A Two-Way ANOVA Example

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1 The Data

The table below gives the survival times in hours for animals in an experiment whose design consisted of three poissons, four treatments, and four observations per cell (from Rice, J. (1988), *Mathematical Statistics and Data Analysis*, Wadsworth and Brooks/Cole, Pacific Grove, California, p. 432).

The data are entered the way they need to be for Stataquest. The first variable is the response, while the next three are the poisson number, treatment number, and treatment combination.

X	Poiss	Treat	TC
3.1	1	1	1
4.6	1	1	1
4.5	1	1	1
4.3	1	1	1
8.2	1	2	2
8.8	1	2	2
11.0	1	2	2
7.2	1	2	2
4.3	1	3	3
6.3	1	3	3
4.5	1	3	3
7.6	1	3	3
4.5	1	4	4
6.6	1	4	4
7.1	1	4	4
6.2	1	4	4
3.6	2	1	5
4.0	2	1	5
2.9	2	1	5
2.3	2	1	5
9.2	2	2	6
4.9	2	2	6
6.1	2	2	6
12.4	2	2	6
4.4	2	3	7
3.1	2	3	7
3.5	2	3	7
4.0	2	3	7
5.6	2	4	8
7.1	2	4	8
10.0	2	4	8
3.8	2	4	8
2.2	3	1	9
1.8	3	1	9
2.1	3	1	9
2.3	3	1	9
3.0	3	2	10
3.8	3	2	10
3.7	3	2	10
2.9	3	2	10
2.3	3	3	11
2.4	3	3	11
2.5	3	3	11
2.2	3	3	11
3.0	3	4	12
3.1	3	4	12
3.6	3	4	12
3.3	3	4	12

2 Testing Significance of Treatment Combinations

Using One-Way ANOVA in Stataquest shows the means for the 12 treatment combinations are highly significantly different, with an F statistic of 9.14 and a p-value equal to 0 to four decimal places. Figure 1 is a Stataquest plot of the 12 sample means with confidence intervals placed on each one. This plot helps us see which means appear to be different.

3 Two-Way ANOVA

Using Two-Way ANOVA in Stataquest shows that there is no significant interaction (p-value of 0.11 and the interaction plot in Figure 2 shows no strong interaction), but highly significant main effects. Thus the different poissons and treatments each lead to significantly different mean responses and their combined effect is just the sum of their individual effects.

Testing Significance of Treatment Combinations

var4	Summary of var1 Mean	Std. Dev.	Freq.
1	4.125	.69462224	4
2	8.8	1.6083118	4
3	5.6750001	1.5671098	4
4	6.0999999	1.1284207	4
5	3.2	.75277264	4
6	8.1499999	3.3630342	4
7	3.75	.56862414	4
8	6.6249999	2.6234519	4
9	2.1	.2160247	4
10	3.35	.46547463	4
11	2.35	.12909944	4
12	3.2499999	.2645751	4
Total	4.7895833	2.5196453	48

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	219.692286	11	19.972026	9.14	0.0000
Within groups	78.6924966	36	2.18590268		
Total	298.384782	47	6.34861239		

Bartlett's test for equal variances: chi2(11) = 44.7515 Prob>chi2 = 0.000

Two-Way ANOVA for Survival Data

Number of obs = 48   R-squared = 0.7363
Root MSE = 1.47848   Adj R-squared = 0.6557

Source	Partial SS	df	MS	F	Prob > F
Model	219.692286	11	19.972026	9.14	0.0000
var2	103.042916	2	51.5214578	23.57	0.0000
var3	91.9039547	3	30.6346516	14.01	0.0000
var2*var3	24.7454155	6	4.12423592	1.89	0.1100
Residual	78.6924966	36	2.18590268		
Total	298.384782	47	6.34861239		

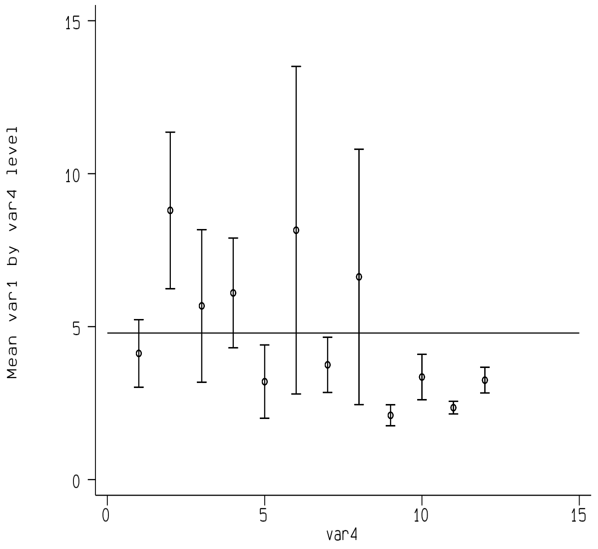

Figure 1: Plot of Means of Treatment Combinations for Survival Data

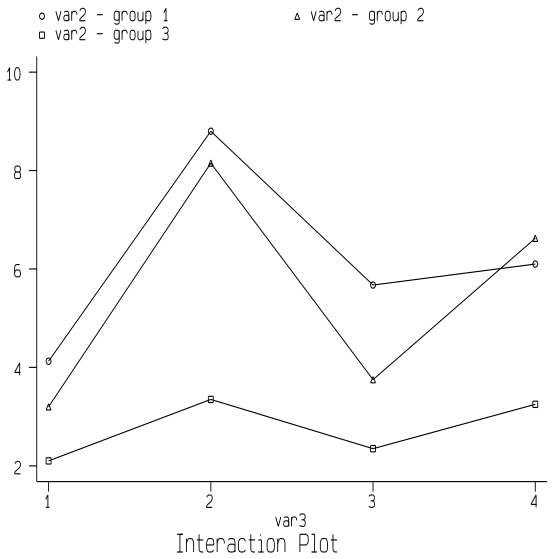

Figure 2: Interaction Plot for Survival Data