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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
 ORGANISATION OF ISLAMIC COOPERATION (OIC)
 DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester Final Examination

Summer Semester: 2022-2023

Course No.: CEE 4655

Full Marks: 150

Course Title: Civil Engineering Data Analysis

Time: 3.0 Hours

There are 7 (Seven) questions. Question No. 1, 2, 3, 4 are compulsory. Answer any 2 (two) questions from Question No. 5, 6 and 7. Programmable calculators are not allowed. It's an OPEN BOOK exam. Only ONE TEXT BOOK is allowed in the exam. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

- 1(a) The mean number of errors due to a particular bug occurring in a minute is 0.0001. (10)
 (i) What is the probability that no error will occur in 20 minutes? (CO1-PO1)
 (ii) How long would the program need to run to ensure that there will be a 99.95% chance that an error will show up to highlight this bug?
- (b) A report from the Secretary of Health and Human Services stated that 70% of single vehicle traffic fatalities that occur at night on weekends involve an intoxicated driver. If a sample of 15 single-vehicle traffic fatalities that occur at night on a weekend is selected, find the probability that exactly 12 involve a driver who is intoxicated. (05) (CO1-PO1)
- (c) A shipment of two boxes, each containing six telephones, is received by a store. Box 1 contains one defective phone, and box 2 contains two defective phones. After the boxes are unpacked, a phone is selected and found to be defective. Find the probability that it came from box 2. (05) (CO1-PO1)
- (d) The continuous random variable X has probability density function $f(x)$, given by (10) (CO1-PO1)
- $$f(x) = \begin{cases} \frac{x^2}{60} & 2 \leq x \leq 4 \\ 0 & \text{otherwise} \end{cases}$$
- (i) Find the value of $E(X)$.
 (ii) Show that the standard deviation of X is 0.516
- The cumulative distribution function of X , is denoted by $F(x)$.
- (iii) Find and specify fully $F(x)$.
 (iv) Determine $P(X > 3.5)$.

2. A study is conducted to determine the relationship between a driver's age and the number of accidents he or she has over a 1-year period. The data are shown below. If there is a significant relationship, predict the number of accidents of a driver who is 28.

Driver's age, x	16	24	18	17	23	27	32
No. Of accidents, y	3	2	5	2	0	1	1

- (a) Using a graph paper construct a scatter plot of data. Does a simple linear regression model appear to be plausible?
- (b) Determine the regression line equation.
- (c) If there is a significant relationship, predict the number of accidents of a driver who is 28.
- (d) Test at the 5% level of significance for the statistical significance of the parameter x .
- (e) Test the significance of the correlation coefficient at $\alpha=0.01$
3. The sample data were run on STATA and following results are obtained.

Analysis of Variance			
Source	DF	SS	MS
Regression	5	100	20
Error	20	40	2
Total	25	140	
Predictor	Coefficient	Standard Deviation(Standard error)	t-ratio
Constant	3.00	1.50	2.00
X_1	4.00	3.00	1.33
X_2	3.00	0.20	15.00
X_3	0.20	0.05	4.00
X_4	-2.50	1.00	-2.50
X_5	3.00	4.00	0.75

- (i) If the dependent variable is Y , write down the regression equation.
- (ii) What is the sample size?
- (iii) Compute the R^2 value.
- (iv) Compute the multiple standard error of estimate.
- (v) Conduct a global test of hypothesis to determine whether any of the regression coefficients are not equal to zero. Use the 0.05 level of significance. Test the regression coefficients individually. Would you consider omitting any variable(s)? If so, which one(s)? Use the 0.05 significance level.

- 4(a) A sample of nine local banks shows their deposits (in billions of dollars) 3 years ago and their deposits (in billions of dollars) today. At $\alpha=0.05$, can it be concluded that the average in deposits for the banks is greater today than it was 3 years ago? Use $\alpha = 0.05$. (10)
(CO2-PO2)

- (b) A survey of 1000 drivers this year showed that 29% of the people send text messages while driving. Last year a survey of 1000 drivers showed that 17% of those send text messages while driving. At $\alpha = 0.01$, can it be concluded that there has been an increase in the number of drivers who text while driving? (10)
(CO2-PO2)

5. A highway engineer records the numbers of vehicles passing a point in a road in 120 consecutive one-minute intervals, as follows. Test the hypothesis that the data come from a Poisson distribution. Use the 5% level of significance. (20)
(CO2-PO2)

Number of vehicles	0	1	2	3	4	5	6	7	8	9	10	11
Number of intervals	0	5	10	20	30	20	15	7	6	4	2	1

6. A state employee wishes to see if there is a significant difference in the number of employees at the interchanges of three state toll roads. The data are shown below. At $\alpha=0.05$, can it be concluded that there is a significant difference in the average number of employees at each interchange? (20)
(CO2-PO2)

Pennsylvania Turnpike	Mon-Fayette Expressway	Beaver Valley Expressway
7	10	1
14	1	12
32	1	1
19	0	9
10	11	1
11	1	11

- 7(a) The standard deviation of the average waiting time to see a doctor for non-life-threatening problems in the emergency room at an urban hospital is 32 minutes. At a second hospital, the standard deviation is 28 minutes. If a sample of 16 patients was used in the first case and 18 in the second case, is there enough evidence to conclude at the 0.01 significance level that the standard deviation of the waiting times in the first hospital is greater than the standard deviation of the waiting times in the second hospital? (10)
(CO2-PO2)

- (b) Two different types of tips can be used in a Rockwell hardness tester. Eight coupons from test ingots of a nickel-based alloy are selected, and each coupon is tested twice, once with each tip. The Rockwell C-scale hardness readings are shown in the following table. Use the sign test with $\alpha=0.05$ to determine whether or not the two tips produce equivalent hardness readings. (10)
(CO2-PO2)

Coupon	Tip 1	Tip 2
1	63	60
2	52	51
3	58	56
4	60	59
5	55	58
6	57	54
7	53	52
8	59	61