Last Name:

First Name:

SCIPER:

Practice Problems: Exercise 8 – Microengineering 110

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Prof. Vivek Subramanian

1. In an experiment to compare the tensile strengths of I = 5 different types of copper wire, J = 4 samples of each type were used. The between-samples and within samples estimates of σ^2 were computed as MS_T = 2673.3 and MS_R = 1094.2, respectively. Use the F test at level .05 proof or disprove the null hypothesis.

$$\text{The computed value of } F \text{ is } f = \frac{\text{MSTr}}{\text{MSE}} = \frac{2673.3}{1094.2} = 2.44$$

Using socscicalc with DF of 4,15, we find that P is 0.09, so the null hypothesis is not rejected.

2. The following data on total Fe for four types of iron formations was found in pre-cambrian samples, obtained by geologists (1 = carbonate, 2 = silicate, 3 = magnetite, 4= hematite)

1:	20.5	28.1	27.8	27.0	28.0
	25.2	25.3	27.1	20.5	31.3
2:	26.3	24.0	26.2	20.2	23.7
	34.0	17.1	26.8	23.7	24.9
3:	29.5	34.0	27.5	29.4	27.9
	26.2	29.9	29.5	30.0	35.6
4:	36.5	44.2	34.1	30.3	31.4
	33.1	34.1	32.9	36.3	25.5

Carry out an analysis of variance F test at significance level .01, and summarize the results in an ANOVA table.

Using the one-way ANOVA for independent means in socscistats, we obtain the following table:

Result Details				
Source	*SS*	*df*	*MS*	
Between-treatments	509.122	3	169.7073	*F* = 10.84904
Within-treatments	563.134	36	15.6426	
Total	1072.256	39		

The p-value for is is approximately 0, so the null hypothesis is strongly rejected.

3. An experiment was carried out to compare electrical resistivity for six different low-permeability concrete bridge deck mixtures. There were 26 measurements on concrete cylinders for each mixture; these were obtained 28 days after casting. The entries in the accompanying ANOVA table are based on information obtained from this experiment. Fill in the remaining entries and test appropriate hypotheses. Note that the mixture row is the "Between treatments" row, and the "Error" row is the within treatments row, since each mixture is a different treatment, and the error is the built-in variation.

Source	df	Sum of Squares	Mean Square	*f*
Mixture				
Error			13.929	
Total		5664.415		

We can proceed by noting that there at 6 treatments, so DF for the mixture row is 5.
There are 26 samples for each measurement, so the DF for the D sub-table is 155. That means the DF for the error row is 150.

*Given this, we can calculate the SSError `= 150*13.929 = 2089.350*
From the Total SS, we can then calculate SSTreatments = 5664.415-2089.350 = 3575.065
We can then find MSTreeatments = 3575.065 / 5 = 715.013
Then, we can find F = 715.013 / 13.929 = 51.3

Source	df	SS	MS	*f*
Treatments	5	3575.065	715.013	51.3
Error	150	2089.350	13.929	
Total	155	5664.415		

The P value is approximately 0, indicating that the null hypothesis is strongly rejected. In other words, the choice of mixture affects the resistivity.

4. Six samples of each of four types of cereal grain grown in a certain region were analyzed to determine thiamin content, resulting in the following data (mg/g):

Wheat 5.2 4.5 6.0 6.1 6.7 5.8
Barley 6.5 8.0 6.1 7.5 5.9 5.6
Maize 5.8 4.7 6.4 4.9 6.0 5.2
Oats 8.3 6.1 7.8 7.0 5.5 7.2

Does this data suggest that at least two of the grains differ with respect to true average thiamin content? Use a level $\alpha = .05$ test.

Using soscistats, we obtain the following table:

Result Details				
Source	*SS*	*df*	*MS*	
Between-treatments	8.9833	3	2.9944	$F = 3.95654$
Within-treatments	15.1367	20	0.7568	
Total	24.12	23		

The P value is 0.022, which is less that 0.05, indicating that the null hypothesis is rejected, and there is therefore a different is thiamin content between at least 2 of the grain types.