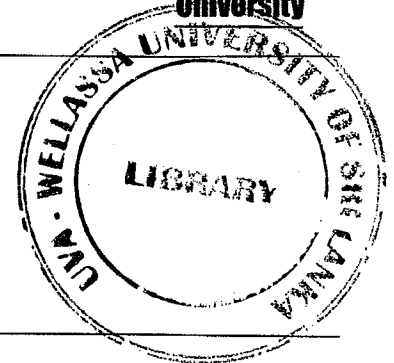


Uva Wellassa University of Sri Lanka
 Faculty of Science and Technology
 Department of Science and Technology
 200 level 2nd Semester Examination – Sept. / Oct. 2015
 SCT 202-2 Statistical Methods



Part B

Instructions to candidates

Duration: One (01) hour and 30 minutes
Number of questions: Three (03) essay questions
Mark allocation: 80
 Answer All Questions.
 Scientific Calculators are allowed.

1. A pharmaceutical company has developed a new headache treatment which is being field tested on 1000 volunteers. In a test some volunteers have received the treatment and some a placebo (a harmless neutral substance). The results of the test are as follows:

	Treatment received	Placebo received
Some improvement	600	125
No improvement	150	125

Calculate:

- a. the probability that a volunteer has shown some improvement. (4 mark)
 - b. the conditional probability that the volunteer has shown some improvement given that he or she has received the treatment. (4 mark)
 - c. the conditional probability that the volunteer has received the treatment given that no improvement has been observed. (4 mark)
 - d. the conditional probability that the volunteer has received the placebo given that some improvement has been observed. (4 mark)
 - e. Briefly explain what the evidence in the table suggests to you about the effectiveness of the treatment. (4 mark)
2. Anthropologists analyse human skeletal remains to determine the height of the person when alive. A linear relationship is assumed to hold between the length (x cm) of metacarpal bone and structure (y cm). The summary statistics are given below:

$$n = 10 \quad \sum_{i=1}^{10} x_i = 461 \quad \sum_{i=1}^{10} y_i = 1727 \quad \sum_{i=1}^{10} x_i y_i = 79886$$

$$\sum_{i=1}^{10} x_i^2 = 21411 \quad \sum_{i=1}^{10} y_i^2 = 298843$$

- a. Compute the correlation between x and y . Based on this, comment on the strength and nature of the linear relationship. (6 mark)
- b. Find the equation of the least-square regression line. (6 mark)
- c. A person, whose bone was 45cm long, was 171cm tall. Compute the residual for this observation. (3 mark)
- d. Construct the Analysis of Variance (ANOVA) Table (6 mark)
- e. How much proportion of variation can be explained by the fitted regression model? (3 mark)

f. What are the model assumptions and mention appropriate tests to check the validity of assumptions? (6 mark)

3. Four different coatings (A, B, C, & D) are being considered for corrosion protection of a certain type of metal pipe when it is buried in soil. To investigate whether the amount of corrosion depends on the coating, 15 pieces of pipe are available. Coatings enough for 5, 3, 4 and 3 pieces of pipe are available from type A, B, C, & D respectively. Each piece is to be coated with one of the four coating, and to be buried in soil for a fixed time, after which the amount of corrosion will be measured.

Suppose an engineer seeks your help to design an experiment and analyze data in order to determine whether all four coatings have the same capability to protect pipes from corrosion.

- a. Explain clearly how an experiment should be carried out to test this corrosion protection of pipes (5 mark)
- b. What is the model that you will use? (5 mark)
- c. What is/are the hypothesis (hypotheses) that you intend to test? (4 mark)
- d. What is/are the test statistic(s) that you will use to test above hypothesis (hypotheses)? (3 mark)

Now suppose an engineer has carried out an experiment, and has recorded the data in a table as follows. The column C1, C2, C3 & C4 contain the amount of corrosion observed in pipes that were coated with coating A, B, C, & D respectively.

Amount of corrosion observed in pipes that were coated with coating A, B, C, & D respectively			
A	B	C	D
48	81	54	65
49	85	45	70
47	89	50	69
50		53	
53			

- e. Suppose that in usual notation, $SSE = 116.20$, and $SST = 3101.73$. Construct the ANOVA table and interpret the results in ANOVA table with a suitable hypothesis. (8 mark)
- f. Interpret the following MINITAB output in your own words by writing appropriate hypotheses.

Table 01: All pairwise comparisons among levels of method

Grouping Information Using Tukey Method and 95.0% Confidence			
Coating	N	Mean	Grouping
2	3	85.00	A
4	3	68.00	B
3	4	50.50	C
1	5	49.40	C

Means that do not share a letter are significantly different.

(5 mark)

Useful Formula



$$1. r = 1 - 6 \sum \frac{d_i^2}{n(n^2-1)}$$

$$2. r = \frac{(\sum_{i=1}^n X_i Y_i - n\bar{X}\bar{Y})}{\sqrt{(\sum_{i=1}^n X_i^2 - n\bar{X}^2)(\sum_{i=1}^n Y_i^2 - n\bar{Y}^2)}}$$

$$3. \beta_1 = \frac{(\sum_{i=1}^n X_i Y_i - n\bar{X}\bar{Y})}{(\sum_{i=1}^n X_i^2 - n\bar{X}^2)}$$

$$4. \beta_0 = \bar{Y} - \beta_1 \bar{X}$$

$$5. \text{Sum of Squared total (SST)} = \sum_{i=1}^n Y_i^2 - n\bar{Y}^2$$

$$6. \text{Sum of Squared Regression (SSR)} = \frac{(\sum_{i=1}^n X_i Y_i - n\bar{X}\bar{Y})^2}{(\sum_{i=1}^n X_i^2 - n\bar{X}^2)}$$