

SPSS for a 3-Factor Mixed Model ANOVA

Zar, Example 14.1 Reanalyzed Treating Temperature as a Random Effects Factor

Variable View

Example 14.1 Data.sav - SPSS Data Editor

File Edit View Data Transform Analyze Graphs Utilities Window Help

	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure
1	species	Numeric	1	0	Species	None	None	8	Right	Nominal
2	temp	Numeric	1	0	Temperature	{1, Low}...	None	8	Right	Ordinal
3	sex	Numeric	1	0	Sex	{1, Male}...	None	8	Right	Nominal
4	axb	Numeric	2	0	Species x Temperature	None	None	8	Right	Nominal
5	axc	Numeric	2	0	Species x Sex	None	None	8	Right	Nominal
6	bxc	Numeric	2	0	Temperature x Sex	None	None	8	Right	Nominal
7	axbxc	Numeric	3	0	Species x Temp x Sex	None	None	8	Right	Nominal
8	response	Numeric	3	1	Oxygen Consumed	None	None	8	Right	Scale

Data View

Example 14.1 Data.sav - SPSS Data Editor

File Edit View Data Transform Analyze Graphs Utilities Window Help

	species	temp	sex	axb	axc	bxc	axbxc	response	var	var
1	1	1	1	11	11	11	111	1.9		
2	1	1	1	11	11	11	111	1.8		
3	1	1	1	11	11	11	111	1.6		
4	1	1	1	11	11	11	111	1.4		
5	1	1	2	11	12	12	112	1.8		
6	1	1	2	11	12	12	112	1.7		
7	1	1	2	11	12	12	112	1.4		
8	1	1	2	11	12	12	112	1.5		
9	1	2	1	12	11	21	121	2.3		
10	1	2	1	12	11	21	121	2.1		

A shortcut to set up the interaction variables uses Excel and the Concatenate function, then fill down:

Microsoft Excel - Example 14.1 Data.xls

File Edit View Insert Format Tools Data Window Help

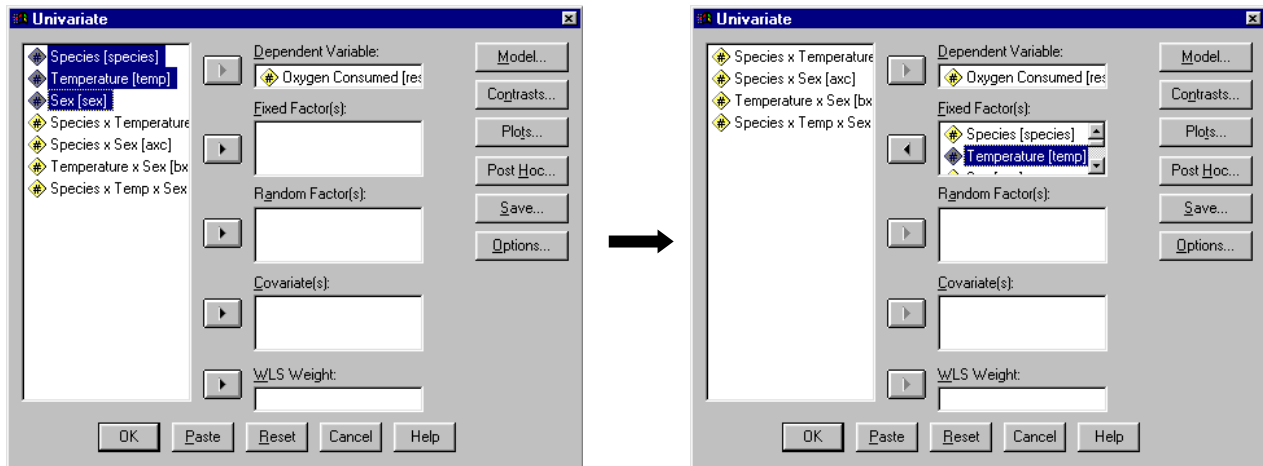
Times New Roman 11 B I U \$ % , +.00 +.00

D1 = =CONCATENATE(A1,B1)

	A	B	C	D	E	F	G	H	I	J
1	1	1	1	11	11	11	111	1.9		
2	1	1	1	11	11	11	111	1.8		
3	1	1	1	11	11	11	111	1.6		
4	1	1	1	11	11	11	111	1.4		
5	1	1	2	11	12	12	112	1.8		
6	1	1	2	11	12	12	112	1.7		
7	1	1	2	11	12	12	112	1.4		

Note that the values in columns A, B, and C must be formatted as TEXT, not GENERAL values.

Although Temperature is a random effects factor, it must be placed in the Fixed Factors Box in the GLM Univariate Dialog. If it is placed in the Random Factors Box, the wrong ANOVA table is produced.



Do not use any of the interaction terms as factors.

Set up the rest of the dialog the same way as for the 2-Factor Mixed Model ANOVA, then click on the Paste Button to modify the syntax. Remember that in the fixed effects model all of the F-tests will use MS_E for the within-groups term. Add a /TEST command for each of the F-tests that must be corrected:

```

Syntax2 - SPSS Syntax Editor
File Edit View Analyze Graphs Utilities Run Window Help
UNIANOVA
  response BY species temp sex
  /METHOD = SSTYPE(3)
  /INTERCEPT = INCLUDE
  /SAVE = RESID
  /PRINT = HOMOGENEITY
  /CRITERIA = ALPHA(.05)
  /TEST = species VS species*temp
  /TEST = sex VS sex*temp
  /TEST = species*sex VS species*sex*temp
  /DESIGN = species temp sex species*temp species*sex temp*sex species*temp
            *sex .
    
```

If any *post hoc* tests are performed (planned or unplanned comparisons), also modify those commands so they use the appropriate MS.

Run the analysis by selecting "All" from the Run Menu.

3-Factor Crossed Mixed Model ANOVA Output

Tests of Between-Subjects Effects

Dependent Variable: Oxygen Consumed

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	28.350 ^a	17	1.668	44.914	.000
Intercept	389.205	1	389.205	10482.329	.000
SPECIES	1.817	2	.909	24.475	.000
TEMP	24.656	2	12.328	332.024	.000
SEX	8.889E-03	1	8.889E-03	.239	.627
SPECIES * TEMP	1.102	4	.275	7.418	.000
SPECIES * SEX	.370	2	.185	4.986	.010
TEMP * SEX	.175	2	8.764E-02	2.360	.104
SPECIES * TEMP * SEX	.221	4	5.514E-02	1.485	.220
Error	2.005	54	3.713E-02		
Total	419.560	72			
Corrected Total	30.355	71			

a. R Squared = .934 (Adjusted R Squared = .913)

Custom Hypothesis Tests #1

Test Results

Dependent Variable: Oxygen Consumed

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	1.817	2	.909	3.300	.142
Error ^a	1.102	4	.275		

a. SPECIES * TEMP

Custom Hypothesis Tests #2

Test Results

Dependent Variable: Oxygen Consumed

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	8.889E-03	1	8.889E-03	.101	.780
Error ^a	.175	2	8.764E-02		

a. TEMP * SEX

Custom Hypothesis Tests #3

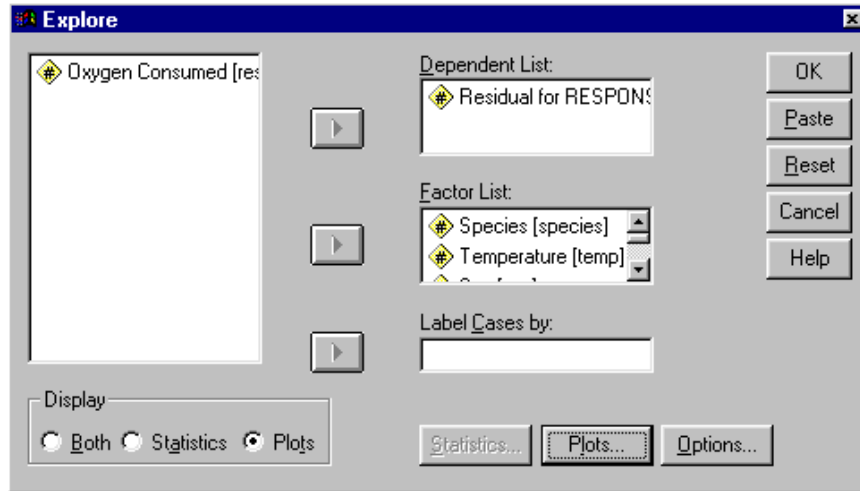
Test Results

Dependent Variable: Oxygen Consumed

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	.370	2	.185	3.358	.139
Error ^a	.221	4	5.514E-02		

a. SPECIES * TEMP * SEX

To check the test assumptions of normal distribution of error and homogeneity of variances, use the Explore Procedure:



Place all of the factors and interaction terms in the Factor List Box. In this example, the residuals of the response variable are used to check the assumptions.

Explore Output

Species

Tests of Normality

	Species	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Residual for RESPONSE	1	.145	24	.200*	.944	24	.198
	2	.124	24	.200*	.952	24	.296
	3	.139	24	.200*	.947	24	.228

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Test of Homogeneity of Variance

	Levene Statistic	df1	df2	Sig.	
Residual for RESPONSE	Based on Mean	2.276	2	69	.110
	Based on Median	1.677	2	69	.194
	Based on Median and with adjusted df	1.677	2	65.600	.195
	Based on trimmed mean	2.321	2	69	.106

Temperature

Tests of Normality

Temperature		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Residual for RESPONSE	Low	.093	24	.200*	.961	24	.454
	Medium	.146	24	.200	.951	24	.281
	High	.113	24	.200*	.964	24	.514

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Residual for RESPONSE	Based on Mean	.019	2	69	.981
	Based on Median	.019	2	69	.981
	Based on Median and with adjusted df	.019	2	67.730	.981
	Based on trimmed mean	.019	2	69	.981

Sex

Tests of Normality

Sex		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Residual for RESPONSE	Male	.106	36	.200*	.961	36	.236
	Female	.085	36	.200*	.970	36	.427

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Residual for RESPONSE	Based on Mean	.703	1	70	.405
	Based on Median	.703	1	70	.405
	Based on Median and with adjusted df	.703	1	69.622	.405
	Based on trimmed mean	.702	1	70	.405

Species x Temperature

Tests of Normality

Species x Temperature		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Residual for RESPONSE	11	.203	8	.200*	.924	8	.467
	12	.235	8	.200*	.940	8	.611
	13	.218	8	.200*	.926	8	.476
	21	.122	8	.200*	.978	8	.953
	22	.223	8	.200*	.861	8	.122
	23	.159	8	.200*	.939	8	.600
	31	.116	8	.200*	.970	8	.900
	32	.139	8	.200*	.959	8	.796
	33	.263	8	.109	.897	8	.273

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Residual for RESPONSE	Based on Mean	.549	8	63	.815
	Based on Median	.472	8	63	.871
	Based on Median and with adjusted df	.472	8	51.097	.870
	Based on trimmed mean	.565	8	63	.802

Species x Sex

Tests of Normality

Species x Sex		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Residual for RESPONSE	11	.159	12	.200*	.911	12	.219
	12	.211	12	.145	.923	12	.310
	21	.166	12	.200*	.929	12	.373
	22	.111	12	.200*	.976	12	.961
	31	.149	12	.200*	.943	12	.538
	32	.147	12	.200*	.946	12	.586

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Residual for RESPONSE	Based on Mean	1.770	5	66	.131
	Based on Median	1.574	5	66	.180
	Based on Median and with adjusted df	1.574	5	62.263	.181
	Based on trimmed mean	1.766	5	66	.132

Temperature x Sex

Tests of Normality

Temperature x Sex		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Residual for RESPONSE	11	.101	12	.200*	.947	12	.593
	12	.111	12	.200*	.976	12	.961
	21	.130	12	.200*	.962	12	.811
	22	.189	12	.200*	.914	12	.238
	31	.154	12	.200*	.952	12	.671
	32	.126	12	.200*	.967	12	.872

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Residual for RESPONSE	Based on Mean	.344	5	66	.884
	Based on Median	.338	5	66	.888
	Based on Median and with adjusted df	.338	5	63.325	.888
	Based on trimmed mean	.344	5	66	.884

Species x Temp x Sex

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Residual for RESPONSE	Based on Mean	.581	17	54	.891
	Based on Median	.545	17	54	.916
	Based on Median and with adjusted df	.545	17	37.649	.910
	Based on trimmed mean	.580	17	54	.892

Tests of Normality

Species x Temp x Sex	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Residual for RESPONSE						
111	.214	4	.	.963	4	.798
112	.208	4	.	.950	4	.714
121	.215	4	.	.946	4	.689
122	.298	4	.	.849	4	.224
131	.237	4	.	.939	4	.650
132	.364	4	.	.840	4	.195
211	.192	4	.	.971	4	.850
212	.210	4	.	.982	4	.911
221	.208	4	.	.950	4	.714
222	.208	4	.	.950	4	.714
231	.214	4	.	.963	4	.798
232	.192	4	.	.971	4	.850
311	.192	4	.	.971	4	.850
312	.192	4	.	.971	4	.850
321	.151	4	.	.993	4	.972
322	.192	4	.	.971	4	.850
331	.151	4	.	.993	4	.972
332	.364	4	.	.840	4	.195

a. Lilliefors Significance Correction

If the assumptions are not met at any level

1. Transform the original observed values.
2. Re-run the ANOVA using the transformed values as the dependent variable, and generate a new set of residual values.
3. Re-run Explore using the new residual values as the dependent variable.