

## SPSS for 2-Factor Crossed ANOVA

### I. Data File Format

Need four columns; one for Factor A treatment level designations, one for Factor B treatment level designations, one for the combinations of levels of Factor A and Factor B, and one for the Response Variable. See the data file example below. Note that this particular example will be a mixed model (Model III) with Factor A as the fixed factor and Factor B as the random factor.

	afixed	brandom	axb	response	var	var
1	1	1	11	7.00		
2	2	1	21	5.30		
3	1	1	11	4.90		
4	2	1	21	8.80		
5	1	2	12	9.90		
6	2	2	22	5.70		
7	1	2	12	7.60		
8	2	2	22	8.90		
9	1	3	13	8.50		
10	2	3	23	4.70		
11	1	3	13	5.50		
12	2	3	23	8.10		

### II. The Analysis

Remember to check assumptions on EACH factor for which an F-statistic will be computed. In this example: Factor A, Factor B, and their interaction (Factor A x Factor B). In addition, by default SPSS uses a different model of variance structure for the Mixed Model than we will use. To work around this, we will use the SPSS menu and dialogs to set up most of the analysis, then we will modify the command syntax.

(1) From the pull-down menu select:

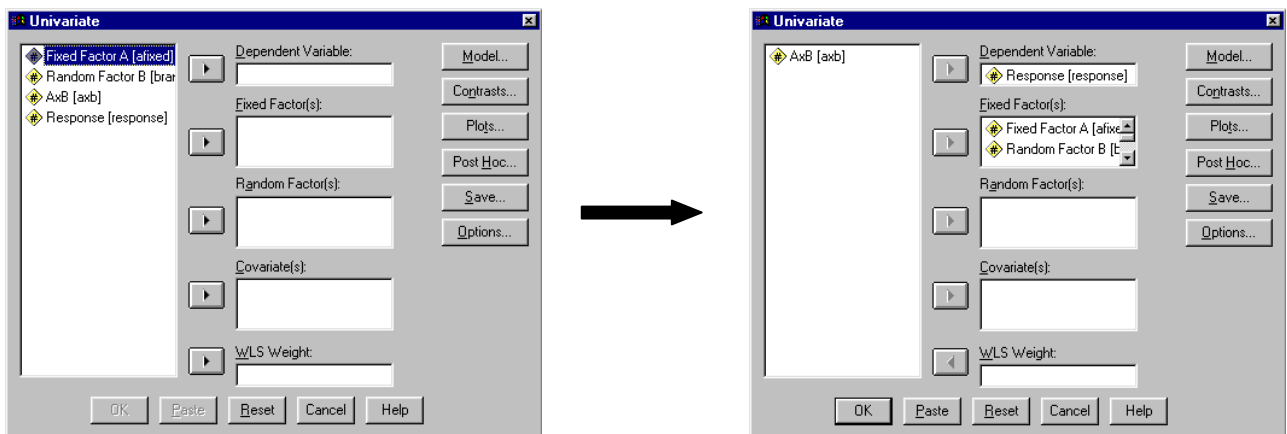
*Analyze* → *General Linear Models* → *Univariate*

(2) In the Univariate Dialog Menu specify the appropriate variables:

Do this by highlighting the variable of interest in the left window menu, then click on the appropriate arrow to define the dependent variable, and then the two independent variables

(a) Model I and Mixed Models

Put both factors in the FIXED Factors Box. Do not list any variable as random, even if it is so in the design – this is necessary to avoid a problem.

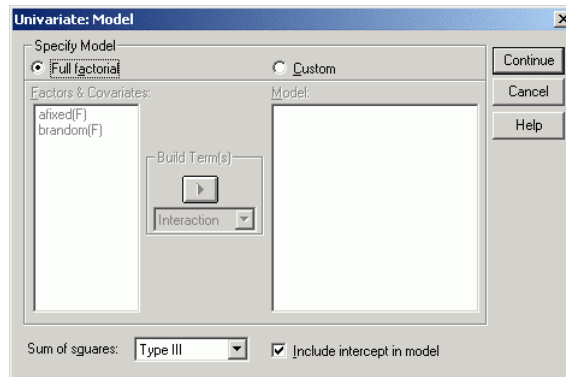


(b) Model II

Put both factors in the Random Factors Box.

(3) The Model Dialog Menu

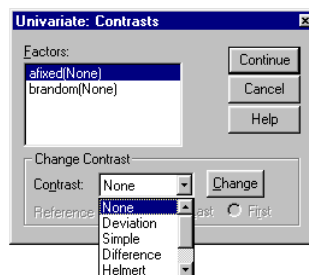
The default model is "Full Factorial" using a Type III Sum of Squares. Nothing needs to be changed here.



If you opened this dialog to look at it, click on the Continue Button to close it.

(4) The Contrasts Dialog Menu

If the analysis includes fixed factors, and one of the pre-set a priori contrasts is of interest, select it by clicking on the variable name of the factor, then on the contrast in the menu; then click on the Change Button. You can get a short description of each contrast by left-clicking on it to make it the current selection, then right-clicking on it.



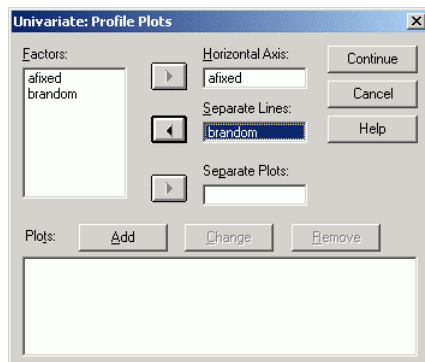
To set up Custom F Contrasts (Orthogonal Contrasts) using contrast coefficients, the command syntax must be modified. This will be done after everything else is set up (see the last part of this handout for instructions).

Click on the Continue Button to exit this dialog.

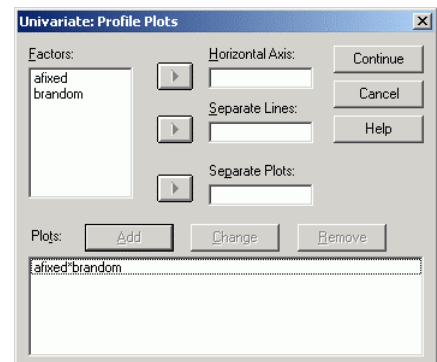
(5) Obtaining Interaction Plots

Click on the Plots Button.

In the Plots Dialog Box, highlight a factor and click on the appropriate arrow to specify which variable will serve as the "horizontal" factor (x-axis) on the plot, and which variable will be plotted as "separate lines." Click on the Add Button to add this plot to the output.



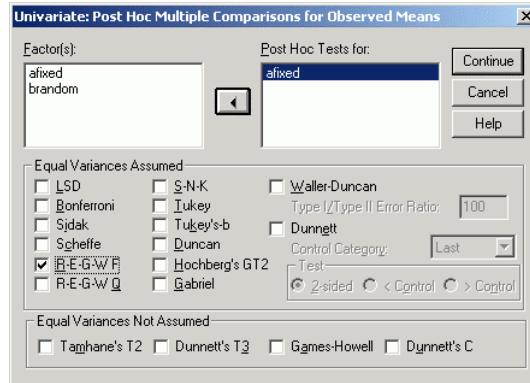
After clicking the Add Button, the plot will be listed in the lower pane of the dialog



Click on the Continue Button to exit this dialog.

(6) Post Hoc Multiple Comparisons

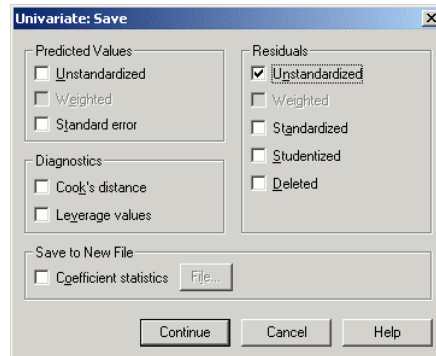
If the analysis includes a fixed factor, and unplanned multiple comparisons or Dunnett's Test are of interest, click on the Post Hoc Button. In the dialog, select the factor for which multiple comparisons should be performed, then click on the arrow to move it to the Post Hoc Tests For Box. Select the appropriate tests by clicking on the checkbox next to it. You can get a short description of each test by right-clicking on its name.



Click the Continue Button to exit this dialog.

(7) Save Residual Values for Assumption Checking

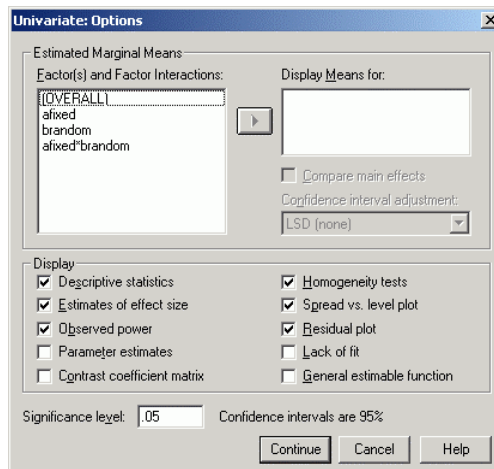
To obtain the residual values, click on the Save Button to open the Save Dialog. In the Residuals Box, select Unstandardized.



Click on the Continue Button to exit this dialog.

(8) Options

Use the Options Dialog to select any additional calculations you want. These might include observed power (note that is not the same as the power of the test for detecting a biologically significant minimum difference), estimate of effect size (one way of calculating the proportion of variance contributed by a factor), Levene's Test of Variances, or a plot of residual values. The results of Levene's Test are given only for the lowest order interaction.



- (9) At this point, everything that can be set up using the menus and dialogs has been done. If the analysis is a pure Model I or Model II, and no custom F Contrasts are required, the analysis is ready to run. Click on the OK Button. Otherwise, continue with the next step.

(10) Mixed Models:

- (a) To get an ANOVA F-statistic with the appropriate mean square in the denominator, you'll need to alter the command language. This will create another ANOVA table with the correct F-test for the fixed factor, that will be printed out after the complete ANOVA table. When presenting your results, use the output from this test to replace the result for the fixed factor in the original test. **DO NOT** present both results.

To obtain the corrected test result, click on the Paste Button to open the Syntax Window:

```

Syntax3 - SPSS for Windows Syntax Editor
File Edit View Analyze Graphs Utilities Run Window Help
UNIVANNOVA
  response BY afixed brandom
  /METHOD = SSTYPE(3)
  /INTERCEPT = INCLUDE
  /SAVE = RESID
  /POSTHOC = afixed ( FREGW )
  /PLOT = PROFILE( afixed*brandom )
  /PRINT = ETASQ OPOWER HOMOGENEITY
  /PLOT = SPREADLEVEL RESIDUALS
  /CRITERIA = ALPHA(.05)
  /DESIGN = afixed brandom afixed*brandom .
  
```

Just before the "/DESIGN" subcommand line in the code, add the following line to specify another F-test where the fixed effect mean square is divided by the interaction mean square. You must use the actual variable names NOT the labels:

/TEST = fixedvariablename VS fixedvariablename\*randomvariablename

For the example in this handout, the dialog would look like this:

```

Syntax3 - SPSS for Windows Syntax Editor
File Edit View Analyze Graphs Utilities Run Window Help
UNIVANNOVA
  response BY afixed brandom
  /METHOD = SSTYPE(3)
  /INTERCEPT = INCLUDE
  /SAVE = RESID
  /POSTHOC = afixed ( FREGW ) VS afixed*brandom
  /PLOT = PROFILE( afixed*brandom )
  /PRINT = ETASQ OPOWER HOMOGENEITY
  /PLOT = SPREADLEVEL RESIDUALS
  /CRITERIA = ALPHA(.05)
  /TEST = afixed VS afixed*brandom
  /DESIGN = afixed brandom afixed*brandom .
  
```

- (b) To obtain a multiple comparison test for a mixed model design with the correct MS Error term, you must also alter the program's code. After you have specified the factors to be tested and the multiple comparison tests to be run in the other dialogs, click on the Paste Button in the Univariate Dialog, and alter the /POSTHOC line by adding the appropriate MS Error term after VS in the line as follows:

old line: /POSTHOC = independentvariablename (TESTNAME)

new line: `/POSTHOC = independentvariablename (TESTNAME) VS appropriateMSErrorname`  
 For the example in this document, calling for the REGWF-test, it should look like this:

```

UNIANOVA
  response BY afixed brandom
  /METHOD = SSTYPE(3)
  /INTERCEPT = INCLUDE
  /SAVE = RESID
  /POSTHOC = afixed ( FREGW ) VS afixed*brandom
  /PLOT = PROFILE( afixed*brandom )
  /PRINT = ETASQ OPOWER HOMOGENEITY
  /PLOT = SPREADLEVEL RESIDUALS
  /CRITERIA = ALPHA(.05)
  /TEST = afixed VS afixed*brandom
  /DESIGN = afixed brandom afixed*brandom .
    
```

(11) Obtaining Custom F Contrasts

Custom Contrasts also require you to modify the syntax. If the Syntax Window is not already open, click the Paste Button in the Univariate Dialog. Add a line similar to the following before the `/DESIGN` statement:

```

/CONTRAST (factormame) = SPECIAL(2 0 -1 -1)
    
```

The parentheses are required. Also, note that the factor name must be the actual variable name for the factor, not the label. The numbers in the second set of parentheses are the contrast coefficients. Separate the coefficient values with spaces. For the example in this handout, the fixed factor has only two treatment levels, so there is not really any point in doing this test with this data; however, for the sake of example, the coefficient matrix would have two values, which must sum to zero, and the completed syntax dialog would look like this:

```

UNIANOVA
  response BY afixed brandom
  /METHOD = SSTYPE(3)
  /INTERCEPT = INCLUDE
  /SAVE = PRED RESID
  /PLOT = PROFILE( afixed*brandom )
  /PRINT = ETASQ HOMOGENEITY
  /PLOT = SPREADLEVEL RESIDUALS
  /CRITERIA = ALPHA(.05)
  /TEST = afixed VS afixed*brandom
  /CONTRAST (afixed) = SPECIAL(1 -1)
  /DESIGN = afixed brandom afixed*brandom .
    
```

(12) Once the program for the analysis is set up in the Syntax Dialog, run the analysis using the Run Menu:  
 Select *Run* → *All*

(13) Obtaining Multiple Comparisons for the Interaction Term

This is done in a round-about way, basically by running a separate 1-Factor Model I ANOVA and Multiple Comparisons using the Treatment Combinations column as the Factor. In this example, the variable axb would be the fixed factor. In the results, ignore the ANOVA output (you would only be doing this if the 2-Factor ANOVA already indicated a significant interaction), and focus on the multiple comparison test to interpret the nature of the interaction.