

Final Assessment Test – May 2024



Course: **BMAT202L - Probability and Statistics**
 Class NBR(s): 1674 / 1675 / 1677 / 1679 / 1681 / 1683 /
 1685 / 1739 / 1741 / 4939

Slot: B1+TB1

Time: Three Hours

Max. Marks: 100

- KEEPING MOBILE PHONE/ELECTRONIC DEVICES EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
 ➤ DON'T WRITE ANYTHING ON THE QUESTION PAPER

General Instructions:

1. "fx series" - Non Programmable Calculator are Permitted: YES.
2. Reference Tables Permitted: YES (Statistical Tables)

Answer any **TEN** Questions
 (10 X 10 = 100 Marks)

1. Calculate the mean, median and mode for the following data: [10]

| Class | 130-134 | 135-139 | 140-144 | 145-149 | 150-154 | 155-159 | 160-164 |
|-----------|---------|---------|---------|---------|---------|---------|---------|
| Frequency | 5 | 15 | 28 | 24 | 17 | 10 | 1 |

2. a) The mean and standard deviation of 20 items are found to be 10 and 2 respectively. At the time of checking it was found that one item 8 was incorrect. Calculate the mean and standard deviation if the wrong item is omitted. [5]
 b) Find the mean and standard deviation of the first n natural numbers. [5]

3. If the probability function of an infinite discrete distribution is given by [10]

$$P(X = x) = \frac{1}{2^x}, x = 1, 2, 3, \dots, \infty,$$

then find

- (i) the mean and variance of the distribution.
- (ii) $P(X \text{ is even})$.
- (iii) $P(X \text{ is divisible by } 3)$.

4. If the joint probability density function of a two dimensional random variable (X, Y) is given by [10]

$$f(x, y) = \begin{cases} x^2 + \frac{xy}{3}, & \text{if } 0 < x < 1, 0 < y < 2 \\ 0, & \text{otherwise,} \end{cases}$$

Find (i) $P(X > \frac{1}{2})$ (ii) $P(Y < X)$ (iii) $P(Y < \frac{1}{2} | X < \frac{1}{2})$.

5. The marks obtained by the students in the subjects Statistics and Calculus are given in the following table: [10]

| | | | | | | | | | | |
|------------|----|----|----|----|----|----|----|----|----|----|
| Statistics | 55 | 48 | 58 | 52 | 61 | 36 | 49 | 38 | 54 | 65 |
| Calculus | 43 | 46 | 49 | 41 | 56 | 52 | 51 | 50 | 63 | 59 |

Find the coefficient of correlation between Statistics and Calculus.

6. The sale of a product in lakhs of rupees (Y) is expected to be influenced by two variables namely the advertising expenditure (X_1) (in Rs) and the number of sales persons (X_2) in a region. Sample data on 8 regions of a state has given the following results [10]

| Area | Y | X_1 | X_2 |
|------|-----|-------|-------|
| 1 | 110 | 30 | 11 |
| 2 | 80 | 40 | 10 |
| 3 | 70 | 20 | 7 |
| 4 | 120 | 50 | 15 |
| 5 | 150 | 60 | 19 |
| 6 | 90 | 40 | 12 |
| 7 | 70 | 20 | 8 |
| 8 | 120 | 60 | 14 |

Develop a multiple regression model for the above data.

7. In a large consignment of electric bulbs 10% are defective. A random sample of 20 is taken for inspection. Find the probability that [10]
- All are good bulbs.
 - At most there are 3 defective bulbs.
 - At least there are three defective bulbs.
8. A company finds that the time by one of its engineers to complete or repair job has a normal distribution with mean 40 minutes and standard deviation 5. [10]
- State what proportion of job takes
 - less than 35 minutes
 - more than 48 minutes.
 - The company charges Rs.20 if the job takes less than 35 minutes, Rs.40 if it takes between 35 and 48 minutes and Rs.70 if it takes more than 48 minutes. Find the average charge for a repair job.
9. Before an increase in excise duty on tea, 800 people out of a sample of 1000 were consumers of tea. After the increase in duty, 800 people were consumers of tea in a sample of 1200 persons. Find whether there is significant decrease in the consumption of tea after the increase in duty at 1% level of significance. [10]
10. Four coins are tossed 160 times and the number of heads observed is given below: [10]

| No. of heads | 0 | 1 | 2 | 3 | 4 |
|----------------------|----|----|----|----|---|
| Observed frequencies | 17 | 52 | 54 | 31 | 6 |

Under the assumption that the coins are unbiased, find the expected frequencies and test the goodness of fit at 5% LOS.

11. The following table shows the lives in hours of four brands of electric lamps.

| | | | | | | | | |
|---------|------|------|------|------|------|------|------|------|
| Brand A | 1610 | 1610 | 1650 | 1680 | 1700 | 1720 | 1800 | |
| B | 1580 | 1640 | 1640 | 1700 | 1750 | | | |
| C | 1460 | 1550 | 1600 | 1620 | 1640 | 1660 | 1740 | 1820 |
| D | 1510 | 1520 | 1530 | 1570 | 1600 | 1680 | | |

Perform an analysis of variance test the homogeneity of the mean lives of the four brands of lamps at 5% LOS.

12. A critical communications relay has a constant failure rate of 0.1 per day. Once it has failed, the mean time to repair is 2.5 days (the repair rate is constant). [10]

- (i) What are the point availability at the end of 2-days, the interval availability over a 2-day mission, starting from zero and the steady state availability?
- (ii) If two communication relays operate in series, compute the availability at the end of 2 days.
- (iii) If they operate in parallel, compute the steady state availability of the system.
- (iv) If one communication relay operates in a standby mode with no failure in standby, what is the steady state availability?

⇒⇒⇒ H/E/TX ⇒⇒⇒