

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF NATURAL SCIENCE

Semester Final Examination

Summer Semester: 2023-2024

Course Number: Math 4263

Full Marks: 120

Course Title: Statistics I

Time: 2 Hours

Please answer according to the order of the questions. Answer all the 4 (FOUR) questions. The symbols have their usual meanings. Marks of each question and the corresponding CO and PO are written in the brackets.

1. a) Explain correlation and regression with examples. [5]
(CO1)
- b) (i) Guess the correlation between the following pairs of variables: [10]
Unemployment rate and crime rate, Price and demand of sugar, CGPA and height of the students of a class, price and demand of salt, Study time and score. (CO2)
(PO1)
- (ii) Explain different correlation patterns using scatter diagram.
- c) Suppose a new method is designed for determining the amount of magnesium in sea water. If the method is good, there will be a strong relationship between the true amount of magnesium in the water and the amount indicated by this method. 10 samples of sea water are prepared, each with a known amount of magnesium. The samples are then tested using the new method. x represents the true amount of magnesium and y represents the amount determined by the new method. The data is: [15]
(CO3)
(PO1)
- $\Sigma x = 311$, $\Sigma y = 310.1$, $\Sigma x^2 = 10100$, $\Sigma y^2 = 10055.09$, $\Sigma xy = 10074$.
- (i) Find the correlation coefficient and interpret.
(ii) Fit a simple linear regression line of y on x .
(iii) Interpret the regression coefficient.
(iv) Find the expected purchase rate if price per unit is Taka 470.
(v) If the regression coefficient of x on y is 0.667, what is the correlation coefficient?
2. a) Explain sample space, complementary event, mutually exclusive events with and non-mutually exclusive events examples. [10]
(CO1)
(PO1)
- b) A survey was made of 1000 customers in a department store. Some of them visited the store because of a newspaper ad and some did not see the ad. Some of the customers made purchases while the other did not. The exact breakdown is as follows: [15]
(CO2)
(PO1)

	Saw the ad	Did not see the ad
Made a purchase	300	100
Did not make a purchase	300	300

A person was chosen at random from the customers of the departmental store. Find the probability that the chosen person

- (i) saw the ad.
(ii) made a purchase given that he saw the ad.
(iii) made a purchase and did not see the ad.

- c) An egg firm grades the egg into grades A, B, and C. In the long run, 20 per cent are grade A, 50 per cent grade B, and 30 per cent grade C. It has been found that 3 per cent of grade A are cracked, 1 per cent of grade B and 2 per cent of grade C are cracked. An egg is selected at random before grading and found to be cracked. What is the probability that it is grade A? [5]
(CO3)
(PO1)
3. a) Consider an experiment of tossing a coin thrice. Write down the sample space. If x denotes the number heads, then what are the values of x ? Hence show the probability distribution of x . [10]
(CO1)
(PO2)
- b) According to insurance risk, 1 out of every 1000 people dies each year, and 3 out of every 1000 are disabled. The company charges Tk 350 per year for each policy. If a policyholder dies during the year, the insurance company pays Tk 100000 to her nominee, and if a policyholder becomes disabled, the insurance company pays Tk 50000 to the policyholder. Let x denote the expenditure per policy in a year. [15]
(CO2)
(PO1)
- (i) Find the probability distribution of x .
(ii) Find mean and variance of x .
- c) How can you find the company's expected gain per policy holder? If the company sells 2000 policies in a year, find the total expected gain of the company. [5]
(CO3)
(PO1)
4. a) What are the possible outcomes of a Bernoulli trial? Explain binomial distribution. [5]
(CO1)
(PO1)
- b) A manufacturer uses a sampling plan where a sample of 10 is taken from a lot, and the lot is accepted if 2 or fewer defectives are found in the sample. If a lot contains actually 5 percent defective, then what is the probability of accepting the lot? Rejecting the lot? [10]
(CO2)
(PO1)
- c) The longevity of dry cells follows normal distribution. A dry cell has an average longevity of 12 hours with a standard deviation of 3 hours. A dry cell is taken at random. What is the probability that the randomly selected bulb has longevity (i) less than 9 hours? (ii) between 9 and 15.2 hours? [10]
(CO2)
(PO1)
- d) Using the random numbers attached at the end, select a simple random sample of size 5 from the population below. How can you find an unbiased estimate of the population mean? [5]
(CO3)
(PO1)

12	24	39	52	76	81	75	84	28	68
98	35	82	13	20	52	15	21	43	59

Relevant Data:

Binomial probability table for $n = 10$ and probability of success 0.05:

x	0	1	2	3	4	5	6, 7, 8, 9, 10
$P(x)$	0.59874	0.31512	0.07463	0.01048	0.00096	0.00006	0.00000

Partial cumulative probability for standard normal distribution:

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-1.0	0.1587	0.1562	0.1539	0.1513	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
1.0	0.8413	0.8434	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621

Random numbers

22368 46573 25595 85393 30995 89198 27982 53402 93965 34095