

University of Ruhuna
B.Sc.(General) Degree
Level III (Semester I) Examination - August 2017

Subject: Industrial Mathematics/Applied Mathematics
Course Unit: IMT313 β /AMT314 β /MAS3113/MSP316 β
(Applied Statistics II)

Time: Two (02) Hours

**Answer (04) questions only,
Calculators will be provided**

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1. a) A small company usually pays overtime on any given week because of the uncertain demand for its product. The company officials want to know whether the mean of overtime hours has changed. Given here is a sample of 16 weeks of overtime data (in hours per week).

57 46 48 63 56 53 62 53 52 44 55 51 48 46 48 50

Assuming that the data are normally distributed, check whether the mean overtime is equal or not 55 hours per week at 0.05 level of significance.

- b) The data on the following indicate total compensation per hour (in dollars) for a health service workers and educational service workers of the country. Use the Mann-Whitney U Test to determine whether these two groups are significance difference in employee compensation at 0.05 level of significance.

Health Service	Educational service
13	23
17	29
26	14
18	24
21	21
13	23
29	18
	21
	29

2. a) An experiment was designed to compare the effectiveness of two methods of training for new students. New students are expected to attend a one month training and at end of the training, they are tested to measure their knowledge. Determine whether there is significance difference in the mean scores of the two methods at 0.05 level of significance. Assume that the scores are normally distributed and variances are equal.

Method A	56	47	42	50	47	51	52	53	42	44	45	43
Method B	59	52	53	54	57	56	55	64				

- (b) Is there a difference in the number of customers who open the fixed deposits according to the region? To test this, analyst randomly selected adults customers and obtain the following data.

Region 1	Region 2	Region 3
13	24	26
15	16	22
20	19	31
18	22	27
23	25	28
	14	33
	17	

Use the Kruskal-Wallis test to determine whether there is a significance difference between regions at 0.05 level of significance.

3. a) A company manager predicts that the sales of four productions A, B, C and D will be the percentages 8%, 47%, 34% and 11% respectively. The first 207 sales are distributed as in the following table. Do the initial sales justify the manager's prediction? Use $\alpha = 0.05$.

Production Type	A	B	C	D
Number of sales	21	109	62	15

- (b) A random sample of 309 lunch customers is taken and summarized information are in the following table. Is the type of beverage ordered with lunch at a restaurant independent of the age of the customer? Use 0.01 level of significance.

Age	Coffee/Tea	Soft Drink	Other(Milk etc..)
21 - 34	26	95	18
35 - 55	41	40	20
> 55	24	13	32

4. a) A company has three manufacturing plants, and company officials want to determine whether there is a difference in the average age of workers at three plants. The following data are the age of five randomly selected workers at each plant.

Plant 1	Plant 2	Plant 3
29	32	25
27	33	24
30	31	24
27	34	25
28	30	26

- (i) Write down a suitable model of analysis of variance for this problem and explain each term with stating the assumptions clearly.
- (ii) Perform an analysis of variance to determine whether there is a significant difference in the mean ages of the workers at the three plants at 0.05 level of significance.
- b) A random sample of normal population of size 25, hypothesize the mean is 32 and variance is 15. Assume that the critical region is the form $\bar{x} > 30$. Find
- (i) Probability of Type I error
- (ii) Probability of Type II error if population mean is 29.

5. a) The strategic planner for the corporation believes dollars spent on advertising can to some extent be a predictor of total sales dollars. As an aid in long-term planning, they gather the following sales and advertising information from several of the companies for 2016 (in dollar millions)

Advertising Cost(x)	2.5	3.7	2.6	6.0	7.6	6.1	6.8	4.2
Sales(y)	48	55	38	94	54	70	26	37

- a) Assuming the linear regression model $y = \beta_0 + \beta_1 x + \epsilon$ with $E(\epsilon) = 0$ and $Var(\epsilon) = \sigma^2$, estimate the values for β_0 and β_1 .
- b) Test whether the advertising cost and sales are linearly related at 0.05 level of significance.
- c) Calculate the estimate value for σ^2 .
- d) Calculate the coefficient of determination and discuss the suitability of the model.
- e) Test the null hypothesis that $\beta_0 = 20$ at 0.05 level of significance.

6. a) The women were divided into two groups according to the gross sales of the business. Interview 100 female with gross salary of less than \$100,000 and 24 of them define sales as success. Out of 95 female with gross salary \$100,000 to \$500,000 and 39 sales are success. Use this information to test whether there is a difference in the proportion of two groups.
- b) The marketing director of the company wants to test a proposed marketing campaign by running advertisement on local television and whether gasoline sales at a sample of the company is difference after the advertising campaign. Use the suitable non parametric test to determine whether sales are difference after campaign at $\alpha = 0.05$.

Number of sales before advertising	Number of sales after advertising
1950	1760
1840	1870
2015	1810
1580	1660
1790	1340
1925	1765