

**Uva Wellassa University of Sri Lanka**  
**Faculty of Science and Technology**  
**Department of Science and Technology**  
**400 Level 1<sup>st</sup> Semester Examination – June/ July 2017**  
**SCT 401-1 Data Handling and Statistics**



**Instructions to candidates.**

**Duration:** 02 hours

**Number of questions:** Four (04) essay questions

**Mark allocation:** 100 mark

**Answer All Questions.**

1.

- a) Explain the meaning of the following terms used in hypothesis tests.
- i. Type I error. (2 mark)
  - ii. Level of significance. (2 mark)
  - iii. Power of the test. (2 mark)
- b) The researcher wishes to compare the effectiveness of two treatments A and B. In abstracting water from different chemical compounds, each treatment was applied under controlled conditions to random 100-gram samples of 10 different compounds. The weights in grams of water removed were recorded.

Compound No	1	2	3	4	5	6	7	8	9	10
Treatment A	13.3	17.6	4.1	17.3	10.1	3.7	5.0	7.9	8.8	11.7
Treatment B	13.5	17.9	4.7	17.1	10.5	4.1	4.9	7.9	8.8	12.1

Noting any assumptions made and taking into account the paired nature of the data, carry out a two-tailed parametric test of the null hypothesis that treatments A and B are equally effective on average. Comment briefly on your results. (10 mark)

- c) An experiment on the effect of immunization of goats against disease was conducted at a farm. Two batches, each of 10 animals, were taken. One batch was inoculated and other batch was not inoculated. Then, both the batches were exposed to the infection of the disease. The frequencies of dead and survived animals were observed in both of the batches. The results are given in the table below. From the results, test whether the inoculation is effective against disease by using appropriate statistical test.

	Dead	Survived	Total
Inoculation	2	8	10
Not inoculation	7	3	10
Total	9	11	20

(10 mark)



2. An experiment was conducted to determine the extent to which the growth rate of certain fungus could be affected by filling test tubes containing the same medium at the same temperature with different gasses. Thirty such experiment were performed each of three gases, and the growth rate over these thirty tests was used as the response. The molecular weight (mg) of each gas used and the growth rate in milliliters per hour for the thirty tests are given in table below.

(The data are stored in a Minitab work sheet named "Fungus.mtw" given on your computer.)

Gas	Growth rate (milliliters per hour)	Molecular Weight (mg)	Gas	Growth rate (milliliters per hour)	Molecular Weight (mg)	Gas	Growth rate (milliliters per hour)	Molecular Weight (mg)
A	3.23	14.00	B	3.20	28.20	C	2.67	83.80
A	3.19	20.20	B	2.93	39.90	C	2.27	121.30
A	3.19	19.26	B	3.10	25.21	C	2.27	110.05
A	3.24	18.53	B	3.11	25.02	C	2.31	115.31
A	3.17	14.84	B	3.10	26.12	C	2.80	69.00
A	3.01	17.72	B	3.05	31.44	C	2.28	100.07
A	3.19	14.80	B	2.92	35.45	C	2.53	82.24
A	3.15	19.13	B	3.17	25.29	C	2.31	104.23
A	3.06	20.10	B	3.17	32.84	C	2.80	59.24
A	3.13	15.04	B	3.16	25.63	C	2.32	105.29
A	3.27	16.81	B	2.98	27.62	C	3.09	42.11
A	3.07	18.20	B	2.96	26.33	C	2.59	76.95
A	3.11	19.12	B	3.02	34.36	C	2.93	54.14
A	3.21	15.30	B	3.17	35.70	C	2.97	51.44
A	3.25	19.72	B	2.99	28.24	C	3.03	41.81
A	3.15	19.18	B	3.19	37.33	C	2.40	110.99
A	3.15	17.08	B	2.92	38.91	C	2.83	47.71
A	3.25	17.67	B	2.98	33.76	C	2.90	47.47
A	3.18	17.52	B	2.97	32.88	C	2.42	110.97
A	3.17	19.43	B	3.15	27.62	C	2.63	59.27
A	3.23	15.89	B	3.09	33.88	C	2.97	45.94
A	3.10	17.07	B	2.79	39.58	C	2.41	99.75
A	3.13	14.40	B	2.95	34.34	C	2.44	98.62
A	3.23	19.01	B	2.96	38.43	C	2.63	73.18
A	3.01	15.43	B	2.96	39.69	C	2.80	66.68
A	3.18	18.38	B	3.10	38.13	C	2.70	71.60
A	3.18	15.54	B	3.03	37.16	C	2.87	50.51
A	3.06	17.32	B	2.98	35.04	C	2.67	74.65
A	3.13	17.02	B	3.04	32.62	C	2.84	60.78
A	3.15	16.29	B	2.99	33.44	C	2.96	41.90

- a) Construct a scatterplot to examine the relationship between molecular weight and growth rate with respect to the different gasses. Comment on the scatterplot with correlation. (6 mark)
- b) Find an appropriate multiple regression model to predict the growth rate using molecular weight for each gas. (8 mark)
- c) Write a brief report of your findings (it should include all relevant hypothesis with ANOVA, model checking and validation and necessary and relevant analysis). (10 mark)

3.

- a) In what situations do we use nonparametric tests? (4 mark)
- b) A taste-testing experiment has been designed so that four brands of coffee are to be rated by nine experts. To avoid any carryover effects, the tasting sequence of the four brews is randomly determined for each of the nine expert tasters until a rating on a 7-point scale (1 = extremely unpleasing, 7 = extremely pleasing) is given for each of four characteristics: taste, aroma, richness, and acidity. The following table displays the ratings accumulated over all four characteristics.

Blocks of Experts	Coffee Brand			
	A	B	C	D
E.B.	24	26	25	22
N.B.	27	27	26	24
M.D.	19	22	20	16
M.H.	24	27	25	23
B.J.	22	25	22	21
R.J.	26	27	24	24
B.K.	27	26	22	23
B.M.	25	27	24	21
J.S.	22	23	20	19

"At a level of significance of 0.01 is the sufficient evidence to indicate that there is a difference in the summated ratings of the four brands of coffee? "

Write down a full report to achieve the above target. (Your report should include: appropriate statistical test, Suitable hypothesis, mean comparisons and other necessary analysis with the appropriate conclusions.)

(16 mark)

4. "Experiments are conducted to obtain correct information about real world phenomena"

- a) Briefly discuss the importance of Experimental Designs in research with an examples. (5 mark)
- b) What are the main principles of Experimental Designs? (5 mark)



- c) An experiment was conducted to compare 3 brands of gasoline. Each brand was used with 7 different cars of the same weight and engine size, under similar operating conditions. The data collected were the miles per gallon obtain for each of the cars.

Brand A: 19 24 24 21 20 22 25

Brand B: 25 26 34 25 24 24 23

Brand C: 25 31 28 29 28 30 28

- a) Identify the most suitable experimental design for this experiment giving justifications. (2 mark)
- b) What is the model that you will use? (describe each and every term in the model.) (3 mark)
- c) Construct the complete ANOVA table and interpret the results in ANOVA table with suitable hypothesis. (6 mark)
- d) What is the best brand of gasoline? (5 mark)
- e) What are the advantages and disadvantages of the experimental design you proposed? (4 mark)