

Programme: MScTe (3rd Semester); PhD (1st Semester)
Semester: Winter

Date: 15 December 2023, Friday
Time: 1:30 pm to 4:30 pm, Afternoon

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF TECHNICAL AND VOCATIONAL EDUCATION (TVE)

Semester Final Examination
Course No: TVE 6355
Course Title: Quantitative Research and Advanced Statistics

Winter Semester (2022-2023)
Time: 3 hours
Full Marks: 150

There are seven (7) questions. Answer any six (6) questions.

Figures in the right margin indicate marks of the questions. Necessary formulas are enclosed at the end of the questions. The symbols have their usual meanings.

1. a) What is Type I and Type II error? How do you minimize the risk of committing Type I and Type II errors? (6)
- b) What are the appropriate H_0 and H_a for each of the following research studies? In addition, write whether the hypothesis test is one- or two-tailed. (10)
 - i) A study in which researchers want to test whether there is a difference in spatial ability between left- and right-handed people.
 - ii) A study in which researchers want to test whether nurses who work 8-hour shifts deliver higher-quality care than those who work 12-hour shifts.
 - iii) A study in which researchers want to determine whether people with smoking has high tendency to cancer than the people without the cancer.
- c) Suppose a researcher wants to examine the relationship between the type of after-school program attended by a child and the child's intelligence level. The researcher is interested in whether students who attend after-school programs that are academically oriented (math, writing, computer use) score higher on an intelligence test than students who do not attend such programs. - Based on this research context, write down a research question on the following- i) descriptive, ii) comparison and iii) relationship. (9)
2. (a) Differentiate between confidence interval and confidence level. (5)
- (b) In a test, there were 16 independent observations of a certain magnitude with a mean of 100 and SD of 24. Find out (at 0.05 levels of confidence) the limits of the confidence interval for the population (or true) mean. (5)
- (c) What is variable? How do the quantitative researchers measure the variables? (5)
- (d) Consider a fender bender car accident you are involved with. You hit another car at a stop sign-rammed right into the back of it. While driving you were talking on your cell phone. The pavement was clear, the skies were sunny, and it had not rained for days. - Considering this accidental situation, identify the dependent, independent, control and confounding variable. (10)
3. a) Out of 100 students who enter a classroom, 60 students turn to the right and 40 to the left. Test the hypothesis that the students turn right or left randomly. (10)
- b) In a study of color preference, 48 girls were asked to select the color they liked best out of the three basic colors- red, blue and green. The data collected are as follows: (15)

Red	Blue	Green
24	12	12

- i) Declare H_0 and H_a .
- i) Perform the statistical test at $\alpha = 0.05$
- ii) Draw the diagram.
- iii) Draw final conclusions whether the observed choices differ from a random selection.

4. a) Define degrees of freedom and standard error of mean. (5)
 b) What are the assumptions of conducting a *t*-test? (5)
 c) It is generally known that the habit of reading newspapers and magazines is helpful in bringing about an increase in language vocabulary. A language teacher divides his class into two groups- *experimental* and *control*. Under the assumption that newspaper reading will increase the vocabulary, the experimental group was given two hours daily to read English newspapers and magazines, while no such facility was provided to the control group. After six months, both the groups were given a vocabulary test. The scores obtained are detailed below. (15)

Experimental group:	115	112	109	112	137				
Control Group:	110	112	95	105	111	97	112	102	

- i) State the null and alternative hypothesis. (5)
 ii) Interpret the data and say whether the gain in vocabulary is significant at $\alpha = .05$. (5)
5. a. Among a group of 10-year-old children in a school, it is found that the correlation between IQ and reading achievement is $+ .25$. However, on a school-wide basis the correlation is $+ .70$. Given the large differences between the two correlations, what explanation do you suggest? (10)
 b. In a study on caffeine and stress, college students indicated how many cups of coffee they drink per day and their stress level on a scale of 1 to 10. The data are provided in the following table. (15)

<i>Number of Cups of Coffee</i>	3	2	4	6	5	1	7	3	2	4
<i>Stress Level</i>	5	3	3	9	4	2	10	5	3	8

- i) Draw the scatterplot and regression line.
 ii) Calculate a **Pearson's *r*** to determine the type and strength of the relationship between caffeine and stress level.
 iii) How much of the variability in stress scores is accounted for by the number of cups of coffee consumed per day?
6. a) What is survey design? (5)
 b) How do surveys differ from experimental and correlational designs? (5)
 c) When do researchers use survey research? (5)
 d) Define longitudinal survey design. Discuss different types of longitudinal survey design with examples. (10)
7. a) What are the advantages of conducting a study with three or more levels of independent variable? (5)
 b) A researcher conducts a study of the effects of the amount of sleep on creativity. The creativity scores for four levels of sleep (2 hours, 4 hours, 6 hours, and 8 hours) for $N = 20$ subjects are presented here. (20)

Amount of Sleep (in hours)			
<u>2 hrs</u>	<u>4 hrs</u>	<u>6 hrs</u>	<u>8 hrs</u>
3	4	10	10
5	7	11	13
6	8	13	10
4	3	9	9
2	2	10	10

Complete the following ANOVA summary table.

<u>Source</u>	<u>df</u>	<u>SS</u>	<u>MS</u>	<u><i>F</i>_{obt}</u>
Between groups	?	187.75	?	?
Within groups	?	55.20	?	
Total	?	242.95		

- i) Is F_{obt} significant at $\alpha = .05$?
 ii) What conclusions can be drawn from the *F*-ratio?
 iii) Draw a bar graph from the means.

Formulae: IVE 6355

Difference between means

$$z = \frac{x - M}{\sigma}; \quad t = \frac{M_1 - M_2}{\sigma_D}$$

Standard Error

$$\sigma_D = \sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}; \quad \sigma_D = \sigma \sqrt{\frac{1}{N_1} + \frac{1}{N_2}}$$

Correlation/ Regression

$$r = \frac{\sum z_x z_y}{N} \quad r = \frac{\sum XY - \frac{(\sum X)(\sum Y)}{N}}{\sqrt{(\sum X^2 - \frac{(\sum X)^2}{N})(\sum Y^2 - \frac{(\sum Y)^2}{N})}}$$

$$r_s = 1 - \frac{6 \sum D^2}{n(n^2 - 1)}$$

$$r = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sqrt{SS_x SS_y}} \quad SS_x = \sum x^2 - (\sum x)^2/n \quad \sum(x - \bar{x})(y - \bar{y}) = \sum xy - \frac{(\sum x)(\sum y)}{n}$$

$$SS_y = \sum y^2 - (\sum y)^2/n$$

t-test

$$t = \frac{\bar{X} - \mu}{s_x}$$

$$s_x = \frac{s}{\sqrt{N}}$$

$$s = \sqrt{\frac{\sum(X - \bar{X})^2}{N - 1}}$$

$$t_{\text{obt}} = \frac{\bar{X}_1 - \bar{X}_2}{s_{\bar{X}_1 - \bar{X}_2}}$$

$$s_{\bar{X}_1 - \bar{X}_2} = \sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}$$

$$d = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{2} + \frac{s_2^2}{2}}}$$

$$CI_{95} = \bar{X}_1 - \bar{X}_2 \pm t_{\alpha}(s_{\bar{X}_1 - \bar{X}_2})$$

$$t = \frac{\bar{D} - 0}{s_D}$$

$$s_D = \frac{s_D}{\sqrt{N}}$$

$$s_D = \sqrt{\frac{\sum(D - \bar{D})^2}{N - 1}}$$

$$d = \frac{\bar{D}}{s_D}$$

$$CI_{95} = \bar{D} \pm t_{\alpha}(s_D)$$

Chi-square test

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

$$E = \frac{(RT)(CT)}{N}$$

$$\phi = \sqrt{\frac{\chi^2}{N}}$$

ANOVA

$$1 - (1 - \alpha)^c; \sum(X - \bar{X}_C)^2; \sum(X - \bar{X}_g)^2; \sum[(\bar{X}_g - \bar{X}_C)^2 n]$$

$$SS_{\text{Total}} = SS_{\text{Within}} + SS_{\text{Between}}; df_{\text{Total}} = df_{\text{Within}} + df_{\text{Between}}$$

$$F = \frac{\text{Between groups Variance}}{\text{Within Groups Variance}} = \frac{\text{Systematic Variance} + \text{Error Variance}}{\text{Error Variance}}$$

$$MS_{\text{Between}} = \frac{SS_{\text{Between}}}{df_{\text{Between}}}$$

$$MS_{\text{Within}} = \frac{SS_{\text{Within}}}{df_{\text{Within}}}$$

$$F = \frac{MS_{\text{Between}}}{MS_{\text{Within}}}$$