Chapter 11 – Factorial ANOVA

**Repeated measures two-way ANOVA**

Students’ levels of anxiety were measured based on two sources, examinations and bungee jumping. Both factors were measured pre- and post-activity. Each measurement used a scale of 1 to 10, 1 being the lowest and 10 being the highest. One of the factors is the source of anxiety; the other is time before and after the activity.

Perform a repeated measures two-way ANOVA to analyze the individual and interaction effects of activity and time on the students’ anxiety levels (on the Repeated-measures two-way ANOVA.csv file).

|  |  |  |  |
| --- | --- | --- | --- |
| PreExam\_Anxiety | PostExam\_Anxiety | PreBungee\_Anxiety | PostBungee\_Anxiety |
| 6 | 5 | 9 | 7 |
| 9 | 6 | 6 | 4 |
| 5 | 3 | 8 | 5 |
| 6 | 2 | 5 | 5 |
| 6 | 5 | 9 | 6 |
| 3 | 3 | 7 | 5 |
| 9 | 6 | 7 | 5 |
| 4 | 2 | 4 | 3 |
| 8 | 5 | 6 | 5 |
| 7 | 2 | 8 | 4 |

**Between-Subjects ANOVA**

A fiber company is analyzing the breaking strength of their product on several production batches. Four production machines are chosen, and the operator was also noted. The results are as follows (on the Between Subjects ANOVA.csv file):

|  |  |  |
| --- | --- | --- |
| Breaking strength | Machine | Operator |
| 109 | 1 | 1 |
| 110 | 1 | 1 |
| 110 | 1 | 2 |
| 112 | 1 | 2 |
| 116 | 1 | 3 |
| 114 | 1 | 3 |
| 110 | 2 | 1 |
| 115 | 2 | 1 |
| 110 | 2 | 2 |
| 111 | 2 | 2 |
| 112 | 2 | 3 |
| 115 | 2 | 3 |
| 108 | 3 | 1 |
| 109 | 3 | 1 |
| 111 | 3 | 2 |
| 109 | 3 | 2 |
| 114 | 3 | 3 |
| 119 | 3 | 3 |
| 110 | 4 | 1 |
| 108 | 4 | 1 |
| 114 | 4 | 2 |
| 112 | 4 | 2 |
| 120 | 4 | 3 |
| 117 | 4 | 3 |

Test to see if there is a difference in breaking strength according to the factors considered.

**Mixed ANOVA**

The quality control department of a fabric dye company is analyzing the difference in quality of dyes produced by three machines. In addition, the department wants to study if the dyeing temperature affects the quality; different temperatures can be tried on the same machine. Below are the results (also on the Mixed ANOVA.csv file):

|  |  |  |  |
| --- | --- | --- | --- |
| Cloth  | Machine | 300\_Temperature | 350\_Temperature |
| 1 | 1 | 23 | 24 |
| 2 | 1 | 24 | 23 |
| 3 | 1 | 25 | 28 |
| 4 | 2 | 30 | 38 |
| 5 | 2 | 28 | 36 |
| 6 | 2 | 26 | 35 |
| 7 | 3 | 31 | 34 |
| 8 | 3 | 32 | 36 |
| 9 | 3 | 29 | 39 |

Conduct a mixed ANOVA to identify which factors are associated with dye score.