


Final Assessment Test – April 2025

 Course: **BMAT202L - Probability and Statistics**

 Class NBR(s): **1179 / 1180 / 1181 / 1182 / 1183 / 1184 / 1185 / 1186**

 Slot: **G1+TG1**

 Time: **Three Hours**

 Max. Marks: **100**

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

General Instruction: Statistical Tables are permitted.

Answer ALL Questions

(10 X 10 = 100 Marks)

1. Find the mean, median and mode for the following continuous frequency distribution: [10]

Class interval (x)	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Frequency (f)	5	8	7	12	28	20	10	10

2. A random variable X has the following probability distribution. [10]

$X = x$	-2	-1	0	1	2	3
$P(X = x)$	0.1	K	0.2	$2K$	0.3	$3K$

(i) Find K , (ii) evaluate $P(X < 2)$ and $P(-2 < X < 2)$ (iii) find the cumulative distribution function of X and (iv) estimate the mean of X .

3. The joint density for the random variables (X, Y) , where X is the unit temperature change and Y is the proportion of spectrum shift that a certain atomic particle produces, is [10]

$$f(x, y) = \begin{cases} 10xy^2, & 0 < x < y < 1 \\ 0, & \text{elsewhere.} \end{cases}$$

(i) Find the marginal density function of X and Y .

(ii) Find the conditional density of $f(y|x)$

(iii) Find the probability that the spectrum shifts more than half of the total observations, given that the temperature is increased by 0.25 unit.

4. In a partially destroyed laboratory record of an analysis of correlation data, the following results only are legible: [10]

Variance $X = 9$. Regression equations: $8X - 10Y + 66 = 0$; $40X - 18Y = 214$.

What were

- (i) the mean values of X and Y ,
 (ii) the correlation coefficient between X and Y , and
 (iii) the standard deviation of Y ?

5. The expected remaining life of an electronic part is believed to be related to the age of the part. The ages of 10 of these parts that were in use on a certain date were recorded in operating hours. When each part burned out, the elapsed time was recorded. The results were as follows: [10]

X	170	165	167	162	163	167	166	169	164	171
Y	168	168	167	166	166	168	165	168	165	170

where X is age of the part (in hrs), Y is remaining life (in hrs). Determine the coefficient of correlation.

6. Out of 800 families with 4 children each, how many families would be expected to have (i) 2 boys and 2 girls, (ii) at least 1 boy, (iii) at most 2 girls and (iv) children of both sexes. Assume equal probabilities for boys and girls. [10]
7. In an examination it is laid down that a student passes if he secures 30 per cent or more marks. He is placed in the first, second or third division according as he secures 60% or more marks, between 45% and 60% marks and marks between 30% and 45% respectively. He gets distinction in case he secures 80% or more marks. It is noticed from the results that 10% of the students failed in the examination, whereas 5% of them obtained distinction. Calculate the per centage of students placed in the second division. (Assume normal distribution of marks.) [10]
8. The average hourly wage of a sample of 150 workers in a plant 'A' was Rs. 2.56 with a standard deviation of Rs. 1.08. The average wage of a sample of 200 workers in plant 'B' was Rs. 2.87 with a standard deviation of Rs. 1.28. Can an applicant safely assume that the hourly wages paid by plant 'B' are higher than those paid by plant 'A'? [10]
- 9.a) Four different drugs have been developed for a certain disease. These drugs are used in 3 different hospitals and the results, given below, show the number of cases of recovery from the disease per 100 people who have taken the drugs. [10]

	D1	D2	D3	D4
H1	19	8	23	8
H2	10	9	12	6
H3	11	13	13	10

What conclusion can you draw based on an analysis of variance?

OR

- 9.b) Fit a Poisson distribution to the following data and test the goodness of fit. [10]

x	0	1	2	3	4	5	6
f	275	72	30	1	5	2	1

- 10.a) If the density function of the time to failure in years of the gizmos (for use [10] widgets) manufactured by a certain company is given by

$$f(t) = \frac{200}{(t+10)^3}, t \geq 0$$

then

- (i) Derive the reliability function and determine the reliability for the first year of operation.
- (ii) Compute the Mean Time to Failure (MTTF).
- (iii) What is the design life for a reliability 0.95?
- (iv) Will a one-year burn-in-period improve the reliability in part(i)? If so what is the new reliability?

OR

- 10.b) 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).

- (i) What are the point availability at the end of 2 days, the interval availability over a 2-day mission, starting from the zero and 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/TY ↔↔↔