



University of Ruhuna

B.Sc.(General) Degree

Level III (Semester I) Examination - June 2015

Subject: Industrial Mathematics/Applied Mathematics

Course Unit: IMT313 β /AMT314 β /MAS3113/MSP316 β

(Applied Statistics II)

Time: Two (02) Hours

Answer four(04) questions only

1. a) An experiment was designed to compare the effectiveness of methods of teaching Mathematics. At the beginning of the semester, 15 students from grade six were randomly selected and taught Mathematics under traditional method. A test paper was given to measure their knowledge at the end of the semester. The marks obtained are recorded as follows;

33 57 32 54 52 34 60 40 59 39 40 59 44 32 55

Assuming that the marks were normally distributed, test whether the mean mark was less than 50, at 0.05 level of significance.

- b) For the same students for the second semester, a new teaching method was used to teach Mathematics. At the end of this semester again their knowledge was measured by a test paper. The marks obtained are shown in the same order.

44 60 55 68 40 48 57 49 47 52 58 51 66 60 68

At 0.05 significance level, test whether the mean mark of grade six students under the new method was greater than that of the traditional method.

2. Briefly explain two sample-t test.

In an experiment of finding the reaction time to a certain stimulus, a researcher used randomly selected two independent samples of males and females. The reaction times (in milli seconds) are given below;

Male	14	17	35	39	25	26	37	31	22	23	14	20	22
Female	34	36	25	30	34	43							

Assuming that the reaction time is normally distributed test whether,

- (i) the variances of reaction times of males and females are significantly different at 0.02 level of significance.
- (ii) the mean of reaction time of males is greater than that of females at 0.05 level of significance.

3. a) Describe Mann-Whitney U test used in non parametric statistics.

The ages of two samples of males and females of employees in a certain company are recorded as follows;

Males	36	28	38	33	42	40	44	26	43	35	31	25
Female	44	39	34	47	35	32	35	47	48	34	40	30

Apply Mann-Whitney U test at 0.05 level of significance to test the hypothesis that, there is a difference between the average ages of males and females of the company.

(You may assume that the test statistic obeys a normal distribution with the mean $\frac{n_1 n_2}{2}$ and the variance $\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}$.)

- b) A psychiatrist in a hospital observed a patient for 20 days. Each day he recorded the situation, whether the patient was depressed (D) or not depressed (Nd) as below:

D Nd Nd Nd D D Nd D Nd Nd Nd Nd D D D D Nd Nd D D

Do these data suggest a randomness in the occurrence of depression, at 0.05 level of significance. Justify your answer.

4. In a chemical experiment the reaction time y , is known to depend on the temperature x . The relevant observations taken at different temperatures are recorded below.

temperature (°C)	reaction Time (seconds)
23.1	10.5
32.8	16.7
31.8	18.2
32.0	17.0
30.4	16.3
24.0	10.5
39.5	23.1
24.2	12.4

- Assuming the linear regression model $y = \beta_0 + \beta_1 x + c$ with $E(c) = 0$ and $Var(c) = \sigma^2$, estimate the values for β_0 and β_1 .
- Calculate the coefficient of determination and discuss the suitability of the model.
- At 0.05 level of significance, test whether the reaction time and temperature are linearly related.
- Calculate the estimated value for σ^2 .
- At 0.05 level of significance, test the null hypothesis that $\beta_0 = 1$ against the alternative hypothesis $\beta_0 < 1$.

5. a) Four identical six sided dice, each with faces marked 1 to 6 are rolled 200 times. At each rolling, a record is made of the number of dice whose score on the uppermost face is even. The results are as follows.

Number of even scores (x_i)	0	1	2	3	4
Frequency (f_i)	10	41	70	57	22

- (i) Explain why a binomial model might describe the distribution of X .
(ii) Test goodness of fit of the model at 0.05 level of significance.

- b) The table below indicates the data obtained from 100 students who were classified according to their interest in statistics and their ability.

	Highly interested	Interested	Indifferent	Not Interested
Good	15	12	10	5
Tolerate	10	10	5	5
Intolerate	5	10	8	5

Test whether is there any evidence of association between these characteristics at 0.05 level of significance.

6. a) Amount of rice sales in 10 weeks, in a super market are recorded below:

Week	1	2	3	4	5	6	7	8	9	10
Amount of sale(kg)	41	47	62	39	56	64	60	37	52	38

Using sign test at 0.05 level of significance, test whether the average amount of sales per week is less than 60 kg.

- b) Suppose a company makes four kinds of light bulbs as A , B , C and D . It is required to test whether there are any differences in the durability of bulbs. The following table shows the lifetime of four brands.

A	12	18	10	14	16					
B	30	10	28	26	29	29	27	26	28	27
C	13	15	18	10	26	21	16			
D	27	25	30	15	13					

Using Kruskal-Wallis test, examine whether the lifetimes of four brands are same, at 0.05 level of significance.