Stat 502 Solutions for Review for Exam 1

*Grading note: Hypotheses are expressed in this key in terms of means, but the alternative form of stating null hypothesis in terms of treatment effects (e.g. ) are accecpted* ***if*** *the Model containing these effects is shown and all terms and subscripts explained explicitly).*

**1)** A study was conducted to evaluate the effect of three different drugs on blood cholesterol concentration (mg/100 ml plasma) in women. Each drug could be obtained from two different sources and these were also of specific interest to the researchers.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **DRUG 1** | | **DRU** | **G 2** | **DRUG 3** | |
| **Source A Source Q** | | **Source D Source B** | | **Source L Source S** | |
| 102 | 103 | 108 | 109 | 104 | 105 |
| 104 | 104 | 110 | 108 | 106 | 107 |

a) (10pts) State the Null and Alternative hypotheses for this experiment.

b) (10 pts) Write out the first two columns of the ANOVA table (i.e., Source and df).

Source DF

Drug 2

Source(Drug) 3

Error 6

Total 11

**2)** Consider the following 2-factor factorial, with factor A having 4 levels and factor B having 3 levels, and n=3 observations per treatment combination. Given that the SSA + SSB + SSAxB = 170,

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Source | d.f. | SS | MS | F |
| FactorA | *3* | *120* | 40 | *16* |
| FactorB | *2* | 20 | *10* | *4* |
| AxB | *6* | *30* | *5* | *2* |
| Error | *24* | *60* | *2.5* |  |
| Total | *35* | 230 |  |  |

**a)** (10 pts) Complete the ANOVA table.

**b)** (5pts) What is the FCritical (or Fα) for the test of the AxB interaction? (*Appendix B, Table B4) 2.51*

**c)** (5pts) What decision would you make for H0: there is no AxB interaction?

*Fcaclulated < Fcritical Do not Reject H0.*

**3)** An experiment is conducted to evaluate the thrust force encountered when drilling in a machine shop. The factors of interest are Material (two levels), the feed rate (3 levels) and the drill speed (5 levels). Two replications of each of the 2 x 3 x 5 combinations of treatments were used in a completely randomized design (i.e., the order in which the treatment combinations were set up and tested was randomized).

a) (10pts) State the Null and Alternative hypotheses for this experiment.

b) (10 pts) Write out the first two columns of the ANOVA table (i.e., Source and df).

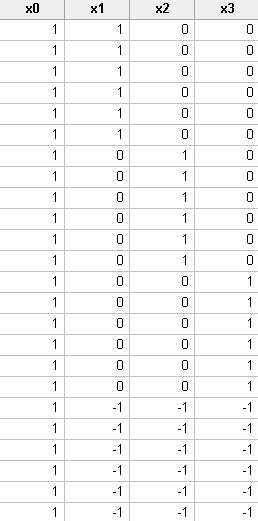


**4)** An experiment was conducted to compare volume delivery (vol) by 4 machines. For each machine, 6 trials (replications) were recorded and we want to fit the ANOVA model

The data, arranged in unstacked format (*i columns* by *j rows)*, was:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| trial | machine1 | machine2 | machine3 | machine4 |
| 1 | 18 | 18 | 15 | 19 |
| 2 | 18 | 19 | 14 | 20 |
| 3 | 19 | 18 | 15 | 18 |
| 4 | 17 | 18 | 16 | 19 |
| 5 | 19 | 19 | 14 | 18 |
| 6 | 18 | 19 | 16 | 19 |

a) (10pts) Construct the design matrix **X,** the matrix containing the indicator vectors as columns, to generate the estimates of for this model using regression.



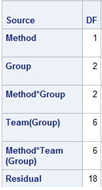
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |

**5)** A military installation is interested in evaluating the speed of reloading a large gun. Two methods of reloading are considered, and 3 groups of cadets were evaluated (slight, average, and heavy individuals). Three teams were set up within each group and they wanted to identify the fastest team within each group to go on to a demonstration for the military officials. The data is in the Excel File ‘navy\_gun\_data.xlsx’.

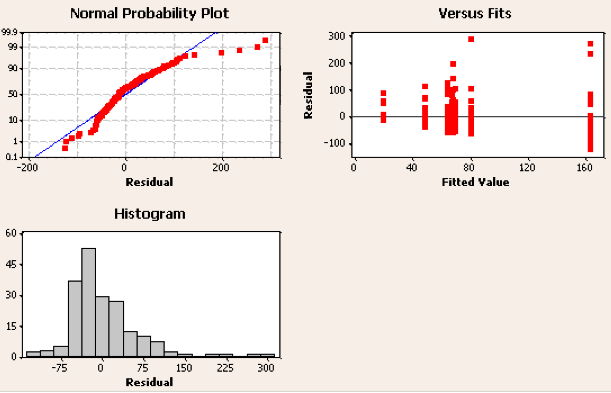
a) (10pts) State the Null and Alternative hypotheses for this experiment

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b) (10 pts) Write out the first two columns of the ANOVA table (i.e., Source and df).



**6)** (10pts) The following graphs resulted from a one-way ANOVA. From the graphs, what can you conclude about the model?



*There are a few concerns here. Most important is non-constancy of variance and suggests a log transformation (residuals are ‘fanning out’ in upper right panel). In addition, the residual distribution is not centered on 0, and appears to violate the normality assumption ( is right skewed).*