COSC6323 - Homework 3

March 2021

Instructions

Please compile your report as a pdf. Submit both: FirstName_LastName.rmd (if used) and FirstName_LastName.pdf files to the black board.

1 Task 1

A manufacturer of air conditioning ducts is concerned about the tensile strength of the sheet metal among the many supplies of this material. Four samples of sheet metal from four randomly chosen supplies are tested for tensile strength. The data are given in Table 1.

Supplier 1	Supplier 2	Suppler 3	Supplier 4
19	80	47	90
21	71	26	49
19	63	25	83
29	56	35	78

Table 1. Data for exercise 1

(a) Perform the appropriate analysis to ascertain whether there is excessive variation among suppliers.
(b) Estimate the appropriate variance components.

2 Task 2

A local bank has three branch offices. The bank has a liberal sick leave policy, and a vice-president was concerned about employees taking advantage of this policy. She thought that the tendency to take advantage depended on the branch at which the employee took for sick leave, she asked each branch manager to sample employees randomly and record the number of days of sick leave during 2008. Ten employees were chosen, and the data are listed in Table 2.

Branch 1	Branch 2	Branch 3
15	11	18
20	15	19
19	11	23
14		

Table 2. Sick Leave by Branch
(a) Do the data indicate a difference in branches? Use a level of significance of 0.05.
(b) Use Duncan's multi-range test to determine which branches differ. Explain your results with a summary plot.

3 Task 3

Brunye et al. (2008) examined the accuracy with which people could understand spatial representations from descriptions that were presented either in survey-perspective form or in route-perspective form. They used regression to examine whether the time spent reading the description (in seconds) would predict the response time (in milliseconds) to questions about the description. They state: There was strong evidence that increases in route description reading times predicted... response times [β = -.03, t(18) = -2.11, p < .05]
Note that the degrees of freedom for the t test statistic are shown within parentheses.
(a) What is the implication of the negative slope?
(b) Give a 95% confidence interval for the expected change in response time, if reading time increases by 20 seconds.
(c) Calculate r^2. Is reading time an accurate predictor of individual response times?

4 Task 4

The data in Table 3 represent the result of a test for the strength of an asphalt concrete mix. The test consisted of applying a compressive force on the top of different sample specimens. Two responses occurred: the stress and strain at which a sample specimen failed. The factors relate to mixture proportions, rates of speed at which the force was applied, and ambient temperature. Higher values of the response variables indicate stronger materials.

Obs	X1	X2	X3	Y1	Y2
1	5.3	0.02	77	42	3.20
2	5.3	0.02	32	481	0.73
3	5.3	0.02	0	543	0.16
4	6.0	2.00	77	609	1.44
5	7.8	0.20	77	444	3.68
6	8.0	2.00	104	194	3.11
7	8.0	2.00	77	593	3.07
8	8.0	2.00	32	977	0.19
9	8.0	2.00	0	872	0.00
10	8.0	0.02	104	35	5.86
11	8.0	0.02	77	96	5.97
12	8.0	0.02	32	663	0.29
13	8.0	0.02	0	702	0.04
14	10.0	2.00	77	518	2.72
15	12.0	0.02	77	40	7.35
16	12.0	0.02	32	627	1.17
17	12.0	0.02	0	683	0.14
18	12.0	0.02	104	22	15.00
19	14.0	0.02	77	35	11.80

Table 3. Data for Exercise 4. Asphalt data.

The variables are:
X1: percent binder (the amount of asphalt in the mixture)
X2: loading rate (the speed at which the force was applied)
X3: ambient temperature
Y1: the stress at which the sample specimen failed
Y2: the strain at which the specimen failed.
Perform separate regressions to relate stress and strain to the factors of the experiment. Check the residuals for possible specification errors. Interpret all results.

5 Task 5

Martinussen et al. (2007) studied burnout among Norwegian policemen. In a sample of n = 220, they regressed y = frequency of psychosomatic complaints on demographic variables gender (0 = man, 1 = woman) and age (m = 2). This regression has $R^2 = 0.05$. They then added independent variables exhaustion burnout score, cynicism burnout score, and professional efficacy burnout score (m = 5). The regression had $R^2 = 0.34$. Given that TSS = 33.7, is there significant evidence that at least one of the burnout scores is related to psychosomatic complaints, after controlling for gender and age? Use $\alpha = 0.05$.