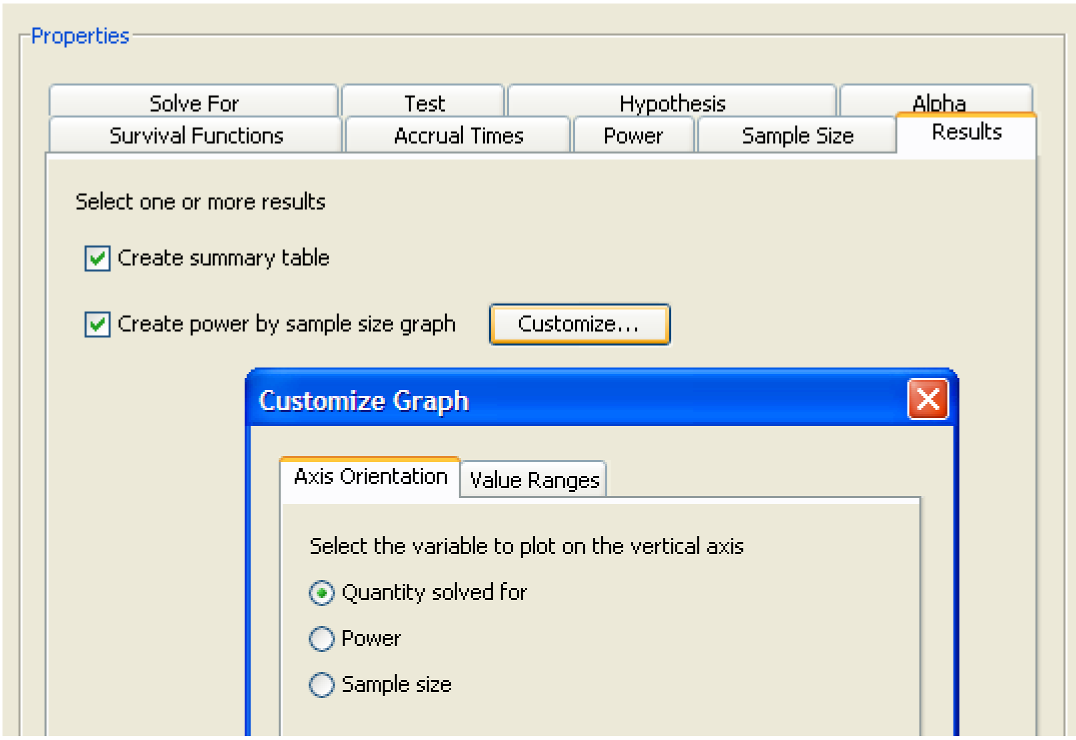
Result Options

Click the **Results** tab to specify the desired result options. For the example, request both results by selecting both the **Create summary table** and **Create power by sample size graph** check boxes.

Specifying only one power (as in this example) produces a graph with a single point. You might be interested in a plot of sample sizes for a range of powers—say, between 0.75 and 0.85. You can customize the graph by specifying the values for the power axis. Also, you might want to change the appearance of the graph to have sample size (per group) on the vertical axis and power on the horizontal axis.

Click the **Customize** button beside the **Create power by sample size graph** check box to customize the graph. The Customize Graph window is displayed, as shown in Figure 72.86.

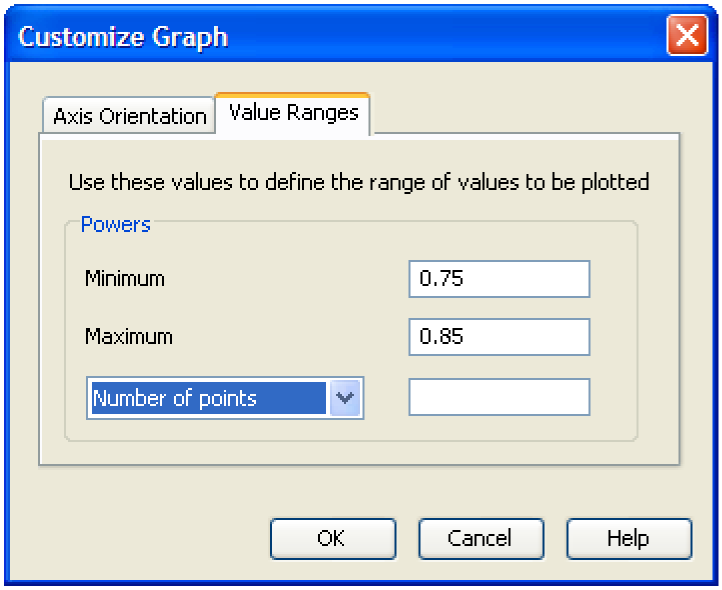
Figure 72.86 Customize Graph Window with Axis Orientation Tab



Click the **Axis Orientation** tab to select which variable to plot on the vertical axis. For the example, select the **Quantity solved for** option, as shown in Figure 72.86. This option plots sample size on the vertical axis and power on the horizontal axis. You could also have chosen the **Sample size** option.

Click the **Value Ranges** tab to enter minimum and maximum values for a plot axis. For the example, enter a minimum of `0.75` and a maximum of `0.85` in the Powers text boxes. This sets the range of values on the axis for powers. The completed Value Ranges tab of the window is displayed in Figure 72.87. You can set the axis values only for the quantity that is not being solved for.

Figure 72.87 Customize Graph Window with Value Ranges Tab



Click **OK** to save the values that you have entered and return to the Edit Properties page.

Then, click **Calculate** to perform the analysis. If there are no errors in the input parameter values, the View Results page appears. If there are errors in the input parameter values, you are prompted to correct them.

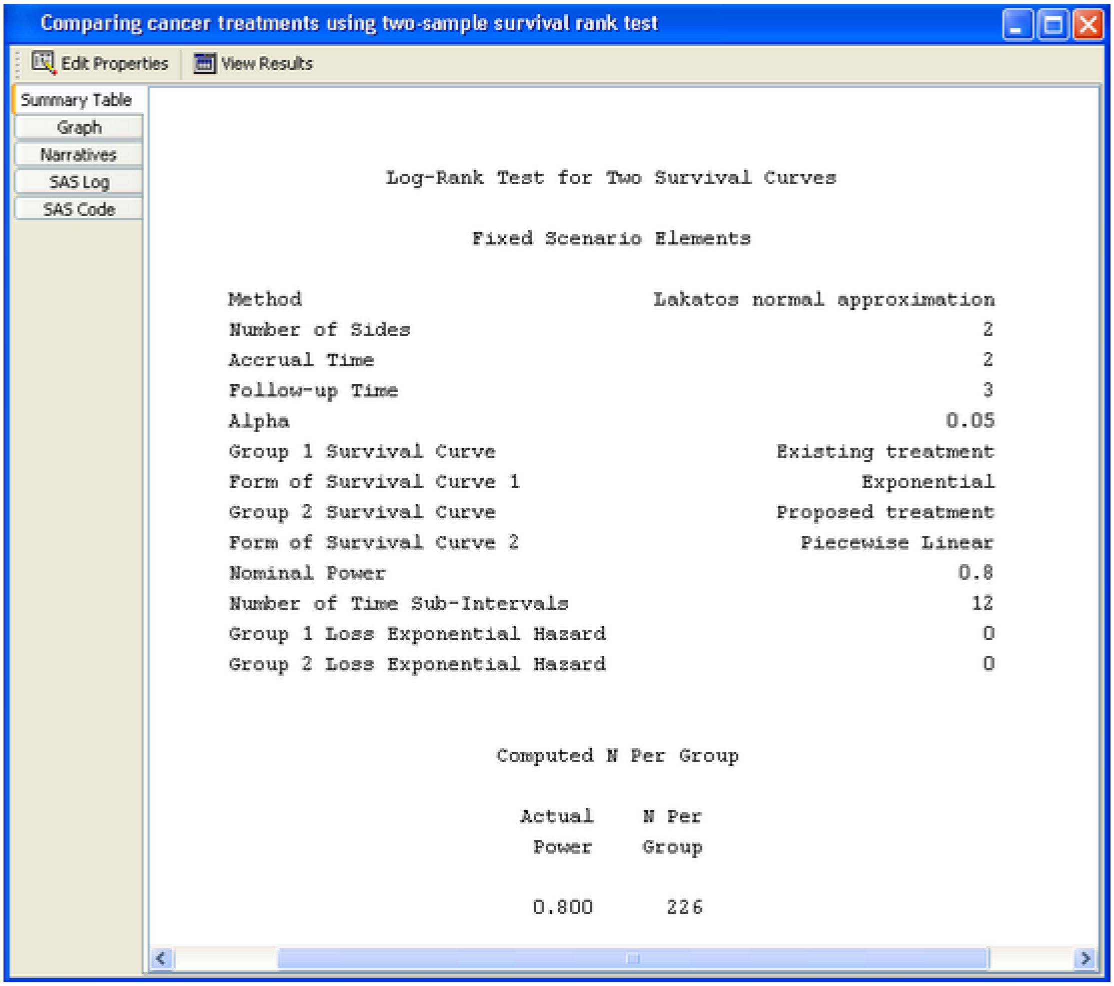
Viewing Results

The results appear in separate tabs on the View Results page of the project. Select the tab of each result that you want to view.

Summary Table

Click the **Summary Table** tab to view the summary table. It is composed of two subtables. As shown in Figure 72.88, the `Fixed Scenario Elements` and `Computed N Per Group` tables include the values of the input parameters and the computed quantity (in this case, sample size per group, `N per group`). The sample size per group for the single requested scenario is 226.

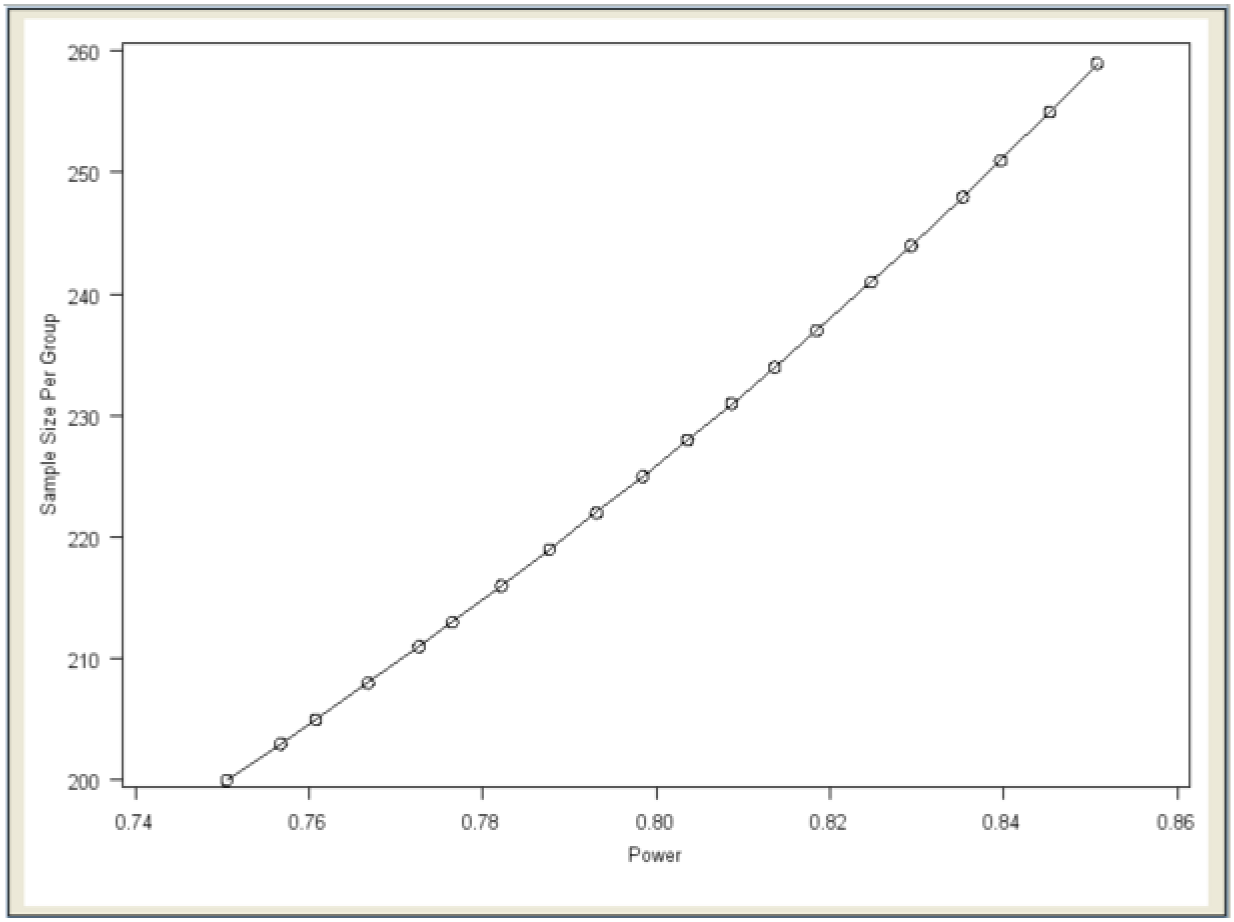
Figure 72.88 Summary Table



Power by Sample Size Graph

Click the **Graph** tab to view the power by sample size graph.

Figure 72.89 Power by Sample Size Graph



As you can see in Figure 72.89, the graph is curved slightly upward with larger powers associated with larger sample sizes. Sample size is plotted on the vertical axis as requested in the Customize Graph window.

Narratives

Click the **Narratives** tab to create one or more narratives. To generate a narrative, select the single scenario in the narrative selector table at the bottom of the tab. The narrative for this task does not include the survival times and probabilities for the survival curves:

> For a log-rank test comparing two survival curves with a two-sided significance level of 0.05, assuming uniform accrual with an accrual time of 2 and a follow-up time of 3, a sample size of 226 per group is required to obtain a power of at least 0.8 for the exponential curve, "Existing treatment," and the piecewise linear curve, "Proposed treatment." The actual power is 0.800.

For information about selecting additional narratives when multiple scenarios are present, see the section "Creating Narratives" on page 6179.

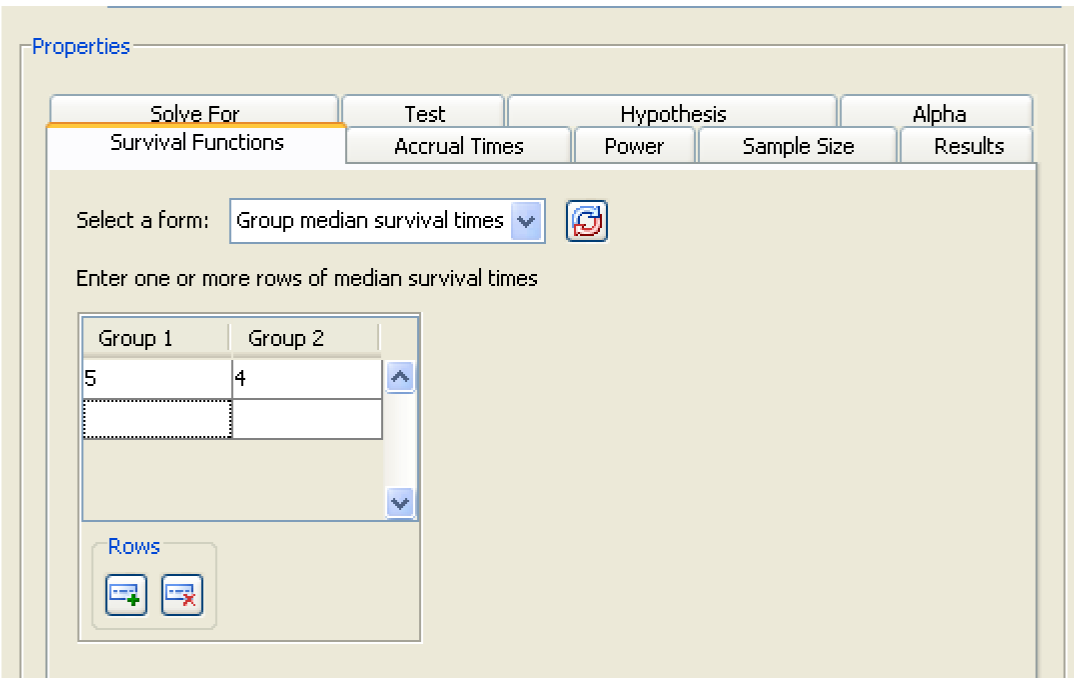
Additional Topics

Using the Other Survival Curve Forms

Survival functions can be specified as median survival times, hazards, or a combination of hazards for one group and hazard ratios. These all assume exponential curves.

Suppose you are interested in comparing the proposed and existing treatments using their median survival times. The survival times are five years and four years for the two groups, respectively.

Figure 72.90 Median Survival Times and List of Alternate Forms



Click the **Survival Functions** tab and examine the list of alternate forms available in the **Select a form:** list. For this example, select the **Group median survival times** option.

For the example, enter `5` and `4` in the first row of the table. The completed table is shown in Figure 72.90.

You can enter one or more sets of two median survival times. The results of the analysis are not shown.

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Your Turn

We welcome your feedback.

- If you have comments about this book, please send them to **yourturn@sas.com**. Include the full title and page numbers (if applicable).
- If you have comments about the software, please send them to **suggest@sas.com**.