Multivariate Model with Repeated Measures

One common use of multivariate fitting is to analyze data with repeated measures, also called *longitudinal data*. A subject is measured repeatedly across time, and the data are arranged so that each of the time measurements form a variable. Because of correlation between the measurements, data should not be stacked into a single column and analyzed as a univariate model unless the correlations form a pattern termed *sphericity*. See the previous section, "Univariate Tests and the Test for Sphericity", for more details about this topic.

With repeated measures, the analysis is divided into two layers:

- Between-subject (or across-subject) effects are modeled by fitting the sum of the repeated measures columns to the model effects. This corresponds to using the **Sum** response function, which is an **M**-matrix that is a single vector of 1s.
- Within-subjects effects (repeated effects, or time effects) are modeled with a response function that fits differences in the repeated measures columns. This analysis can be done using the **Contrast** response function or any of the other similar differencing functions: **Polynomial**, **Helmert**, **Profile**, or **Mean**. When you model differences across the repeated measures, think of the differences as being a new within-subjects effect, usually time. When you fit effects in the model, interpret them as the interaction with the within-subjects effect. For example, the effect for Intercept becomes the Time (within-subject) effect, showing overall differences across the repeated measures. If you have an effect `A`, the within-subjects tests are interpreted to be the tests for the `A*Time` interaction, which model how the differences across repeated measures vary across the `A` effect.

Corresponding Multivariate and Univariate Tests shows the relationship between the response function and the model effects compared with what a univariate model specification would be. Using both the **Sum** (between-subjects) and **Contrast** (within-subjects) models, you should be able to reconstruct the tests that would have resulted from stacking the responses into a single column and obtaining a standard univariate fit.

There is a direct and an indirect way to perform the repeated measures analyses:

- The direct way is to use the popup menu item Repeated Measures. This prompts you to name the effect that represents the within-subject effect across the repeated measures. Then it fits both the **Contrast** and the **Sum** response functions. An advantage of this way is that the effects are labeled appropriately with the within-subjects effect name.
- The indirect way is to specify the two response functions individually. First, do the **Sum** response function and second, do either **Contrast** or one of the other functions that model differences. You need to remember to associate the within-subjects effect with the model effects in the contrast fit.

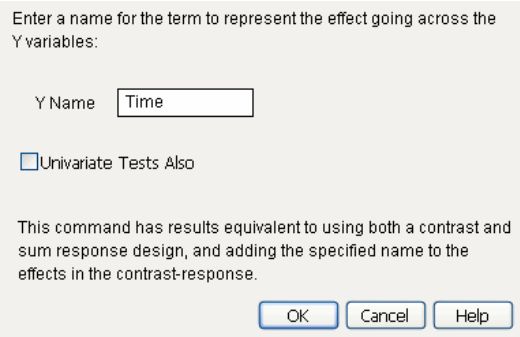
Repeated Measures Example

sFor example, consider a study by Cole and Grizzle (1966). The results are in the Dogs.jmp table in the sample data folder. Sixteen dogs are assigned to four groups defined by variables drug and dep1, each having two levels. The dependent variable is the blood concentration of histamine at 0, 1, 3, and 5 minutes after injection of the drug. The log of the concentration is used to minimize the correlation between the mean and variance of the data.

1. Open the Dogs.jmp sample data table.
2. Select **Analyze > Fit Model**.
3. Select LogHist0, LogHist1, LogHist3, and LogHist5 and click **Y**.
4. Select drug and dep1 and select **Full Factorial** from the **Macros** menu.
5. For Personality, select **Manova**.
6. Click **Run**.
7. In the **Choose Response** menu, select **Repeated Measures**.

   Time should be entered for YName. If you check the **Univariate Tests Also** check box, the report includes univariate tests, which are calculated as if the responses were stacked into a single column.
8. Click **OK**.

Repeated Measures Window



Corresponding Multivariate and Univariate Tests shows how the multivariate tests for a **Sum** and **Contrast** response designs correspond to how univariate tests would be labeled if the data for columns LogHist0, LogHist1, LogHist3, and LogHist5 were stacked into a single *Y* column, with the new rows identified with a nominal grouping variable, Time.

Corresponding Multivariate and Univariate Tests

Sum M-Matrix Between Subjects		**Contrast M-Matrix Within Subjects**	
Multivariate Test	**Univariate Test**	**Multivariate Test**	**Univariate Test**
intercept	intercept	intercept	time
drug	drug	drug	time*drug
dep1	dep1	dep1	time*dep1

The between-subjects analysis is produced first. This analysis is the same (except titling) as it would have been if **Sum** had been selected on the popup menu.

The within-subjects analysis is produced next. This analysis is the same (except titling) as it would have been if **Contrast** had been selected on the popup menu, though the within-subject effect name (`Time`) has been added to the effect names in the report. Note that the position formerly occupied by `Intercept` is `Time`, because the intercept term is estimating overall differences across the repeated measurements.
