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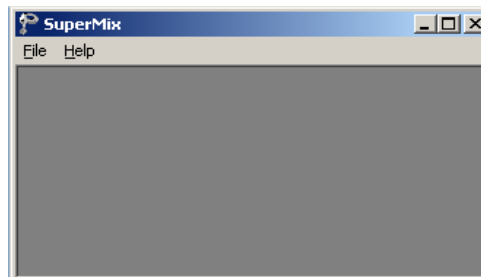
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## 2 Graphical User Interface

The SuperMix graphical user interface (GUI) consists of a main window, a spreadsheet window, and a graph window. The main window is used to create or open SuperMix data files, whereas the spreadsheet window is used to display SuperMix data files and to allow access to the **Model Setup** window. The graph window is used to display SuperMix graph files. SuperMix data files have the default extension **.ss3** and are known as **ss3** or spreadsheet files, while SuperMix model files have the default extension **.mum**. SuperMix graph files have the default extension **.mug**. The main window and its menus and dialog boxes are reviewed in the next section, and the menus and dialogs of the spreadsheet and graph windows are reviewed in the sections to follow.

### 2.1 The main window

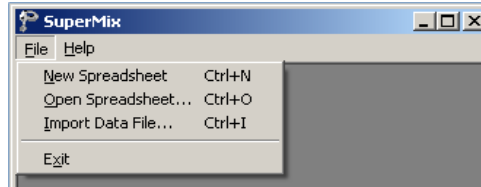
The SuperMix main window is accessed when you start the program. SuperMix can be opened from the **Programs** option on the Windows **Start** menu, by double-clicking on the SuperMix application or by clicking on a shortcut for SuperMix. Any of these actions opens the following main window.



The SuperMix main window consists of a **File** menu and a **Help** menu. These menus are reviewed separately in the following two sections.

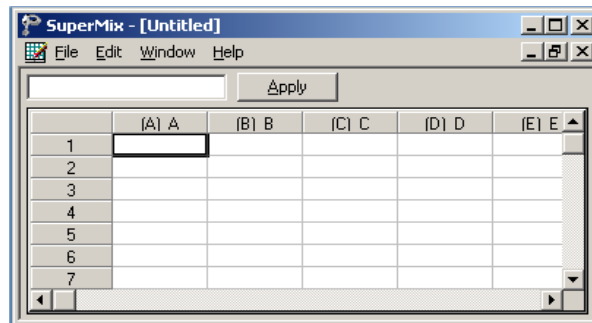
## 2.1.1 The File menu

The options on the **File** menu of the SuperMix main window provide access to a sequence of three dialog boxes that can be used to create or to open a SuperMix data file in a spreadsheet format.



### The New Spreadsheet option

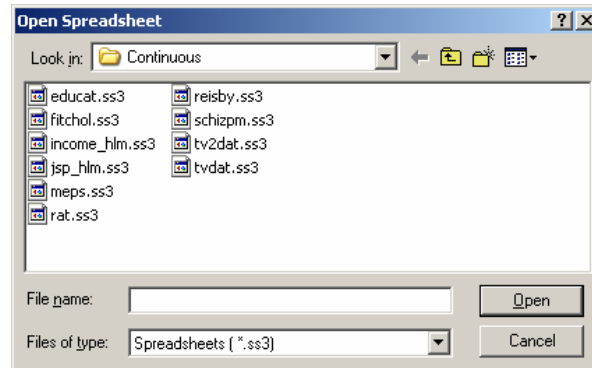
Click on the **New Spreadsheet** option to open an empty SuperMix spreadsheet window.



You can use the window above to enter data manually. Use the **Save As** option on the **File** menu to save the data to an **ss3** file. Alternatively, data can be imported into the empty spreadsheet via the **File, Import Data File** option.

### The Open Spreadsheet option

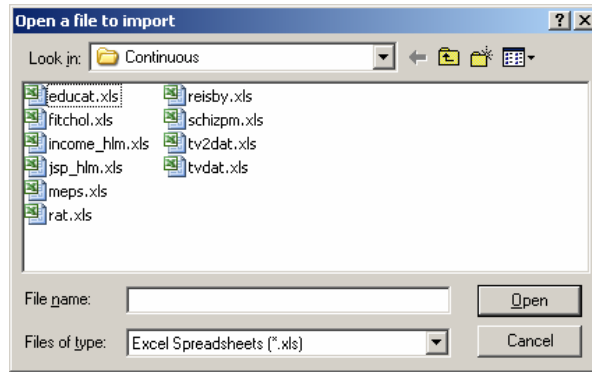
The **Open** option on the **File** menu is used to open an existing SuperMix data file. Click on the **Open Spreadsheet** option to load the following **Open Spreadsheet** dialog box.



Next, browse for the **ss3** file, select it, and click on the **Open** button to open the SuperMix spreadsheet window.

### The Import Data File option

Use the **Import Data File** option on the **File** menu to convert the data in a Microsoft Excel workbook (\*.xls), statistical files and databases (SAS, SPSS, etc.) or a comma delaminated text file to a SuperMix data file. To import an Excel data file, click on the **Import Data File** option to load the following **Open a file to import** dialog box.



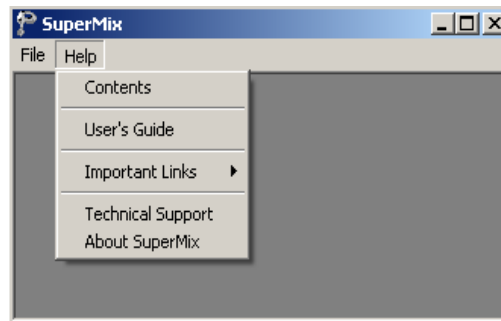
Next, browse for the Microsoft Excel workbook or the text file and select it. Click on the **Open** button to load the **Save As** dialog box. Enter a name for the **ss3** file and click on the **Save** button to open the SuperMix data file in a spreadsheet window.

### The Exit option

Close the SuperMix main window by clicking on the **Exit** option on the **File** menu.

### 2.1.2 The Help menu

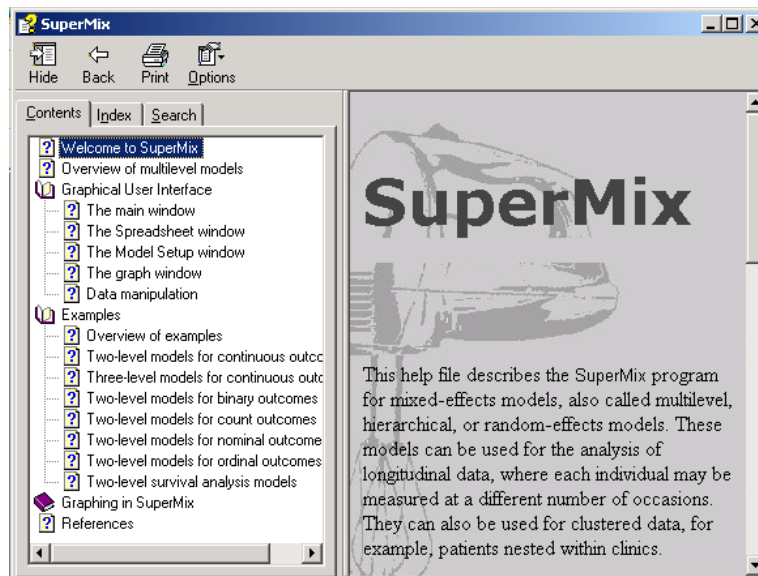
The options on the **Help** menu on the SuperMix main window provide access to the contents of the SuperMix online help file, the SuperMix user's guide, the SuperMix website, technical support and other information.



The five options on the **Help** menu shown above are discussed in the following sections.

### The Contents option

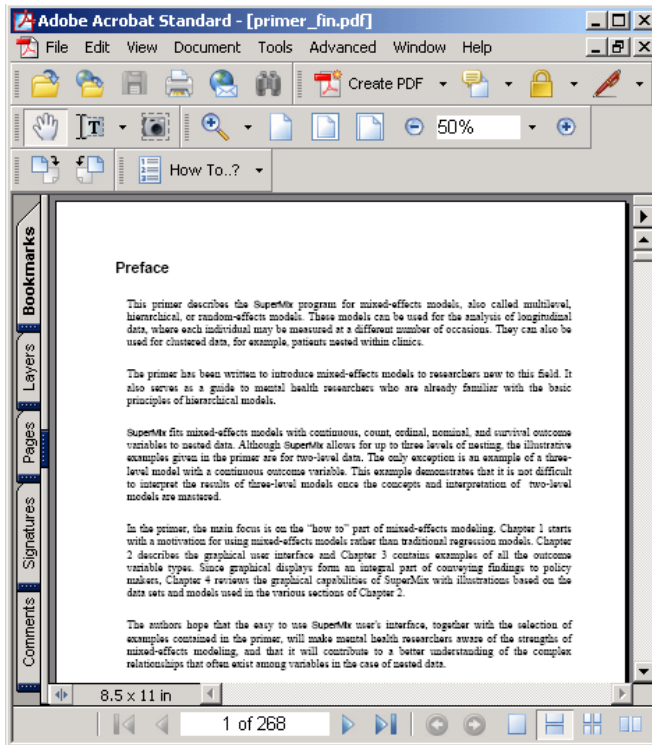
The **Contents** option on the **Help** menu is used to open the SuperMix online help file. Click on the **Contents** option to open the following help window for the SuperMix online help file.



Use the menus or buttons or click on one of the links to browse the different sections of the SuperMix online help file.

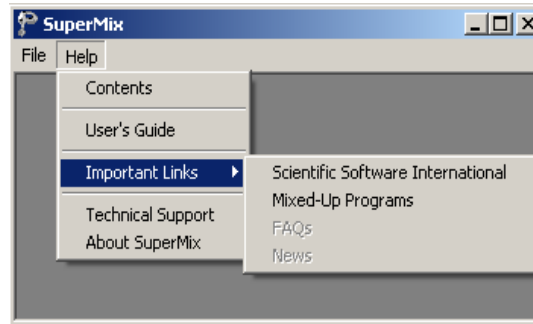
### The User's Guide option

The **User's Guide** option on the **Help** menu provides access to the PDF copy of the SuperMix user's guide. Adobe Reader (which can be downloaded for free from Adobe's website) is needed to open a PDF file. A click on the **User's Guide** option opens the following Adobe Reader window.



## The Important Links option

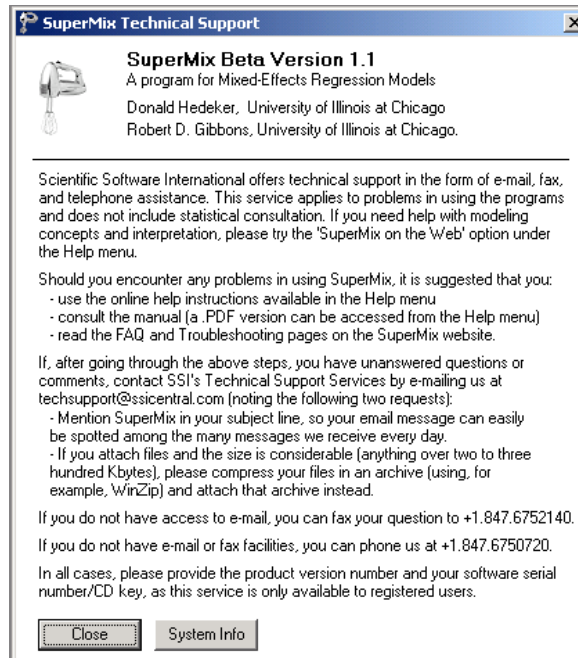
The **Important Links** option on the **Help** menu provides access to the online resources of SuperMix.



Select an option from the pop-up menu above to open the corresponding web page with your default internet browser.

### The Technical Support option

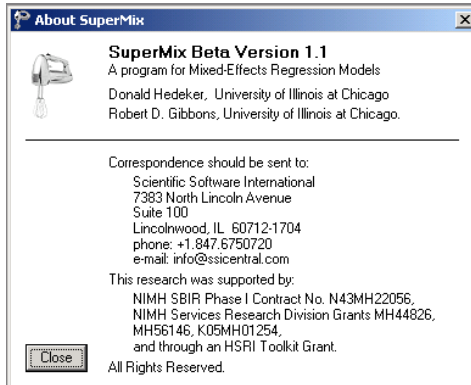
The **Technical Support** option provides information about obtaining assistance in troubleshooting problems encountered with SuperMix.



The **Close** button is used to return to the current SuperMix window. The **System Info** button provides complete details of the computer used to run SuperMix. This information can be useful to address technical support issues.

### The About SuperMix option

Use the **About SuperMix** option to obtain general information about SuperMix.



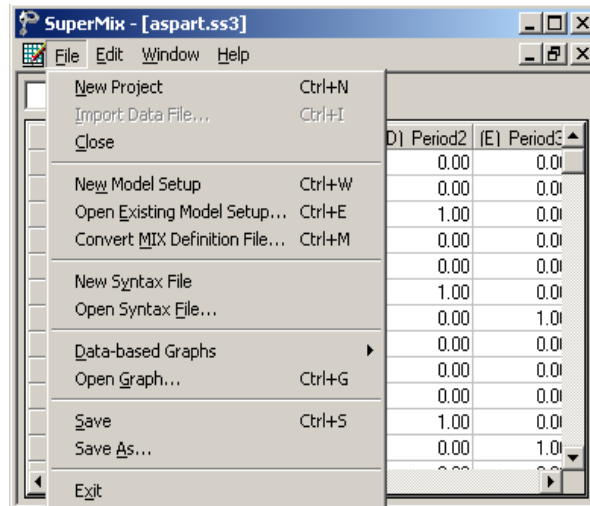
Click on the **Close** button to return to the current SuperMix window.

## 2.2 The spreadsheet window

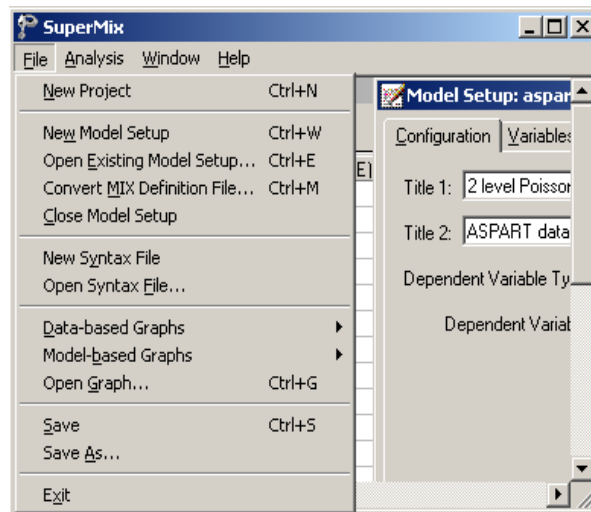
The SuperMix spreadsheet window is used to display a new or existing SuperMix data file. The menus on the spreadsheet window can be used to manipulate the data entries in an existing SuperMix data file. It is also used to access the **Model Setup** window, which is used to specify a mixed-effects model and to edit existing SuperMix model files. These menus can also be used to create new or open existing SuperMix graph files. In Section 2.5 some basic spreadsheet operations are illustrated. In the sections to follow, we review the four menus of the SuperMix spreadsheet window.

### 2.2.1 The File menu

The options on the **File** menu of the spreadsheet window are used to open a new SuperMix project, open an existing **ss3** file, create a new SuperMix model (**.mum**) file, edit an existing model file, or convert an existing MIX definition file to a SuperMix model file. It is also used to create or edit a SuperMix graph file. An example of the **File** menu is shown below.



When an **ss3** file as well as a SuperMix model file are opened, the **File** menu changes as shown in the following window.



### The New Project option

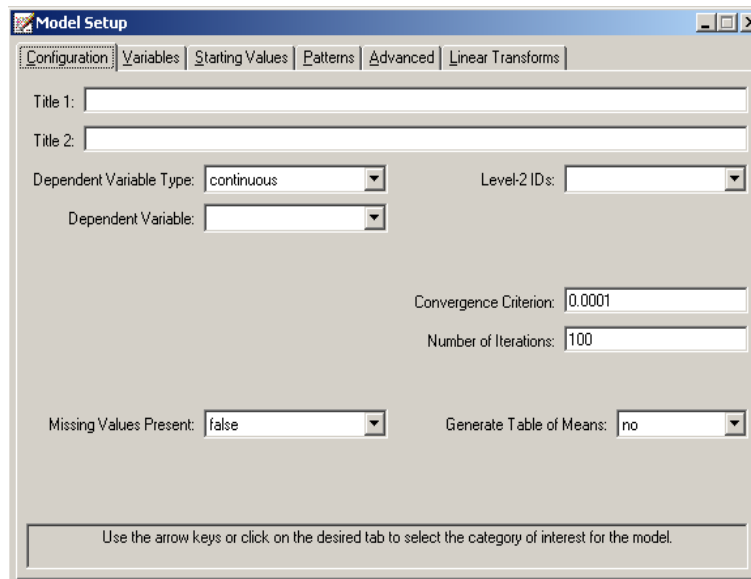
The **New Project** option is used to open an independent SuperMix main window.

## The Exit option

The **Exit** option is used to close the current open SuperMix main window.

## The New Model Setup option

The **New Model Setup** option of the spreadsheet window provides access to the **Configuration**, **Variables**, **Starting Values**, **Patterns**, **Advanced** and **Linear Transforms** screens of the **Model Setup** window shown below. Each screen is opened by clicking on the corresponding tab.



The screenshot shows the 'Model Setup' window with the 'Configuration' tab selected. The window has a title bar with standard Windows window controls. Below the title bar is a tabbed interface with tabs for 'Configuration', 'Variables', 'Starting Values', 'Patterns', 'Advanced', and 'Linear Transforms'. The 'Configuration' tab is active and contains the following fields:

- Title 1: [Text input field]
- Title 2: [Text input field]
- Dependent Variable Type: [dropdown menu, value: continuous]
- Level-2 IDs: [dropdown menu]
- Dependent Variable: [dropdown menu]
- Convergence Criterion: [text input field, value: 0.0001]
- Number of Iterations: [text input field, value: 100]
- Missing Values Present: [dropdown menu, value: false]
- Generate Table of Means: [dropdown menu, value: no]

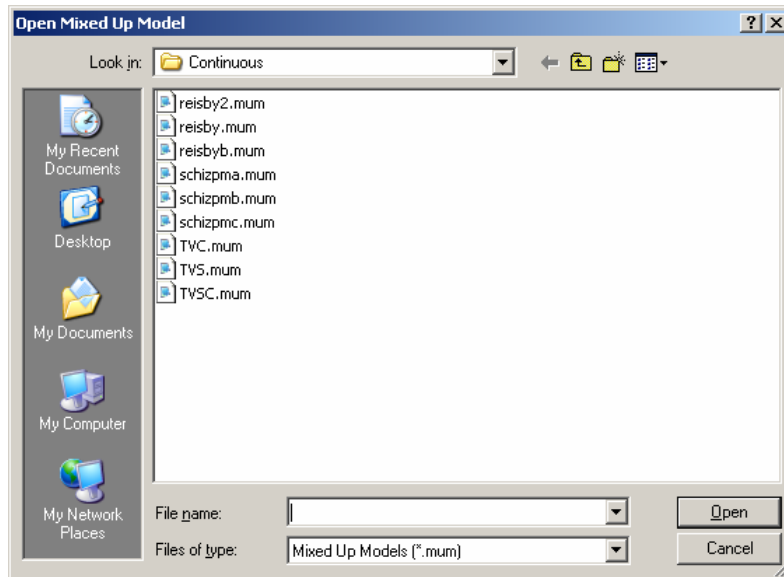
At the bottom of the window, there is a note: "Use the arrow keys or click on the desired tab to select the category of interest for the model."

These screens are used to specify a mixed-effects model to be fitted to the data in the open spreadsheet window. The appearance of the screens depends on the type of outcome (dependent) variable (continuous, count, ordered, or nominal) that is selected on the **Configuration** screen shown above. A detailed description of each of these screens is given in Section 2.4. Once a model is defined, it can be saved as a **.mum** file.

## The Open Existing Model Setup option

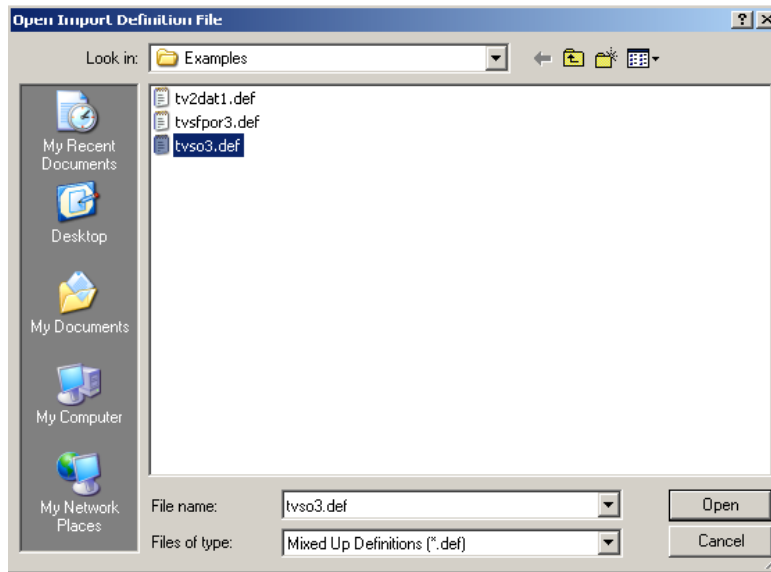
The **Open Existing Model Setup** option is used to open the **Model Setup** window of an existing SuperMix model file. This is accomplished by clicking on the **Open Existing Model Setup** option, which loads the following **Open Mixed Up Model** dialog box.

Browse for the desired SuperMix model file, select it, and click on the **Open** button to load the **Model Setup** window for the selected SuperMix model file.



## The Convert MIX Definition File option

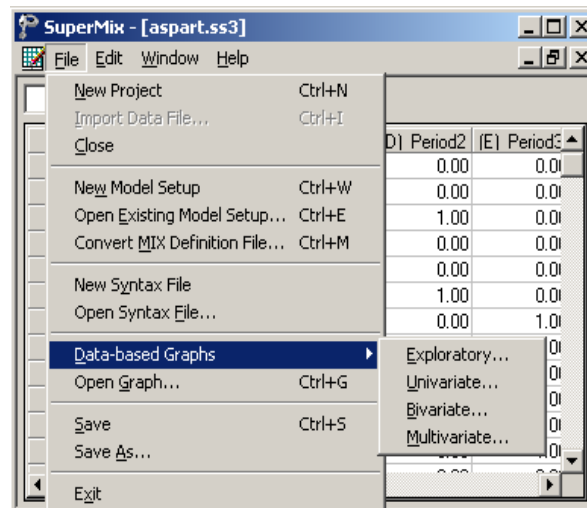
The **Convert MIX Definition File** option is used to convert a MIX definition file, which has the default extension **.def**, to a SuperMix model file. Selecting this option loads the following **Open Import Definition File** dialog box.



Next, browse for the desired MIX definition file, select it, and click on the **Open** button to load the **Model Setup** window for the SuperMix model file created from the selected MIX definition file.

### **The Data-based Graphs pop-up menu**

The **Data-based Graphs** pop-up menu is used to create a new SuperMix graph from the data displayed in the open **ss3** file in a SuperMix graph window. The menus and dialogs of the SuperMix graph window for new and existing SuperMix graphs are reviewed in Chapter XXX.

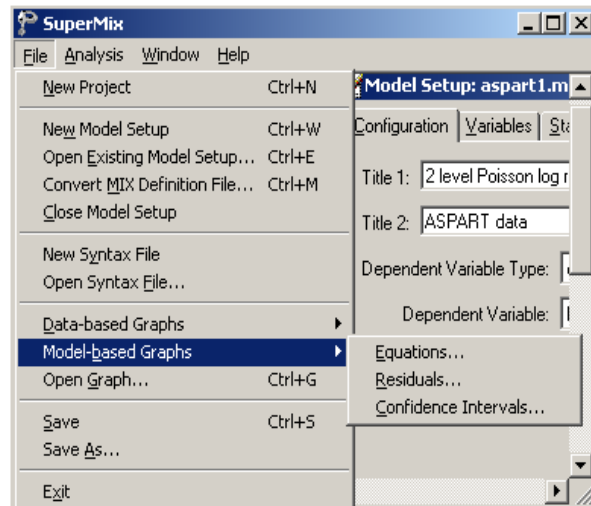


The options listed below are discussed in detail in Chapter XXX, which contains examples of all the plots that SuperMix can produce.

- The **Exploratory** option is used to produce single or overlay color-coded  $Y$  against  $X$  plots. Groups of plots are obtained by using a filter variable. A typical example is given in Section 3.2.
- The **Univariate** option on the **Data-based Graphs** pop-up menu is used to create a bar chart, a pie chart or a histogram for the data displayed in the spreadsheet window.
- The **Bivariate** option on the **Data-based Graphs** pop-up menu is used to create a scatter plot, a line plot, a combination line and scatter plot, a box-and-whisker plot, or a 3-dimensional bar chart for the data in the open SuperMix data file.
- The **Multivariate** option on the **Data-based Graphs** pop-up menu is used to make a matrix scatter plot based on the data in the open **ss3** file. This provides an organized way of simultaneously looking at a set of bivariate plots.

## The Model-based Graphs pop-up menu

The options on the **Model-based Graphs** pop-up menu are activated when a model setup file is opened. These options are used to create a new SuperMix graph from the data displayed in the open spreadsheet window. The menus and dialogs of the SuperMix graph window for new and existing SuperMix graphs are reviewed in Chapter XXX.

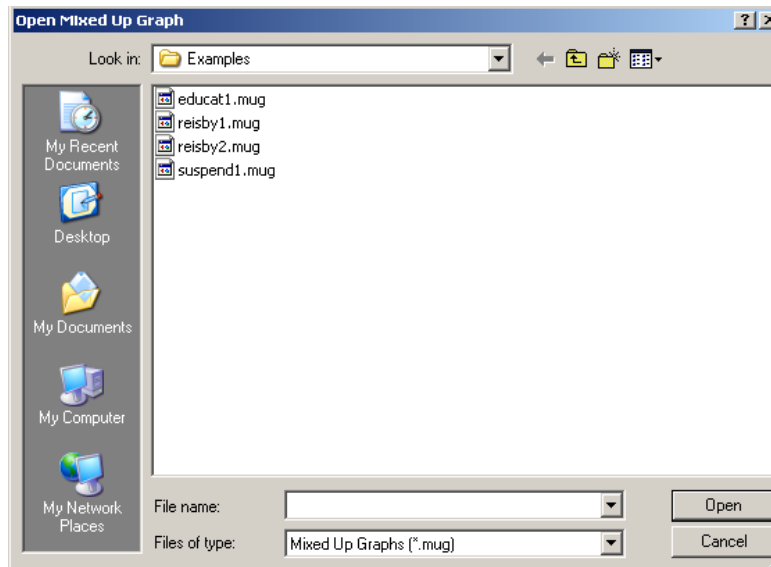


Available options are:

- The **Equations** option on the **Model-based Graphs** pop-up menu loads the **Plot Equations for** dialog box which can be used to plot model equations of an outcome variable for given values of the predictors in the model.
- The **Residuals** option on the **Model-based Graphs** pop-up menu provides access to the **Plot of Residuals** dialog box, which is used to create a residual plot for the residuals based on the current SuperMix analysis.
- The **Confidence Intervals** option is used to open the **95% C.I. for Level-1 Variables** dialog box, which is used to create confidence interval plots.

## The Open Graph option

The **Open Graph** option is used to open an existing SuperMix graph file with a default extension **.mug**. You first click on the **Open Graph** option to load the following **Open Mixed Up Graph** dialog box.



The next steps are to browse for the desired SuperMix graph file, select it, and click on the **Open** button to open the graph window for the selected SuperMix graph file.

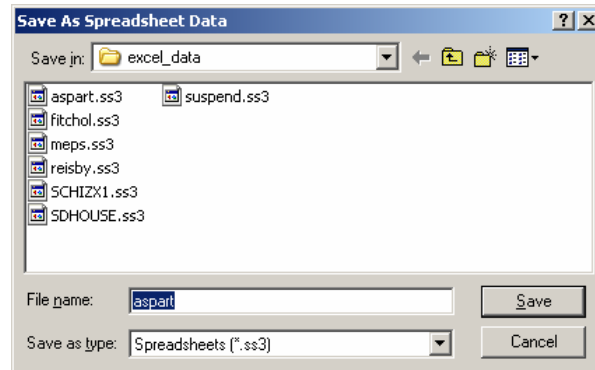
## The Save option

The **Save** option on the **File** menu is used to save any changes made to the data or the model setup file (mum). Please note that any change to the data will not be saved to file unless you use this option or the **Save As** option.

## The Save As option

The **Save As** option on the **File** menu is used to save the opened **ss3** file or **mum** file as another SuperMix data file or mum file. To save the spreadsheet data as another

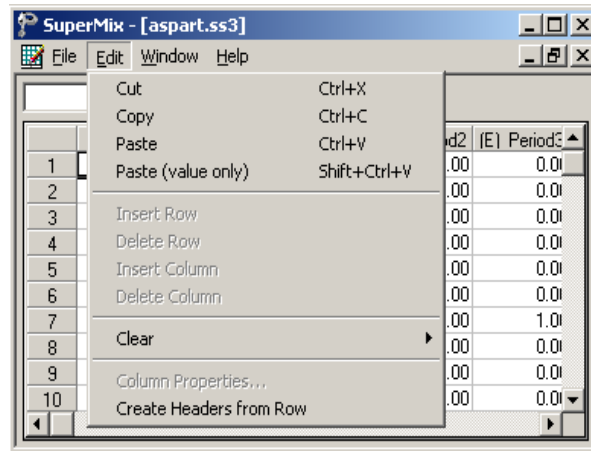
file, select the **Save As** option to load the following **Save As Spreadsheet Data** dialog box.



Enter the file name in the **File name** string field and click on the **Save** button to save the SuperMix data file.

## 2.2.2 The Edit menu

The options on the **Edit** menu of the SuperMix spreadsheet window are used to edit the data entries of the open SuperMix data file. To use these options, select the data to be edited (cell(s), row(s) or columns(s)). Then click on the **Edit** menu to produce the following window.



The next step is to select one of the options available, which have the following effects on the selected data.

- The **Cut** option cuts the data selection from the spreadsheet window and places it into the Windows clipboard.
- The **Copy** option places the data selection in the Windows clipboard.
- The **Paste** option pastes data from the Windows clipboard into the selected area of the spreadsheet window.
- The **Paste (value only)** option pastes only the actual values (ignoring the formats) of the data from the Windows clipboard into the selected area of the spreadsheet window.
- The **Clear** option replaces the selected data with empty cell(s). Choosing this option activates the following drop-down menu.



- The **Clear All** option deletes the values and the formulas of the selected data.

- The **Clear Data** option deletes the values of the data selection, but leaves the corresponding formulas intact.
- The **Clear Formula** option deletes the formulas of the selected data, but not the corresponding values.
- The **Create Header from Row** creates spreadsheet headers that correspond to the labels in the selected row.

### 2.2.3 The Window menu

The **Window** menu is used to toggle between open spreadsheet windows.

### 2.2.4 The Help menu

The **Help** menu of the spreadsheet window is identical to that of the main window and is reviewed in Section 2.1.2.

## 2.3 The graph window

The SuperMix graph window is opened by creating a new SuperMix graph or by opening an existing SuperMix graph file. We accomplish this by using one of the options on the **Data-based Graphs** pop-up menu or the **Open Graph** option or one of the options on the **Model-based Graphs** pop-up menu (if a SuperMix model file is also open) on the **File** menu of the spreadsheet window reviewed in Section 2.2.1. The menus and dialogs of the SuperMix graph window are reviewed and illustrated in Chapter xxx.

## 2.4 The Model Setup window

A SuperMix **mum** file (model setup file) is always associated with an **ss3** file (data spreadsheet file). This ensures that variable selections are maintained correctly in the **mum** file, regardless of changes to the header text and cut/paste/move operations on the columns of the **ss3** file. For this reason, the **Model Setup** window is accessed via the **File** menu of the spreadsheet window. This is done by selecting the **New Model Setup** or **Open Existing Model Setup** options. The **Model Setup** window has six tabs. By clicking on a tab, the corresponding **Configuration**, **Variables**, **Starting Values**, **Patterns**, **Advanced**, or **Linear Transforms** screen is accessed. The

appearance of a screen depends on the type of outcome variable selected. The purpose of a field is displayed at the bottom of the screen when the field is clicked. Tables 2.1 to 2.13 are summaries of these descriptions.

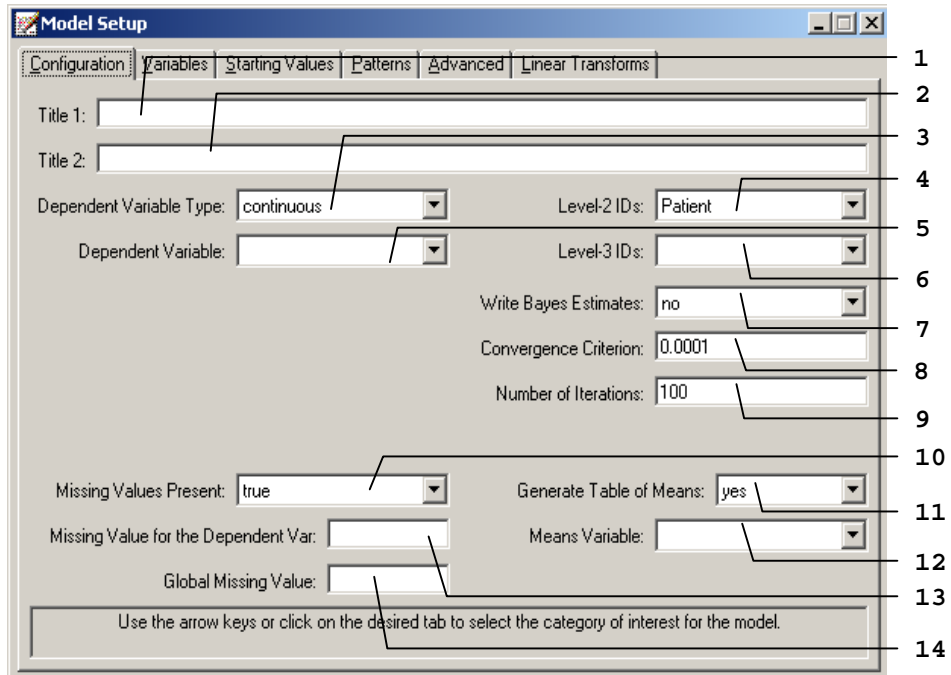
### 2.4.1 The Configuration screen

The **Configuration** screen is used to provide a title for the analysis, to select the type and name of the outcome (dependent) variable, and to indicate identifiers of the level-2 and level-3 units. Additionally, it contains options that control the amount of information to be saved to file and the parameters of the optimization procedure. When the **New Model Setup** or **Open Existing Model Setup** options on the **File** menu are used, the **Configuration** screen is, by default, the first screen displayed.

The same **Configuration** screen is used for continuous and count outcomes, but its contents change when the dependent variable type is ordinal or nominal. The screen is the same for ordinal and nominal outcome types. The two cases are discussed separately below.

#### Configuration screen for continuous and count outcomes

An example of the **Configuration** screen of the **Model Setup** window for a continuous response variable is shown below. The layout is identical when the dependent variable type is changed from **continuous** to **count** (see Section 3.4 for an example based on a count outcome variable).



The 14 possible entries on the **Configuration** screen of the **Model Setup** window for continuous or count response variables are summarized in Table 2.1.

**Table 2.1: Entries on the Configuration screen of the Model Setup window for continuous and count outcomes**

Number	Caption	Purpose	Type	Action	Options
1	Title 1	To specify the first line of the title to be listed in the output file.	Text box	Enter a string of not more than 60 characters.	
2	Title 2	To specify the second line of the title to be listed in the output file.	Text box	Enter a string of not more than 60 characters.	
3	Dependent Variable Type	To specify the variable type for the response variable.	Drop-down list box	Select an option from the drop-down list box.	<b>continuous</b> (default)
					ordered
					nominal
					count
4	Level-2 IDs	To specify the variable that defines the second level of the hierarchy in the data.	Drop-down list box	Select a variable from the drop-down list box.	
5	Dependent Variable	To specify the response variable of the model.	Drop-down list box	Select a variable from the drop-down list box.	
6	Level-3 IDs	To specify the variable that defines the 3rd level of the hierarchy in the data.	Drop-down list box	Select a variable from the drop-down list box.	
7	Write Bayes Estimates	To request a text file for the Bayes estimates.	Drop-down list box	Select an option from the drop-down list box.	<b>no</b> (default)
					means only
					means & (co)variances
8	Convergence Criterion	To specify the convergence criterion for the iterative algorithm.	Text box	Enter a non-zero positive real number if the default of 0.0001 is not desired.	

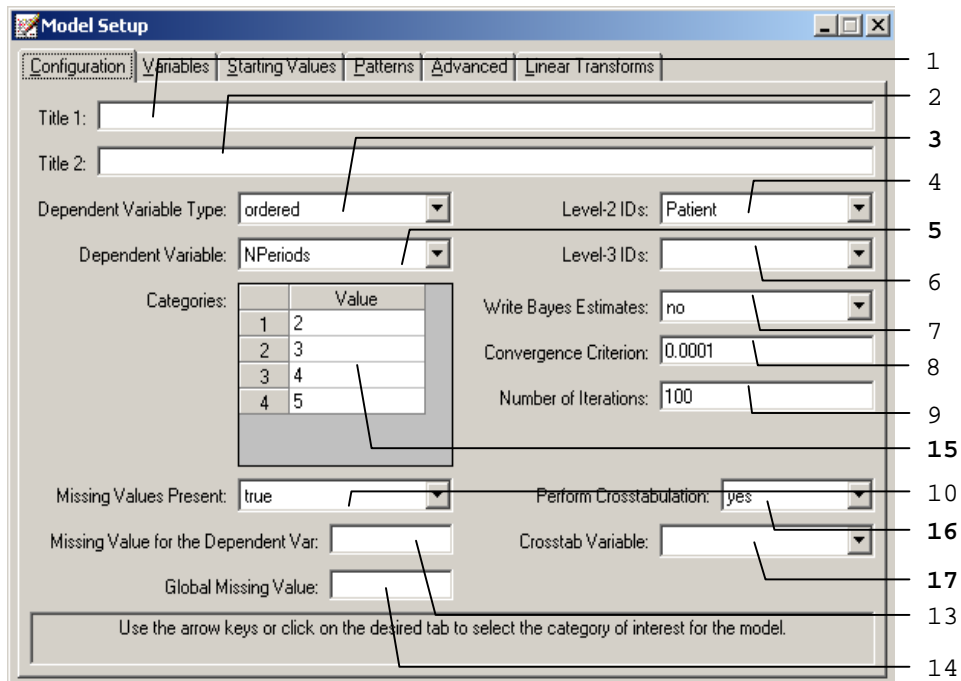
**Table 2.1: Entries on the Configuration screen of the Model Setup window for continuous and count outcomes (continued)**

9	Number of Iterations	To specify the maximum number of iterations for the iterative algorithm.	Text box	Enter a positive integer if the default of 100 is not desired.	
10	Missing Values Present	To specify the missing value status of the data.	Drop-down list box	Select an option from the drop-down list box.	false (default)
					<b>true</b>
11	Generate Table of Means	To request the printing of a table as part of the output.	Drop-down list box	Select an option from the drop-down list box.	no (default)
					<b>yes</b>
12	Means Variable	To specify the variable for which the tables should be created (see 8).	Drop-down list box	Select a variable from the drop-down list box.	
13	Missing Value for the Dependent Var	To specify the missing value code for the response variable.	Text box	Enter a real number.	
14	Global Missing Value	To specify the global missing value code.	Text box	Enter a real number.	

**Configuration screen for ordered, nominal and binary outcomes**

The following screen is an example of the **Configuration** screen of the **Model Setup** window in the case of an ordered response variable. An example of this screen for a nominal outcome variable is given in Section 3.5.

As shown in the image below, the 5 entries shown in bold typeface are either new or different compared with those on the **Configuration** screen of the **Model Setup** window for continuous or count outcome variables. These 5 entries are summarized in Table 2.2. Please refer to Table 2.1 for the information about all the other entries.



**Table 2.2: Entries of the configuration screen for ordered and nominal outcomes**

Number	Caption	Purpose	Type	Action	Options
3	Dependent Variable Type	To specify the variable type for the response variable.	Drop-down list box	Select an option from the drop-down list box.	continuous (default) <b>ordered</b> nominal count
5	Dependent Variable	To specify the response variable of the model.	Drop-down list box	Select a variable from the drop-down list box.	
15	Categories	To show the value of each category of the ordered dependent variable selected in 5.	Grid box		

**Table 2.2: Entries of the configuration screen for ordered and nominal outcomes (continued)**

16	Perform Crosstabulation	To specify a cross tabulation of selected variable by the outcome variable.	Drop-down list box	Select an option from the drop-down list box.	no (default)
					<b>yes</b>
17	Crosstab Variable	To specify the variable to be crosstabulated with the outcome variable (see 8).	Drop-down list box	Select a variable from the drop-down list box.	

## 2.4.2 The Variables screen

Besides the variables screen for the ordered outcome, which doesn't include the option to select an intercept as an explanatory variable, this screen has the same appearance for all outcome types and is used to select explanatory variables and random effects. The unknown model parameters are the coefficients of the explanatory variables and the variances and covariances of the random effects. The appearance of the **Variables** screen depends on the number of levels of the model. For a two-level model, the **3** columns in the **Available** grid and the **L-3** grid will be hidden. By default, an intercept term is included in the fixed part (explanatory variables) and in the random part (random effects) of the model.

The following screen is an example of the **Variables** screen of the **Model Setup** window that is used for variable selection for continuous, count, or nominal response variables. The 9 possible entries of the **Variables** screen of the **Model Setup** window for continuous, count, or nominal response variables are summarized in Table 2.3.

Model Setup

Configuration Variables Starting Values Patterns Advanced Linear Transforms

Available	E	2	3
Patient	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
HDRS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Week	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
ENDOG	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
WxENDOG	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Explanatory Variables

Week  
ENDOG  
WxENDOG

L-2 Random Effects

Week

Include Intercept

L-3 Random Effects

Week

Include Intercept

Include Intercept

Select the columns of the spreadsheet to be used as explanatory variables and random effects.

1a  
2a  
3a  
2b  
1b  
5  
3b  
6  
4

**Table 2.3: Entries of the Variables screen**

Number	Caption	Purpose	Type	Action	Options	
1	a	E	To specify the explanatory variable(s) of the model.	Column of check box(es)	Check the E column(s) of the variable(s).	
	b	Explanatory Variables	Displays the variable(s) selected in 1a.	Grid box		
2	a	2	To specify the level-2 random effects of the model.	Column of check box(es)	Check the 2 column(s) of the variable(s).	
	b	L-2 Random Effects	Displays the variable(s) selected in 2a.	Grid box		
3	a	3	To specify the level-3 random effects of the model.	Column of check box(es)	Check the 3 column(s) of the variable(s).	
	b	L-3 Random Effects	Displays the variable(s) selected in 3a.	Grid box		
4	Include Intercept	To specify an intercept term for the fixed part of the model.	Check box	Uncheck the check box if an intercept is not desired.	<b>Check (default)</b> Uncheck	
5	Include Intercept	To specify a random intercept at level-2 of the model.	Check box	Uncheck the check box if a level-2 random intercept is not desired.	<b>Check (default)</b> Uncheck	
6	Include Intercept	To specify a random intercept at level-3 of the model.	Check box	Uncheck the check box if a level-3 random intercept is not desired.	<b>Check (default)</b> Uncheck	

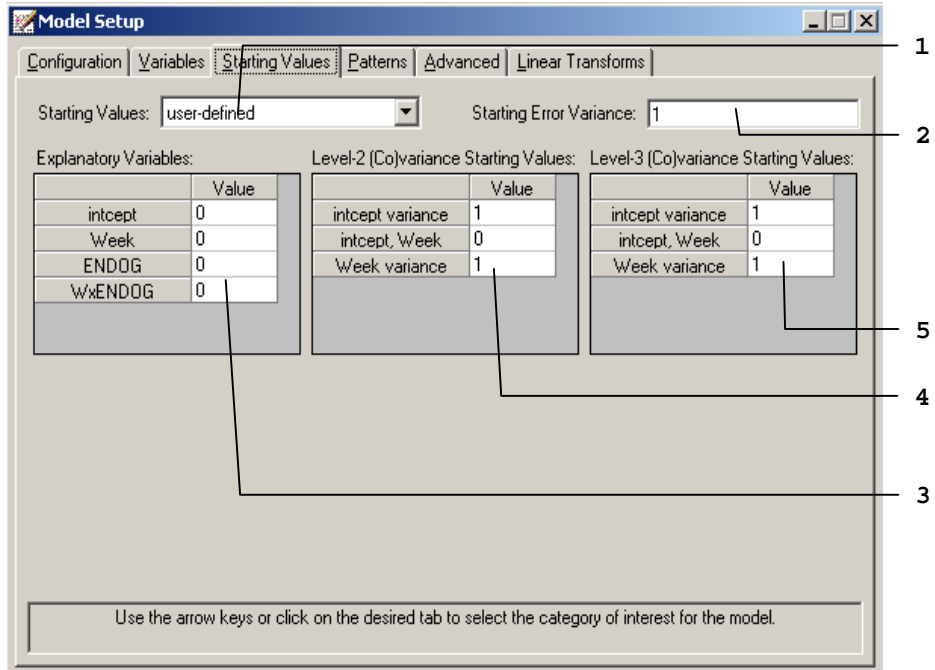
### 2.4.3 The Starting Values screen

The unknown parameters in a mixed-effects model cannot, in general, be obtained as a closed-form expression. To estimate these parameters, use is made of an iterative procedure based on the method of maximum likelihood. For count, ordinal, and nominal outcomes, the likelihood function is approximated by numerical integration. For more than one random effect, this procedure is computationally intensive. All iterative procedures start with initial estimates of the values of the unknown parameters and, at each iteration, the algorithm attempts to improve this estimate until convergence is obtained. The closer these initial estimates (the starting values) are to the maximum likelihood solution, the fewer iterations are needed to obtain convergence and reach the final solution.

SuperMix automatically generates starting values for the model parameters and typically these values are sufficient to ensure convergence. There may, however, be cases where a model with many parameters takes a long time to run, and if small modifications are made to such a model, one can use the parameter estimates from the previous analysis as starting values for the next analysis. Alternatively, one may want to fix some of the parameter values at specific values, for example, the slope coefficient of variable  $X$  at 0.1. This can be accomplished by selecting the user-defined option and entering this value for  $X$ . Note that the value of 0.1 will remain fixed during the optimization procedure if it is specified as fixed for  $X$  on the **Patterns** screen discussed in Section 2.4.4.

#### **Starting Values screen for continuous or count outcomes**

An example of the **Starting Values** screen of the **Model Setup** window for a continuous or count response variable is shown below.



An example of the **Starting Values** screen of the **Model Setup** window for continuous or count outcomes is shown above. The 5 possible entries of the **Starting Values** screen of the **Model Setup** window for count or nominal response variables are summarized in Table 2.4.

**Table 2.4: Entries of the Starting Values screen for continuous and count outcomes**

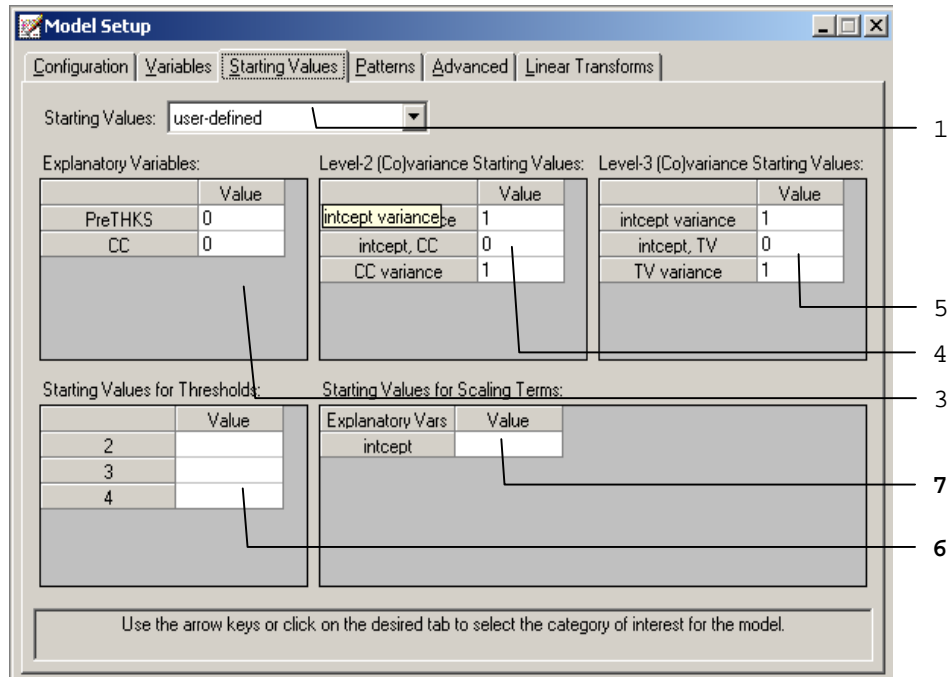
Number	Caption	Purpose	Type	Action	Options
1	Starting Values	To specify the type of starting values to be used.	Drop-down list box	Select an option from the drop-down list box.	automatic (default) <b>user-defined</b>
2	Starting Error Variance	To specify the starting error variances.	Text box	Enter a integer if the default of 1 is not desired.	
3	Explanatory Variables	To specify the starting value(s) for the coefficients of explanatory variable(s) of the fixed part of the model.	Grid box	Enter a real number in the corresponding Value box(es) of the variable(s) of interest.	
4	Level 2 (Co)variances Starting Values	To specify the starting value(s) for the variance(s) and/or covariance(s) of the level-2 random effects.	Grid box	Enter a real number (positive for variances) in the corresponding Value box(es) of the variable(s) of interest.	
5	Level 3 (Co)variances Starting Values	To specify the starting value(s) for the variance(s) or covariance(s) of the level-3 random effects.	Grid box	Enter a real number (positive for variances) in the corresponding Value box(es) of the variable(s) of interest.	

**Starting Values screen for ordered outcomes**

For ordinal outcomes, additional grid boxes appear to allow for user-specified starting values of thresholds and threshold-explanatory variable(s) interaction(s). The following screen is an example of the **Starting Values** screen of the **Model Setup** window.

As shown in the image below, the single entry shown in bold typeface is different from those of the **Starting Values** screen of the **Model Setup** window for continuous

or count outcome variables. This entry is described in Table 2.5. Please refer to Table 2.4 for the information about all the other entries.

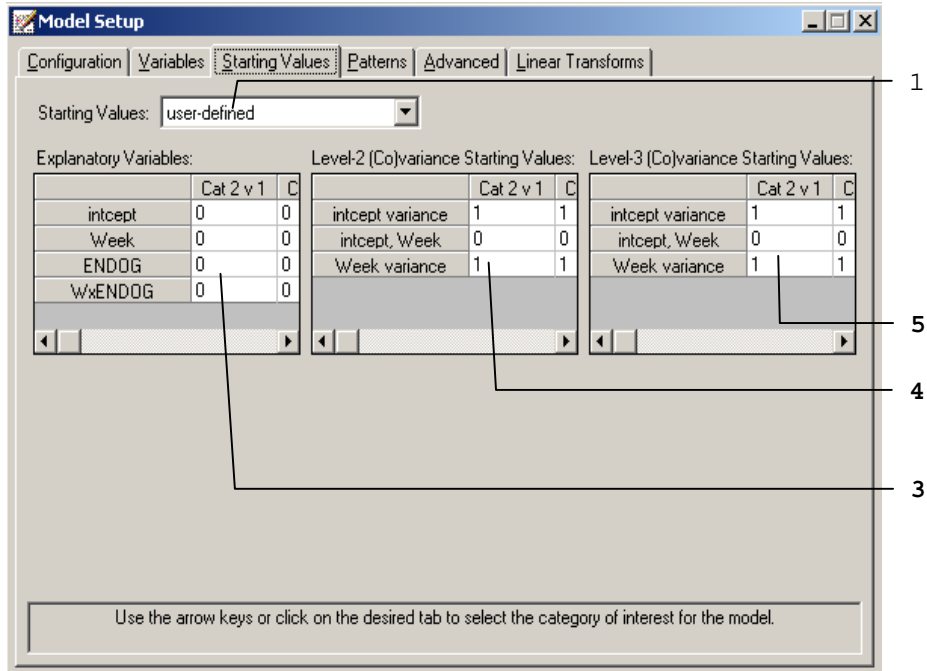


**Table 2.5: Entry of the Starting Values screen for ordered outcomes**

Number	Caption	Purpose	Type	Action
6	Starting Values for Thresholds	Enter the starting values for the thresholds.	Grid box	Enter real numbers. The values must be monotonically increasing.
7	Starting Values for threshold interactions	Enter the starting values for the threshold interaction terms.	Grid box	Enter a real number in each of the corresponding Value box(es) of the variable(s) of interest.

## Starting Values screen for nominal or binary outcomes

When the nominal outcome is selected, the grid boxes appear differently with a slide bar as shown below.



The 3 different entries shown in bold typeface are either new or different compared with those on the **Starting Values** screen of the **Model Setup** window for continuous or count outcome variables. These 4 entries are summarized in Table 2.6. Please refer to Table 2.4 for the information about all the other entries.

**Table 2.6: Entries of the Starting Values screen for nominal outcomes**

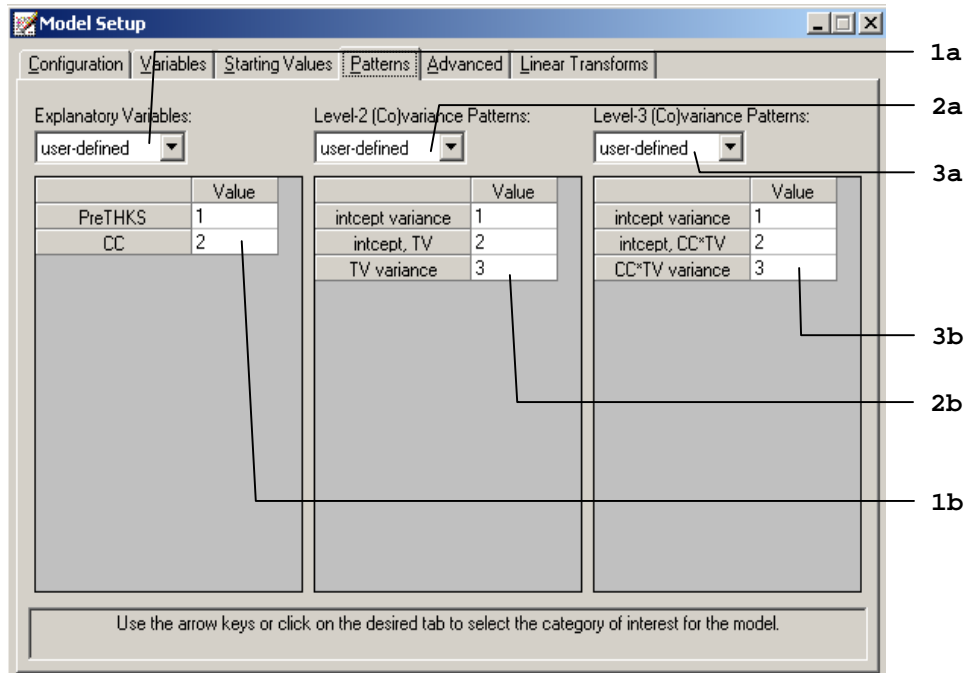
Number	Caption	Purpose	Type	Action
3	Explanatory Variables	To specify the starting value(s) for the coefficients of explanatory variable(s) of the fixed part of the model.	Grid box with slide bar	Enter a real number in the corresponding Value box(es) of the variable(s) of interest.
4	Level 2 (Co)variances Starting Values	To specify the starting value(s) for the variance(s) and/or covariance(s) of the level-2 random effects.	Grid box with slide bar	Enter a real number (positive for variances) in the corresponding Value box(es) of the variable(s) of interest.
5	Level 3 (Co)variances Starting Values	To specify the starting value(s) for the variance(s) or covariance(s) of the level-3 random effects.	Grid box with slide bar	Enter a real number (positive for variances) in the corresponding Value box(es) of the variable(s) of interest.

#### 2.4.4 The Patterns screen

This screen is used to specify patterns or structures for the coefficients of the explanatory variables and variances and covariances of the random effects. A typical **Patterns** screen is shown below. Note that the default numbers for these patterns (1, 2, 3, ...) are dependent on the number of parameters listed in a grid. The default numbers indicate that all parameters are set free. On the other hand, if a number is replaced by a '0', the corresponding parameter is fixed to the default or user-specified value on the **Starting Values** screen.

### Patterns screen for continuous, ordered, nominal and count outcomes

The 6 different entries of the **Patterns** screen of the **Model Setup** window for continuous, ordered, nominal, or count response variables are summarized in Table 2.7. For an ordinal outcome variable, provision is also made for entering user-defined values for threshold parameters.



**Table 2.7: Entries of the Patterns screen for continuous, count and nominal outcomes**

Number	Caption	Purpose	Type	Action	Options	
1	a	Explanatory Variables	To specify the pattern type for the coefficients in the fixed part of the model.	Drop-down list box	Select an option from the drop-down list box.	free (default)
	b		To specify the pattern for the covariance matrix of the fixed part of the model.	Text box	Enter integer values $\geq 0$	<b>user-defined</b>
2	a	Level-2 (Co)variance Patterns	To specify the pattern type for the covariance matrix of the level-2 random effects.	Drop-down list box	Select an option from the drop-down list box.	correlated (default)
	b		To specify the pattern for the covariance matrix of the level-2 random effects.	Text box	Enter integer values $\geq 0$	independent unidimensional <b>user-defined</b>
3	a	Level-3 (Co)variance Patterns	To specify the pattern type for the covariance matrix of the level-3 random effects.	Drop-down list box	Select an option from the drop-down list box.	correlated (default)
	b		To specify the pattern for the covariance matrix of the level-3 random effects.	Text box	Enter integer values $\geq 0$	independent unidimensional <b>user-defined</b>

**Examples of Patterns:**

- The pattern below is used to constrain the coefficients of Treatment 1 and Treatment 2 to be equal. Likewise, the coefficients of Treatment 3 and Treatment 4 are constrained to be equal.

Explanatory Variables	Pattern
Treatment 1	1
Treatment 2	1
Treatment 3	3
Treatment 4	3

Note that a number cannot be larger than the row number on the grid. For example, the following pattern is not recognized by SuperMix:

Explanatory Variables	Pattern
Treatment 1	2
Treatment 2	2
Treatment 3	4
Treatment 4	4

- The table below shows three possible patterns for the level-2 variances and covariances of the random effects Time1, Time2, Time3, and Time4.

Level-3 co(variance)	Pattern 1	Pattern 2	Pattern 3
Variance, Time1	1	1	1
Time1, Time2	2	2	2
Variance, Time2	1	3	3
Time1, Time3	2	0	0
Time2, Time3	2	2	0
Variance, Time3	1	6	6
Time1, Time4	2	0	0
Time2, Time4	2	0	0
Time3, Time4	2	2	9
Variance, Time4	1	10	10

Pattern 1 restricts all the variances to be equal and, likewise, all the covariances to be equal. Pattern 2 specifies that all variances should be estimated freely, all covariances one time unit apart are set equal, and all covariances more than one time unit apart are fixed at the values specified on the **Starting Values** screen, the default for covariances being zero. Pattern 3 specifies that Time1 and Time2 are

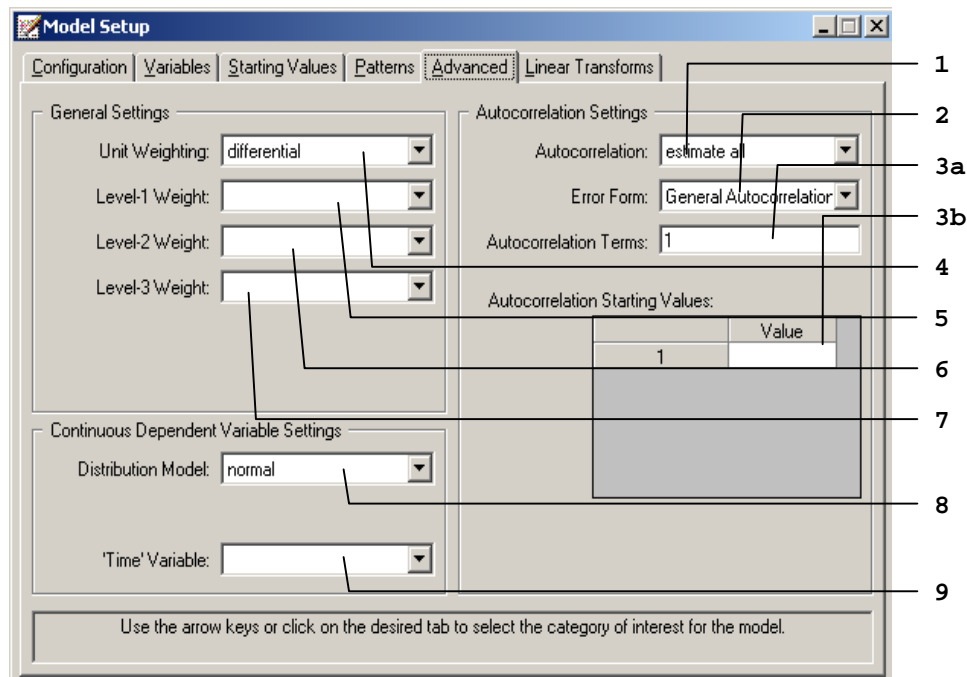
correlated, but uncorrelated with Time3 and Time4, which are correlated with each other.

## 2.4.5 The Advanced screen

The appearance of the **Advanced** screen depends on the type of outcome variable selected on the **Configuration** screen, and is used to change default settings used in SuperMix. Specific examples of the use of this screen are given in Section 3.4 to 3.7. Screens for the various outcome types are given next.

### Advanced screen for continuous outcomes – normal distribution

In repeated measurement studies, the assumption of uncorrelated identically distributed level-1 error terms is often unrealistic. The options on the **Advanced** screen shown below allow for correlated level-1 error terms that follow a time series process.



The 9 different entries of the **Advanced** screen of the **Model Setup** window for continuous response variables are summarized in Table 2.8.

**Table 2.8(a): Entries of the Advanced screen for continuous outcomes with normal distribution**

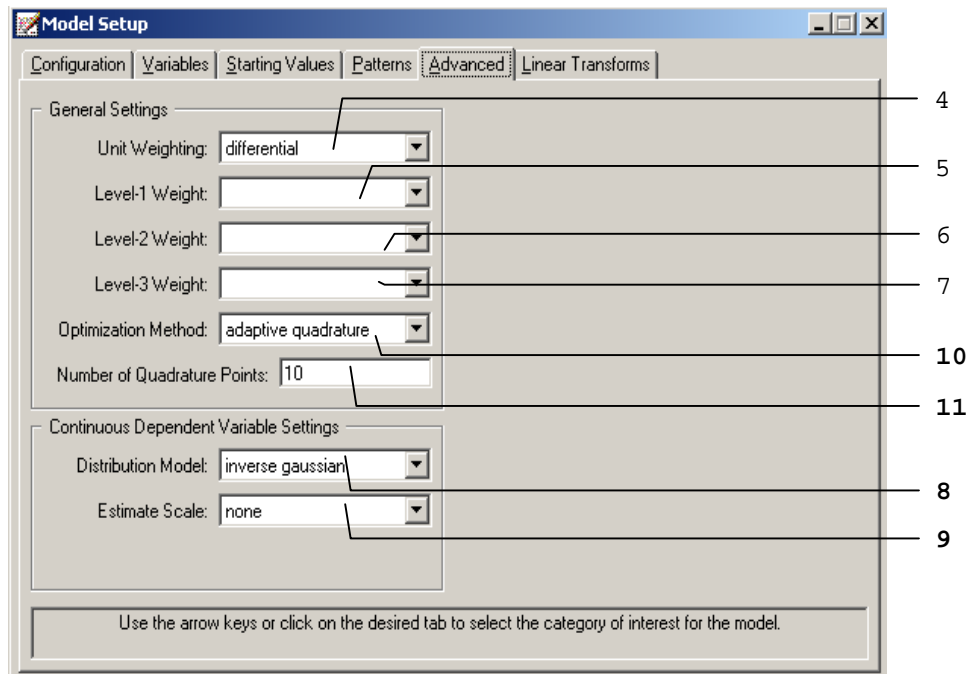
Number	Caption	Purpose	Type	Action	Options
1	Autocorrelation	To specify the type of autocorrelation terms.	Drop-down list box	Select an option from the drop-down list box.	no AC terms (default)
					fixed AC terms
					<b>estimate all</b>
2	Error Form	To specify a time series model for the auto-correlated errors.	Drop-down list box	Select an option from the drop-down list box.	Stationary AR1 (default)
					Non-stationary AR1
					Stationary MA1
					Stationary ARMA(1,1)
					<b>General Auto-correlation</b>
3	a	Autocorrelation Terms	To specify the number of autocorrelation terms.	Text box	Enter an integer if the default 1 is not desired.
	b	Autocorrelation Starting Values	To specify the starting value(s) for the autocorrelation(s).	Grid box	Enter a real number in the region of [-0.99, 0.99].
4	Unit Weighting	To select equal or differential weighting for the unites for continuous dependent variable.	Drop-down list box	Select an option from the drop-down list box.	equal (default)
					<b>differential</b>
5	Level-1 Weight	To specify the weight variable that defines the first level of the hierarchy in the data.	Drop-down list box	Select a variable from the drop-down list box.	

**Table 2.8(a): Entries of the Advanced screen for continuous outcomes with normal distribution (continued)**

6	Level-2 Weight	To specify the weight variable that defines the second level of the hierarchy in the data.	Drop-down list box	Select a variable from the drop-down list box.	
7	Level-3 Weight	To specify the weight variable that defines level-3 of the hierarchy in the data.	Drop-down list box	Select a variable from the drop-down list box.	
8	Distribution Model	To select an appropriate distribution model.	Drop-down list box	Select a distribution from the drop-down list.	normal (default)
					gamma
					inverse Gaussian
9	'Time' Variable	To specify the time variable.	Drop-down list box	Select a variable from the drop-down list box.	

**Advanced screen for continuous outcomes – gamma/inverse Gaussian distribution**

When the gamma or inverse Gaussian distribution is selected, the **Advanced** screen is a little different from when the normal distribution is selected as shown below. The 4 different entries of the **Advanced** screen of the **Model Setup** window for continuous response variables are summarized in Table 2.8.



**Table 2.8(b): Entries of the Advanced screen for continuous outcomes with gamma/inverse Gaussian distribution**

Number	Caption	Purpose	Type	Action	Options
8	Distribution Model	To select an appropriate distribution model.	Drop-down list box	Select a distribution from the drop-down list.	normal (default)
					gamma
					<b>inverse Gaussian</b>
9	Estimate Scale	To specify the method for estimating the scale.	Drop-down list box	Select an estimated scale from the drop-down list box.	<b>none</b> (default)
					deviance
					Pearson
10	Optimization Method	To select the optimization method.	Drop-down list box	Select an optimization method from the drop-down list box.	maximum posterior
					<b>Adaptive quadrature</b>
					non-adaptive quadrature (default)

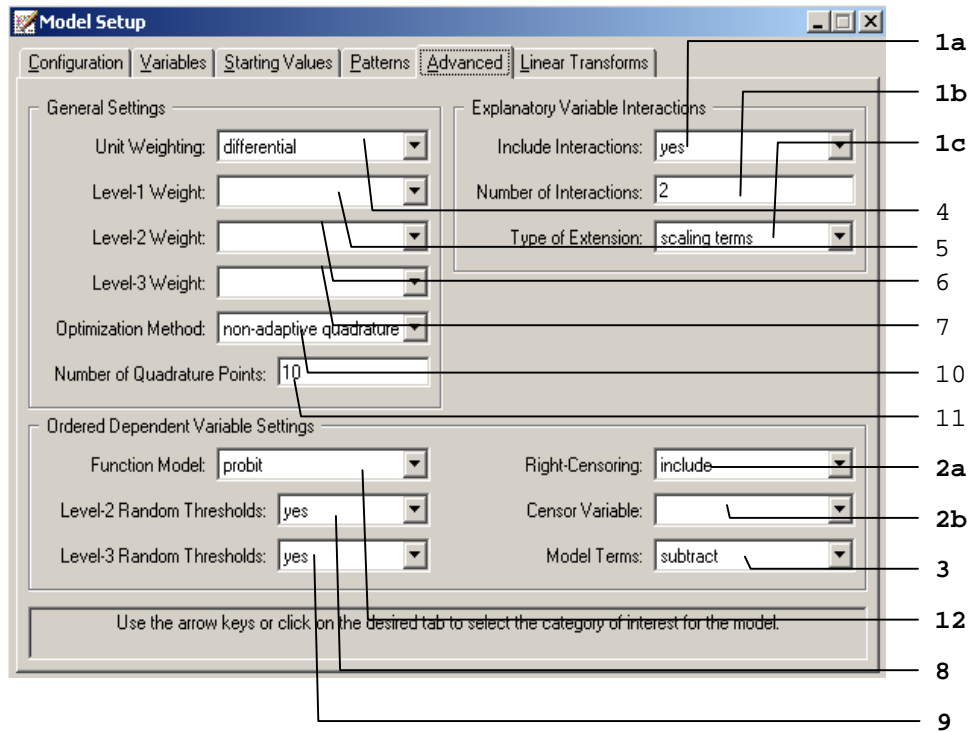
**Table 2.8(b): Entries of the Advanced screen for continuous outcomes with gamma/inverse Gaussian distribution (continued)**

11	Number of Quadrature Points	To enter the quadrature points (per random-effect dimension) to use in the numerical integration.	Text box	Enter an integer if the default 10 is not desired. It is usually set to 10 for 1 effect and 5 to 10 for 2 or 3 effects.	
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**Advanced screen for ordered outcomes**

An important feature of mixed-effects models with ordered outcomes is the inclusion of threshold parameters in the model. As illustrated in Section 3.6, the number of threshold parameters equals  $C - 2$ , where  $C$  is the number of distinct categories of the outcome variable. If right-censoring (see Section 3.7) is included in the model specification, the number of thresholds becomes  $C - 1$  and a **Censor Variable** is selected. The mixed-effects model for ordinal outcomes additionally allows for the inclusion of **Explanatory Variable**-threshold interaction terms. If entry number 10 in the screen below is set equal to 2, for example, then interaction terms of the first two explanatory variables with each of the thresholds are included in the model. One can also select a weight variable, link function (**Function model**) and the number of quadrature points to be used for the approximation of the likelihood function by numerical integration.

Table 2.9 gives a summary of the 12 possible entries of the **Advanced** screen of the **Model Setup** window for an ordered response variable.



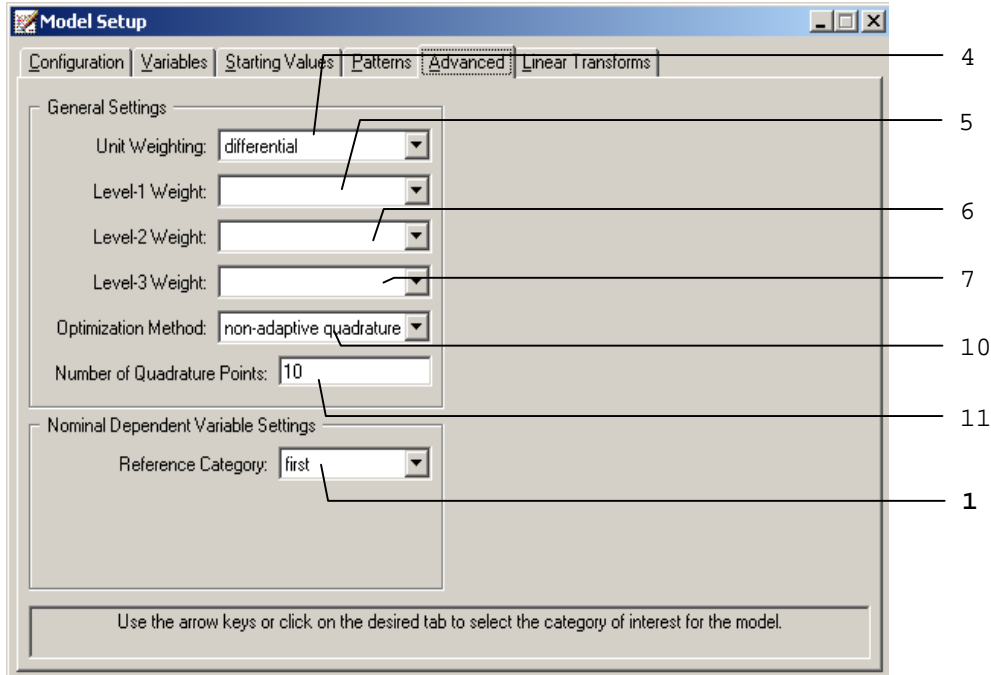
As shown in the above image, the 6 entries shown in bold typeface are either new or different compared with those on the **Advanced** screen of the **Model Setup** window for continuous outcome variables. These 6 entries are summarized in Table 2.9 Please refer to Table 2.8(a) and (b) for the information about all the other entries.

**Table 2.9: Entries of the Advanced screen for ordered outcomes**

Number	Caption	Purpose	Type	Action	Options	
1	a	Include Interactions	To indicate if explanatory variable interactions should be include in the model.	Drop-down list box	Select an option from the drop-down list box.	no (default) yes
	b	Number of Interactions	To specify the number of interactions.	Text box	Enter an integer if the default maximum allowable value is not desired.	
	c	Type of Extension	To select whether to treat the explanatory variables as having scaling effects or threshold interactions.	Drop-down list box	Select an option from the drop-down list box.	scaling terms threshold interactions (default)
2	a	Right-Censoring	To specify is right-censoring is included.	Drop-down list box	Select an option from the drop-down list box.	none (default) include
	b	Censor Variable	To specify the censor variable.	Drop-down list box	Select a variable from the drop-down list box.	
3	Model Terms	To select subtracting or adding the model terms to the threshold.	Drop-down list box	Select an option from the drop-down list box.	subtract means ( $\gamma - \mathbf{X}'\beta$ ) (default) add, means ( $\gamma + \mathbf{X}'\beta$ )	
8	Level-2 Random Thresholds	To specify if there are thresholds for the level-2 random effects.	Drop-down list box	Select an option from the drop-down list box.	no (default) yes	
9	Level-3 Random Thresholds	To specify if there are thresholds for the level-3 random effects.	Drop-down list box	Select an option from the drop-down list box.	no (default) yes	
12	Function Model	To specify the link function.	Drop-down list box	Select an option from the drop-down list box.	probit (default), logistic, complementary log-log, log-log	

### Advanced screen for nominal outcomes

The general settings of this screen is similar to the one used for the continuous and ordinal variables, but nominal dependent variable settings is different as shown in the bold entry number 1 below.



**Table 2.10: Entries of the Advanced screen for nominal outcomes**

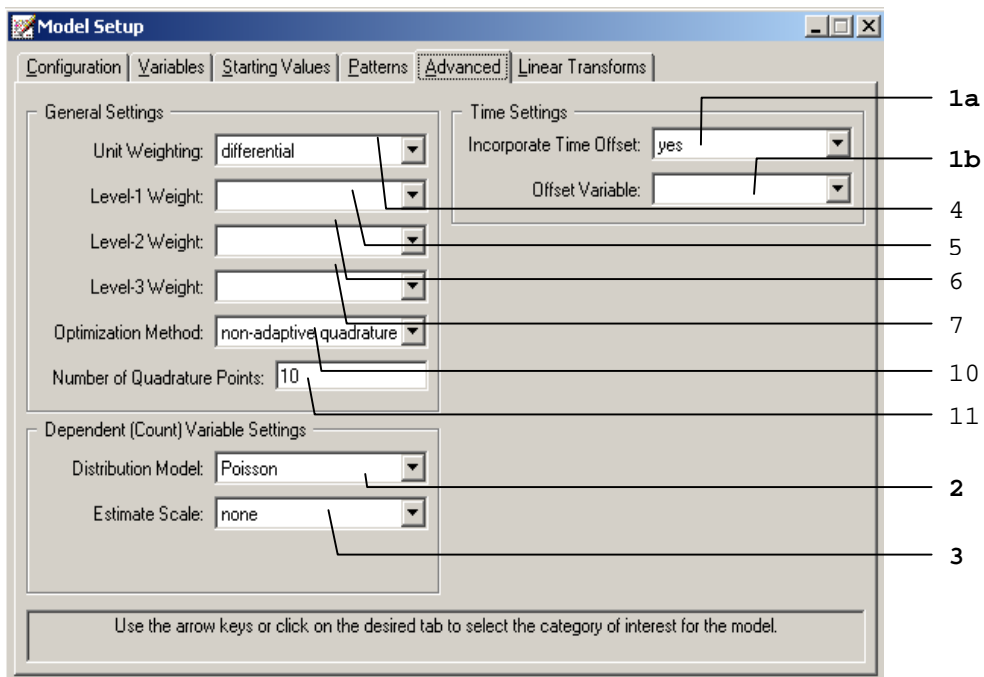
Number	Caption	Purpose	Type	Action	Options
1	Reference Category	To select whether the first or last category of the outcome should be used as the reference category.	Drop-down list box	Select a reference category from the drop-down list.	<b>first</b> (default) last

Note that all the information for the other 6 entries are given in Table 2.8(a) and (b).

### Advanced screen for count outcomes with Poisson distribution

The screen below has the same functionality as the screen used for nominal outcomes, except that provision is made here for the specification of an **Offset Variable**. In practice, it can occur that the coefficient of some covariate is assumed to be unity. This covariate is commonly known as an offset variable. Offsets are typically used when the response variable is a rate rather than a number or count.

The 2 entries pertaining to the offset variable on the **Advanced** screen of the **Model Setup** window for a count outcome are summarized in Table 2.11. Note that entries in the **Advanced** screen for the count outcome variable are similar to those for the ordered outcome. The information for the other 2 entries are given in Table 2.9.

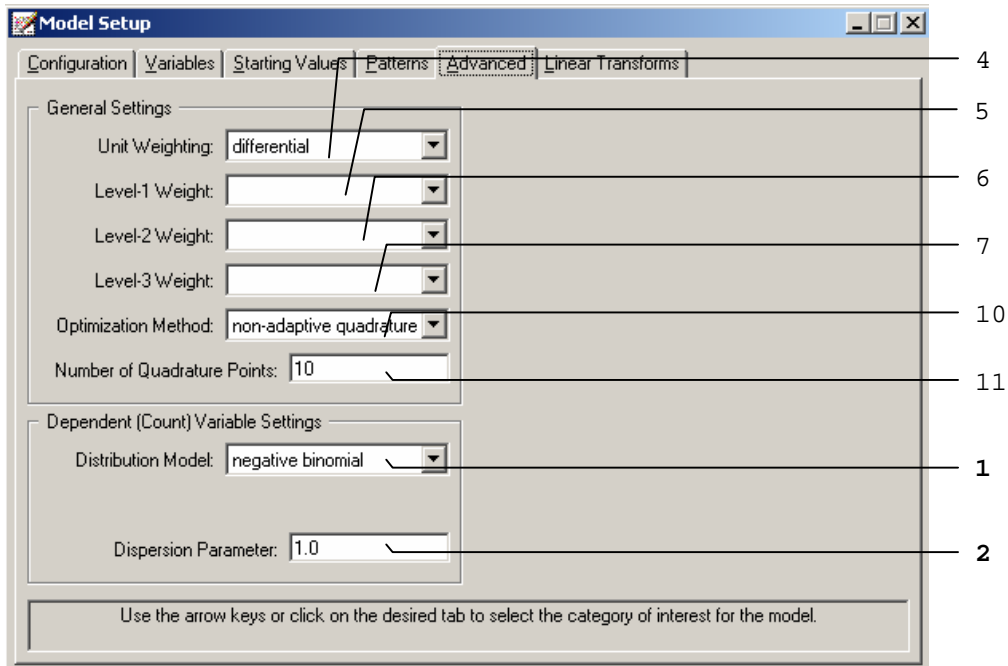


**Table 2.11(a): Entries of the Advanced screen for count outcomes with Poisson distribution**

Number	Caption	Purpose	Type	Action	Options	
1	a	Incorporate Time Offset	To select whether or not to include an offset variable.	Drop-down list box	Select an option from the drop-down list box.	no (default)
						yes
	b	Offset Variable	To specify the offset variable.	Drop-down list box	Select a variable from the drop-down list box.	
2	Distribution Model	To select an appropriate distribution model.	Drop-down list box.	Select a distribution from the drop-down list box.	Poisson (default)	
					negative binomial	
3	Estimate Scale	To specify the method for estimating the scale.	Drop-down list box	Select an estimated scale from the drop-down list box.	none (default)	
					deviance	
					Pearson	

**Advanced screen for count outcomes with negative binomial distribution**

When the negative binomial distribution is selected, the **Advanced** screen of the count variable is slightly different as shown below.



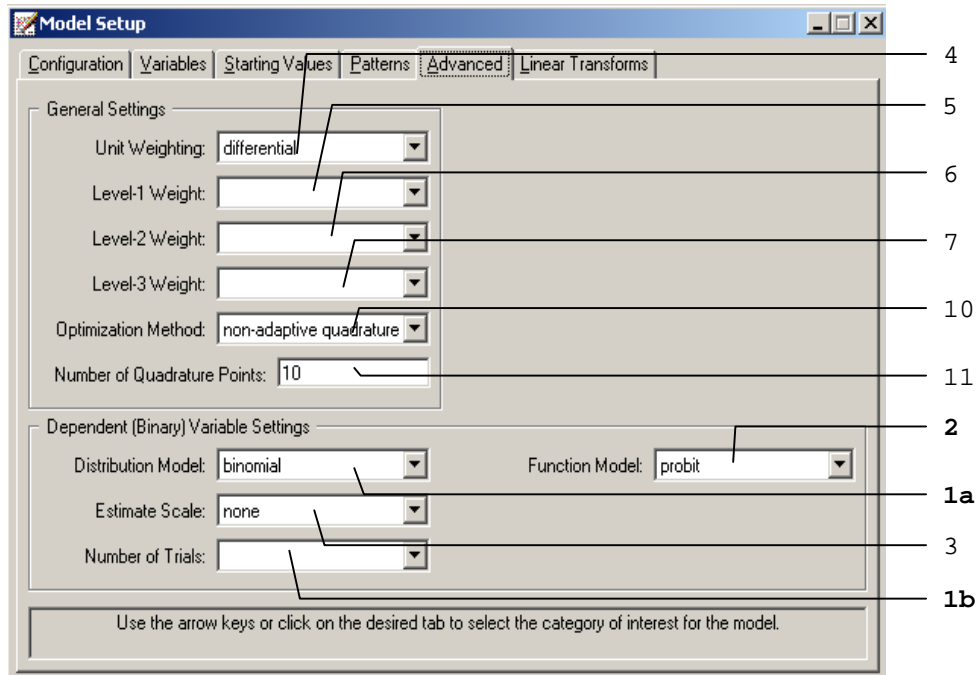
As shown above, the bold font entries 1 and 2 are different from the previous screen.

**Table 2.11(b): Entries of the Advanced screen for count outcomes with negative binomial distribution**

Number	Caption	Purpose	Type	Action	Options
1	Distribution Model	To select an appropriate distribution model.	Drop-down list box.	Select a distribution from the drop-down list box.	Poisson (default) <b>negative binomial</b>
2	Dispersion Parameter	To enter the dispersion parameter for the negative binomial model.	Text box	Enter any numeric value greater than 0.0. The default value is 1.0.	

## Advanced screen for binary outcomes

When the negative binomial distribution is selected, the **Advanced** screen of the count variable is slightly different as shown below.



As shown above, the bold font entries 1 and 2 are different from the previous screen.

**Table 2.12: Entries of the Advanced screen for binary outcomes**

Number	Caption	Purpose	Type	Action	Options	
1	a	Distribution Model	To select an appropriate distribution model.	Drop-down list box.	Select a distribution from the drop-down list box.	Bernoulli (default)
	b	Number of Trials	To select the column of the spreadsheet, which contains the number of trails.	Drop-down list box	Select a variable from the drop-down list box.	<b>binomial</b>
2	Function Model	To select an appropriate link function.	Drop-down list box.	Select a link function from the drop-down list box.	<b>probit</b> (default)	
					logistic	
					complementary log-log	
3	Estimate Scale	To specify the method for estimating the scale.	Drop-down list box	Select an estimated scale from the drop-down list box.	<b>none</b> (default)	
					deviance	
					Pearson	

### 2.4.6 The Linear Transforms screen

Linear transforms are used to test hypotheses of the type

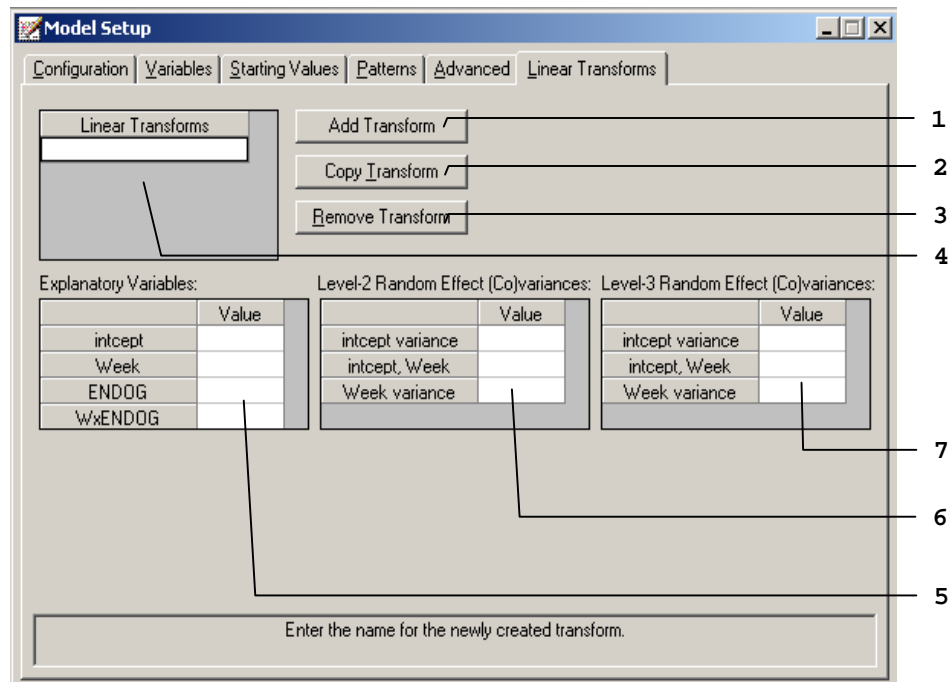
$$H_0 : c_1\beta_1 + c_2\beta_2 + c_3\beta_3 + \dots + c_k\beta_k = 0$$

where  $\beta_1, \beta_2, \beta_3, \dots, \beta_k$  are model parameters and  $c_1, c_2, c_3, \dots, c_k$  user-specified real-valued coefficients. For each linear transform, a  $Z$ -statistic and an associated two-tailed  $p$ -value are saved to the output file. The  $Z$ -statistic is a function of the estimated parameters and the large sample covariance matrix of the estimates. The value of the linear transform when the parameters are replaced with their estimates is also of interest. This value also appears in the output.

An example of the **Linear Transform** screen in the case of an ordinal outcome variable is given below. Also see Section 3.8 for an additional example. For continuous, count and nominal variables the **Linear Transform** screens are identical, but it differ from that for an ordinal outcome in that the screen for an ordinal outcome contains threshold parameter information.

### Linear Transforms screen for continuous and count outcomes

The buttons and options on the **Linear Transforms** screen are shown below.



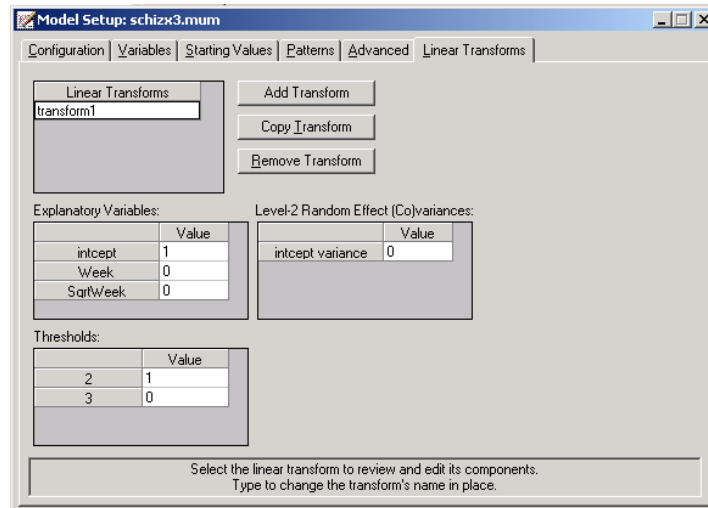
A summary of the 3 buttons and 4 different entries of the **Linear Transforms** screen of the **Model Setup** window for an ordered outcome is given in Table 2.12.

**Table 2.13: Entries of the Linear Transforms screen for continuous and count outcomes**

Number	Caption	Purpose	Type	Action	Options
1	Add Transform	To create a new linear transform in 4.	Click Button	Click to add a blank transform.	
2	Copy Transform	To create a copy the selected transform in 4 with a different name.	Click Button	Click to copy and paste the select transform.	
3	Remove Transform	To delete the selected transform in 4.	Click Button	Click on the button to delete the selected transform.	
4	Linear Transforms	To select the linear transform and edit it's components.	Grid box	Enter string(s) as names for transforms.	
5	Explanatory Variables	To specify the coefficient(s) for the linear transformation(s) of the fixed part of the model.	Grid box	Enter real number(s).	
6	Level-2 Random Effect (Co)variances	To specify the coefficient(s) for the linear transformation(s) of the covariance matrix of the level-2 random effects.	Grid box	Enter real number(s).	
7	Level-3 Random Effect (Co)variances	To specify the coefficient(s) for the linear transformation(s) of the covariance matrix of the level-3 random effects.	Grid box	Enter real number(s).	

For example, in the **Linear Transforms** screen shown below we wish to test the hypothesis that

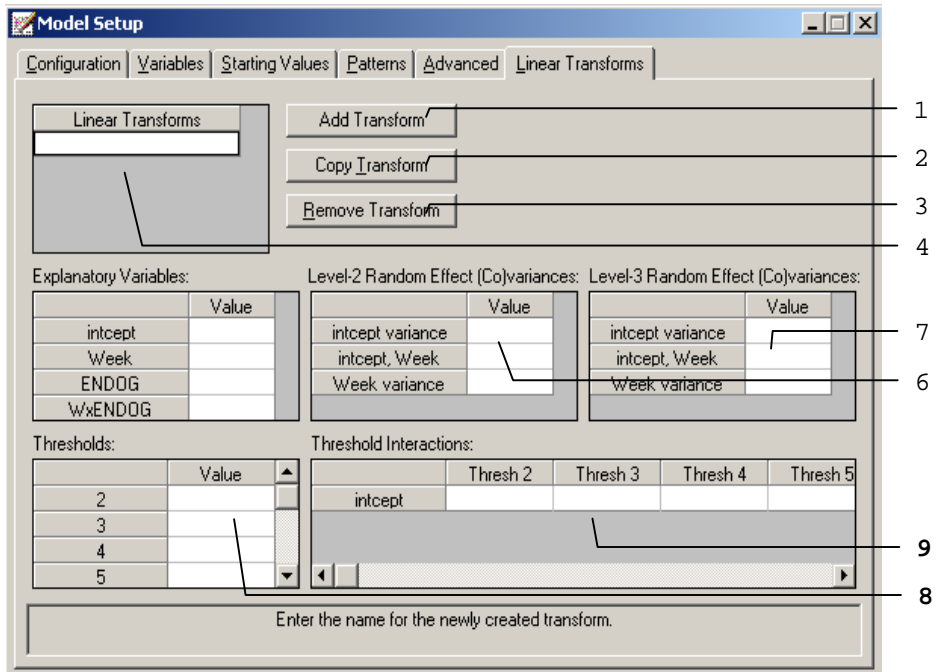
$$\beta_{intercept} + \beta_{Threshold1} = 0.$$



### Linear Transforms screen for ordered outcomes

Additional grid boxes appear to allow for user-specified starting values of thresholds and threshold-explanatory variable(s) interaction(s) for ordinal outcomes. The following screen is an example of the **Linear Transforms** screen of the **Model Setup** window.

Only the 2 entries shown in bold typeface are either new or different compared with those on the **Linear Transforms** screen of the **Model Setup** window for continuous or count outcome variables. These 2 entries are summarized in Table 2.13. Please refer to Table 2.12 for the information about all the other entries.

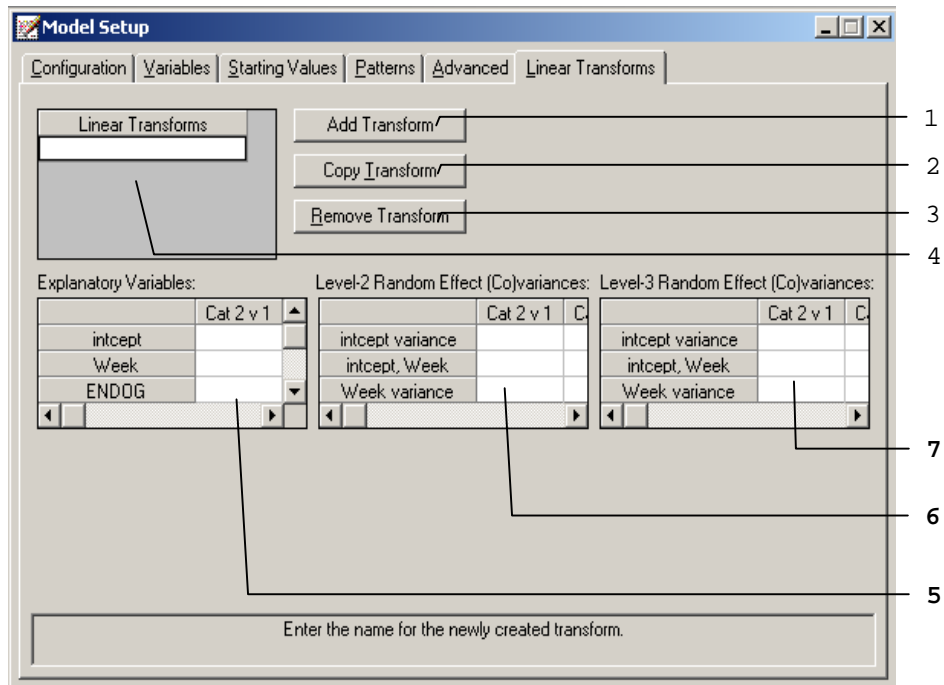


**Table 2.14: Entries of the Linear Transforms screen for ordered outcomes**

Number	Caption	Purpose	Type	Action
8	Thresholds	To specify the coefficient(s) for the linear transformation(s) of the thresholds.	Grid box	Enter real number(s).
9	Thresholds Interactions	To enter thresholds for the selected transform	Grid box	Enter real number(s).

## Linear Transforms screen for nominal and binary outcomes

Additional slide bar appears as shown in the following screen is an example of the **Linear Transforms** screen of the **Model Setup** window.



Only the 2 entries shown in bold typeface are either new or different compared with those on the **Linear Transforms** screen of the **Model Setup** window for continuous or count outcome variables. These 2 entries are summarized in Table 2.14. Please refer to Table 2.12 for the information about all the other entries.

**Table 2.15: Entries of the Linear Transforms screen for nominal outcomes**

<b>Number</b>	<b>Caption</b>	<b>Purpose</b>	<b>Type</b>	<b>Action</b>
5	Explanatory Variables	To specify the coefficient(s) for the linear transformation(s) of the fixed part of the model.	Grid box with slide bar	Enter real number(s).
6	Level-2 Random Effect (Co)variances	To specify the coefficient(s) for the linear transformation(s) of the covariance matrix of the level-2 random effects.	Grid box with slide bar	Enter real number(s).
7	Level-3 Random Effect (Co)variances	To specify the coefficient(s) for the linear transformation(s) of the covariance matrix of the level-3 random effects.	Grid box with slide bar	Enter real number(s).

## 2.5 Data manipulation

The SuperMix spreadsheet can be manipulated in various ways. Rows and columns can be changed directly, and simple computations or more complex built-in functions can be used in individual cells. Some of these manipulations are discussed and illustrated in the following sections, using **demo.ss3**. There are 15 cases (patients) in the data set.

The spreadsheet window for **demo.ss3** is opened as follows:

- Use the **Open** option on the **File** menu of the main window to load the **Open Spreadsheet** dialog box.
- Browse for the file **demo.ss3** in the **Examples** folder.
- Select the file and click on the **Open** button to open the following SuperMix spreadsheet window.

	(A)_Group	(B)_Age	(C)_WT_kg	(D)_PFat
1	1.00	22.00	107.10	3.00
2	1.00	26.00	78.00	1.90
3	1.00	330.00	83.20	1.50
4	1.00	24.00	70.10	1.80
5	1.00	36.00	98.90	5.30
6	2.00	35.00	95.00	2.90
7	2.00	26.00	64.80	3.80
8	2.00	23.00	72.80	3.30
9	2.00	30.00	70.00	1.40
10	2.00	33.00	71.10	3.30
11	2.00	45.00	99.50	5.20

The variables include:

- Group is a variable with 3 categories, indicating the group number of the patient (5 patients in each group).
- Age is the age of the patient.
- WT\_kg denotes the weight of the patient in kg.
- PFat is a measure of percentage body fat.

### 2.5.1 Basic data manipulations

It is important to note that any change of the data file will not be saved unless you use the **Save** option on the **File** menu.

#### Cells

A careful examination of the data shows that the Age entry of the 3rd observation is 330.00. This is obviously a typing error. Upon further investigation, it turns out that the correct age value is 33. To correct this error, select the cell, change the value of the formula box from 330.00 to 33.00, and then click on the **Apply** button.

SuperMix - [demo.ss3]

File Edit Window Help

33.00 Apply

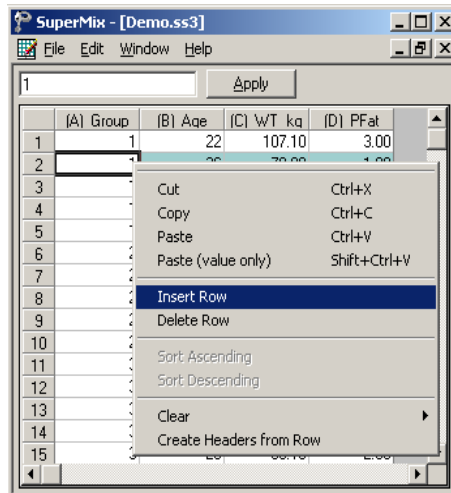
	[A]_Group	[B]_Age	[C]_WT_kg	[D]_PFat
1	1.00	22.00	107.10	3.00
2	1.00	26.00	78.00	1.90
3	1.00	33.00	83.20	1.50
4	1.00	24.00	70.10	1.80
5	1.00	36.00	98.90	5.30
6	2.00	35.00	95.00	2.90
7	2.00	26.00	64.80	3.80
8	2.00	23.00	72.80	3.30
9	2.00	30.00	70.00	1.40
10	2.00	33.00	71.10	3.30
11	2.00	45.00	99.50	5.20

## Rows

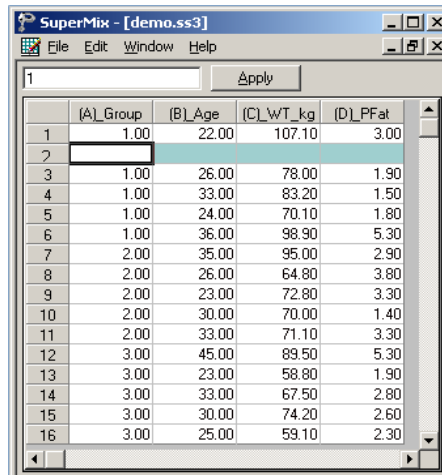
To work with a row (or rows) of the data file, click on the row tab(s) to select the complete row(s) and then right-click on the selection to display all the options from the pop-up menu.

## Insert a row

For example, to insert another row (observation) between the first and the second rows, select the second row by clicking on the row 2 tab, right-click on the selected row to activate the menu and select the **Insert Row** option to create the window as shown below.



An empty row is added to the spreadsheet above the previous second row and the total sample size is changed to 16 as shown below.



## Delete a row

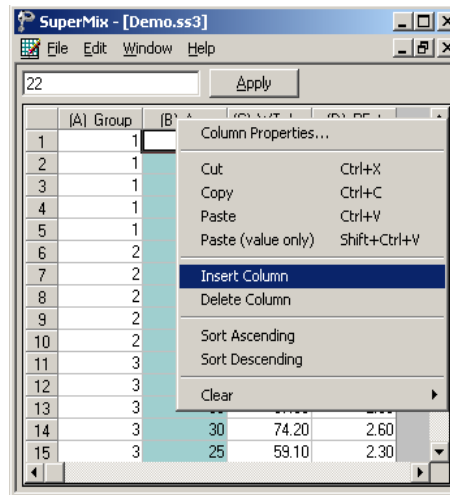
To delete the empty row that was inserted, select the second row by clicking on the row 2 tab. Right click on the selected row and select the **Delete Row** option to delete the second row.

## Columns

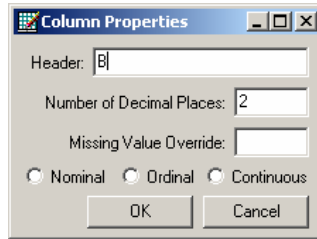
To work with a column (or columns) of the data file, first click on the column header(s) to select the column(s) and then right-click on one of the selected columns to see all the options listed on the pop-up menu.

## Insert a column

To insert another variable between (A)\_Group and (B)\_Age, first click on the header of (B)\_Age, right-click on the column to activate the menu and select the **Insert Column** option to create the window as shown below.



A new column (variable) is added to the spreadsheet. Change the variable name by selecting the column header, right-click and select **Column Properties** to load the dialog box as shown below.



Input a variable name, such as NewVar, and then click on the **OK** button to return to the spreadsheet window as shown below.

	(A)_Group	(B)_NewVar	(C)_Age	(D)_WT_kg	(E)_PFat
1	1.00		22.00	107.10	3.00
2	1.00		26.00	78.00	1.90
3	1.00		33.00	83.20	1.50
4	1.00		24.00	70.10	1.80
5	1.00		36.00	98.90	5.30
6	2.00		35.00	95.00	2.90
7	2.00		26.00	64.80	3.80
8	2.00		23.00	72.80	3.30
9	2.00		30.00	70.00	1.40
10	2.00		33.00	71.10	3.30
11	3.00		45.00	89.50	5.30
12	3.00		23.00	58.80	1.90
13	3.00		33.00	67.50	2.80
14	3.00		30.00	74.20	2.60
15	3.00		25.00	59.10	2.30

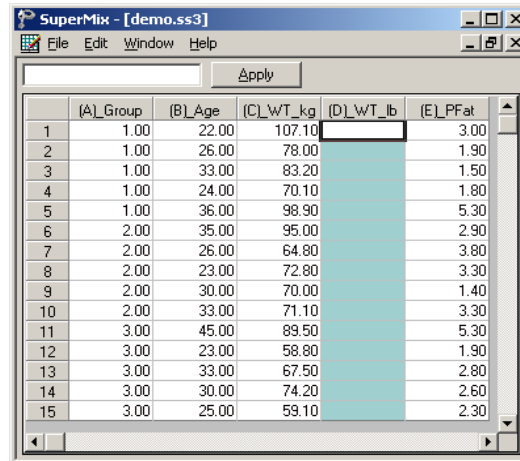
### Delete a column

To delete the NewVar column that was inserted, select the variable NewVar by clicking on the column header. Right-click and select the **Delete Column** option to delete column B.

## 2.5.2 Simple computations

### Assigning values to a new variable

In **demo.ss3**, the variable **WT\_kg** is a variable denoting weight in kilograms. We would like to use the variable **WT\_lb**, that is, the corresponding weight in pounds. To create this variable, first insert a column and change the column header to **WT\_lb** as illustrated earlier in Section 2.5.1 to generate the following spreadsheet window.



	(A)_Group	(B)_Age	(C)_WT_kg	(D)_WT_lb	(E)_PFat
1	1.00	22.00	107.10		3.00
2	1.00	26.00	78.00		1.90
3	1.00	33.00	83.20		1.50
4	1.00	24.00	70.10		1.80
5	1.00	36.00	98.90		5.30
6	2.00	35.00	95.00		2.90
7	2.00	26.00	64.80		3.80
8	2.00	23.00	72.80		3.30
9	2.00	30.00	70.00		1.40
10	2.00	33.00	71.10		3.30
11	3.00	45.00	89.50		5.30
12	3.00	23.00	58.80		1.90
13	3.00	33.00	67.50		2.80
14	3.00	30.00	74.20		2.60
15	3.00	25.00	59.10		2.30

Select the column containing the variable **WT\_lb**, input the function **2.20462\*(C1)** in the formula box and click on the **Apply** button to get the new variable **WT\_lb** as shown below. The formula applies to each row of (D)\_WT\_lb provided that

- this column is selected (highlighted)
- the first cell of the variable(s) in the formula, in this case C1, is referenced.

The screenshot shows a spreadsheet window titled "SuperMix - [demo.ss3]". The spreadsheet contains 15 rows of data. The columns are labeled (A)\_Group, (B)\_Age, (C)\_WT\_kg, (D)\_WT\_lb, and (E)\_PFat. The values in the (D)\_WT\_lb column are highlighted in light blue.

	(A)_Group	(B)_Age	(C)_WT_kg	(D)_WT_lb	(E)_PFat
1	1.00	22.00	107.10	236.11	3.00
2	1.00	26.00	78.00	171.96	1.90
3	1.00	33.00	83.20	183.42	1.50
4	1.00	24.00	70.10	154.54	1.80
5	1.00	36.00	98.90	218.04	5.30
6	2.00	35.00	95.00	209.44	2.90
7	2.00	26.00	64.80	142.86	3.80
8	2.00	23.00	72.80	160.50	3.30
9	2.00	30.00	70.00	154.32	1.40
10	2.00	33.00	71.10	156.75	3.30
11	3.00	45.00	89.50	197.31	5.30
12	3.00	23.00	58.80	129.63	1.90
13	3.00	33.00	67.50	148.81	2.80
14	3.00	30.00	74.20	163.58	2.60
15	3.00	25.00	59.10	130.29	2.30

Save the changes to **demo.ss3** by clicking on the **Save** option on the **File** menu.

### 2.5.3 Built-in functions

#### LN function

In mixed-effects models, we often consider the natural log of a variable. For example, the natural log of Age in **demo.ss3** may be a more appropriate explanatory variable than the original age given in years. The variable LnAge can easily be created by using the options available in the SuperMix spreadsheet.

First, create a new column with the header LnAge. Next, select the column containing the variable LnAge, input the function **LN(B1)** in the formula box, and click on the **Apply** button. Each value of the new variable LnAge is the natural log of the corresponding values of the variable Age as shown below.

SuperMix - [demo.ss3]

File Edit Window Help

LN(B1) Apply

	(A)_Group	(B)_Age	(C)_LnAge	(D)_WT_kg	(E)_WT_lb
1	1.00	22.00	3.09	107.10	236.11
2	1.00	26.00	3.26	78.00	171.96
3	1.00	33.00	3.50	83.20	183.42
4	1.00	24.00	3.18	70.10	154.54
5	1.00	36.00	3.58	98.90	218.04
6	2.00	35.00	3.56	95.00	209.44
7	2.00	26.00	3.26	64.80	142.86
8	2.00	23.00	3.14	72.80	160.50
9	2.00	30.00	3.40	70.00	154.32
10	2.00	33.00	3.50	71.10	156.75
11	3.00	45.00	3.81	89.50	197.31
12	3.00	23.00	3.14	58.80	129.63
13	3.00	33.00	3.50	67.50	148.81
14	3.00	30.00	3.40	74.20	163.58
15	3.00	25.00	3.22	59.10	130.29

### SQRT function

To add another variable, SqrtAge, which is the square root of Age, we proceed as follows. As above, first create a new column with the header SqrtAge.

Select the column containing the variable SqrtAge, input the function **SQRT(B1)** in the formula box, and click on the **Apply** button. Each value of the new variable SqrtAge is the square root value of the corresponding value of the variable Age as shown below.

SuperMix - [demo.ss3]

File Edit Window Help

SQRT(B1) Apply

	(A)_Group	(B)_Age	(C)_LnAge	(D)_SqrtAg	(E)_WT_kg
1	1.00	22.00	3.09	4.69	107.10
2	1.00	26.00	3.26	5.10	78.00
3	1.00	33.00	3.50	5.74	83.20
4	1.00	24.00	3.18	4.90	70.10
5	1.00	36.00	3.58	6.00	98.90
6	2.00	35.00	3.56	5.92	95.00
7	2.00	26.00	3.26	5.10	64.80
8	2.00	23.00	3.14	4.80	72.80
9	2.00	30.00	3.40	5.48	70.00
10	2.00	33.00	3.50	5.74	71.10
11	3.00	45.00	3.81	6.71	89.50
12	3.00	23.00	3.14	4.80	58.80
13	3.00	33.00	3.50	5.74	67.50
14	3.00	30.00	3.40	5.48	74.20
15	3.00	25.00	3.22	5.00	59.10

Save the changes to **demo.ss3** by clicking on the **Save** option on the **File** menu.

Table 2.16 contains a selection of the built-in functions in SuperMix. A list of values can be any of the following types:

- (B1, B2, B3) is the selection of the first three values of the variable in column B.
- (A1:A15) selects all the values of the variable in column A. Starting with the first and ending with the one in row 15.
- (A1:A5, A7, A11:A15) selects the values of row 1 to row 5, row 7, and row 11 to row 15 of column A.
- (A3:A6, B7, D12:D15) contains a list of values from more than one column. This selection includes the values of row 3 to row 6 of column A, row 7 of column B and row 12 to row 15 of column D.

**Table 2.16: Selection of SuperMix functions**

<b>Function</b>	<b>Definition</b>
ABS(value)	Absolute value
AVERAGE (list of values)	Average
EXP(value)	Exponent base e
LN(value)	Natural log
LOG(value)	Logarithm
MAX(list of values)	Maximum value
MEDIAN(list of values)	Median
MIN(list of values)	Minimum value

**Table 2.16: Selection of SuperMix functions (continued)**

MODE(list of values)	Mode
SQRT(value)	Square root
SQUARE(value)	Square

## 2.5.4 Other useful data manipulations

The data manipulation capabilities of the SuperMix spreadsheet window can be used to create interaction terms, essentially a product of variables, for use in modeling. It can also be used to perform grand mean centering of variables.

### Absolute references

If you do not want SuperMix to adjust references when you copy a formula to a different cell, use an **absolute** reference. For example, if your formula multiplies cell A5 with cell C1 ( $=A5*C1$ ) and you copy the formula to another cell, SuperMix will adjust both references. You can create an absolute reference to cell C1 by placing a **dollar sign** (\$) before the parts of the reference that do not change. To create an absolute reference to cell C1, for example, add dollar signs to the formula as follows:  $=A5*\$C\$1$ .

### Creating an interaction term

Suppose that we want to study the possible interaction between a subject's age and weight (in pounds). This product of Age and WT\_lb, is created in the SuperMix spreadsheet window as follows.

First, create a new column with header Age\_WT. Then, select this column, and input the function **(B1)\*(E1)** in the formula box. Click on the **Apply** button. Each value of the new variable Age\_WT is equal to the product of the corresponding values of Age and WT\_lb as shown below.

SuperMix - [demo.ss3]

File Edit Window Help

[B1]~[F1] Apply

	(A)_Group	(B)_Age	(C)_LnAge	(D)_SqrtAge	(E)_WT_kg	(F)_WT_lb	(G)_Age_w	(H)_PFat
1	1.00	22.00	3.09	4.69	107.10	236.11	5194.53	3.00
2	1.00	26.00	3.26	5.10	78.00	171.96	4470.97	1.90
3	1.00	33.00	3.50	5.74	83.20	183.42	6053.00	1.50
4	1.00	24.00	3.18	4.90	70.10	154.54	3709.05	1.80
5	1.00	36.00	3.58	6.00	98.90	218.04	7849.33	5.30
6	2.00	35.00	3.56	5.92	95.00	209.44	7330.36	2.90
7	2.00	26.00	3.26	5.10	64.80	142.86	3714.34	3.80
8	2.00	23.00	3.14	4.80	72.80	160.50	3691.42	3.30
9	2.00	30.00	3.40	5.48	70.00	154.32	4629.70	1.40
10	2.00	33.00	3.50	5.74	71.10	156.75	5172.70	3.30
11	3.00	45.00	3.81	6.71	89.50	197.31	8879.11	5.30
12	3.00	23.00	3.14	4.80	58.80	129.63	2981.53	1.90
13	3.00	33.00	3.50	5.74	67.50	148.81	4910.79	2.80
14	3.00	30.00	3.40	5.48	74.20	163.58	4907.48	2.60
15	3.00	25.00	3.22	5.00	59.10	130.29	3257.33	2.30

### Grand mean centering

It is often useful to center a predictor variable around its grand mean. To illustrate, we grand mean center the variable PFat.

SuperMix - [Demo.ss3]

File Edit Window Help

(h1)-average(H\$1:H\$15) Apply

	(A)_Group	(B)_Age	(C)_LnAge	(D)_SqrtAge	(E)_WT_kg	(F)_WT_lb	(G)_Age_w	(H)_PFat	(I)_PFat_M
1	1	22	3.09	4.69	107.10	236.11	5194.53	3.00	0.13
2	1	26	3.26	5.10	78.00	171.96	4470.97	1.90	-0.97
3	1	33	3.50	5.74	83.20	183.42	6053.00	1.50	-1.37
4	1	24	3.18	4.90	70.10	154.54	3709.05	1.80	-1.07
5	1	36	3.58	6.00	98.90	218.04	7849.33	5.30	2.43
6	2	35	3.56	5.92	95.00	209.44	7330.36	2.90	0.03
7	2	26	3.26	5.10	64.80	142.86	3714.34	3.80	0.93
8	2	23	3.14	4.80	72.80	160.50	3691.42	3.30	0.43
9	2	30	3.40	5.48	70.00	154.32	4629.70	1.40	-1.47
10	2	33	3.50	5.74	71.10	156.75	5172.70	3.30	0.43
11	3	45	3.81	6.71	89.50	197.31	8879.11	5.30	2.43
12	3	23	3.14	4.80	58.80	129.63	2981.53	1.90	-0.97
13	3	33	3.50	5.74	67.50	148.81	4910.79	2.80	-0.07
14	3	30	3.40	5.48	74.20	163.58	4907.48	2.60	-0.27
15	3	25	3.22	5.00	59.10	130.29	3257.33	2.30	-0.57

To do so, first create a new column with the header of PFat\_Mea. Then, select the PFat\_Mea column, input the function **(H1)-AVERAGE(H\$1:H\$15)** in the formula box and click on the **Apply** button. Each value of the new variable of PFat\_Mea now contains the difference between the corresponding original PFat value and the grand mean of all the PFat values. As illustrated below, the spreadsheet functions are not case sensitive.