

## Balanced Two-Way Factorial Design

### The Data

The example was taken from Box, Hunter, and Hunter<sup>1</sup> (1978). Displayed in the following table are the survival times, in units of 10 hours, of animals in a 3 x 4 replicated factorial experiment. In this experiment, each animal was given one of three poisons, labeled I, II, and III, and one of four treatments, labeled A, B, C, and D. Four animals were used for each combination of poison and treatment, making four replicates.

Table 1: The original data: Balanced Two-Way Factorial Design

Poison	Treatment							
	A		B		C		D	
<b>I</b>	0.31	0.45	0.82	1.10	0.43	0.45	0.45	0.71
	0.46	0.43	0.88	0.72	0.63	0.76	0.66	0.62
<b>II</b>	0.36	0.29	0.92	0.61	0.44	0.35	0.56	1.02
	0.40	0.23	0.49	1.24	0.31	0.40	0.71	0.38
<b>III</b>	0.22	0.21	0.30	0.37	0.23	0.25	0.30	0.36
	0.18	0.23	0.38	0.29	0.24	0.22	0.31	0.33

### The Table of Cell Means

The table of cell means provides a useful summarization of this type of data:

Table 2: Table of Cell Means

Poison	Treatment				row means
	A	B	C	D	
<b>I</b>	0.4125	0.8800	0.5675	0.6100	<b>0.6175</b>
<b>II</b>	0.3200	0.8150	0.3750	0.6675	<b>0.5444</b>
<b>III</b>	0.2100	0.3350	0.2350	0.3250	<b>0.2763</b>
column means	<b>0.3142</b>	<b>0.6767</b>	<b>0.3925</b>	<b>0.5342</b>	<b>0.4794</b>

Also, it can be found that the overall sample variance is  $s_y^2 = 0.06394$ .

### The Interaction Plot

According to the table of cell means, the interaction plot can be made.

<sup>1</sup>Box, G.E.P., Hunter, W.G., and Hunter, J.S. (1978). *Statistics for Experimenters: An Introduction to Design, Data Analysis*. New York: John Wiley & Sons, Inc.

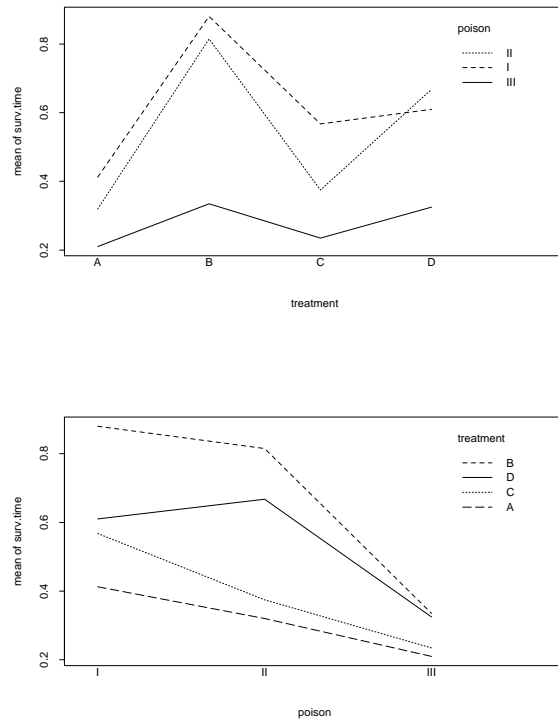


Figure 1: interaction plot

The ANOVA Table

Table 3: ANOVA Table

Source	df	SS	MS	$F$	P-value
Treatment	3	0.921	0.3071	6.456	0.0013
Poison	2	1.033	0.5165	23.22	0.0000
Interaction	6	0.250	0.0417	1.87	0.1123
Error	36	0.801	0.0222		
Total	47	3.004			