



Progressive Education Society's
Modern College of Arts, Science & Commerce Ganeshkhind, Pune – 16,
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S.Y.B.Sc Blended
MTH401: Probability and Statistics
(Semester IV)

Program: B.Sc. Blended
Program Specific: B.Sc. Blended (Chemistry)
Course Type: MTH401
Paper: MTH401: Probability and Statistics

Credits: 4
Time: 3 Hours
Max. Marks: 60
SET: A

Instructions to the candidate:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Draw a well labelled diagram wherever necessary.
- 4) Use of scientific calculator & statistical table is allowed.
- 5) Ask for graph paper if needed.

Q1) Answer the following:

[10 X 1 =10]

- a) Define sample space with an illustration.
- b) State probability mass function (p.m.f.) of Poisson distribution.
- c) Find arithmetic mean (A.M.) of the first n natural numbers.
- d) Define confidence interval for the mean using t-distribution
- e) Compute interquartile range for the following data:
100, 24, 14, 105, 21, 35, 106, 16, 100, 72, 68, 103, 61, 90, 20
- f) Define the term 'Correlation' and state its type.
- g) Define "Regression analysis".
- h) Define Probability of an event.
- i) Tick the correct alternative:
 - I) Which of the following statistical techniques should be used when you wish to examine the relationship between two variables and prediction of a variable, given the other variable?
 - A) Simple regression analysis.
 - B) Chi-square contingency test.
 - C) z- test
 - D) t-test
 - II) If $X \sim \text{Normal}(\mu, \sigma^2)$ & \bar{X} is sample mean based on sample of size n then $\frac{\bar{X}-\mu}{\frac{\sigma}{\sqrt{n}}}$ follows standard normal distribution with parameters
 - A) Mean = Variance = 1
 - B) Mean = 0, Variance = 1
 - C) Mean = 1, Variance = 0
 - D) Mean = Variance = 0
- j) State whether the following statements are **true or false**:
 - i) Arithmetic mean cannot be determined graphically.
 - ii) Events A and B are said to be mutually exclusive if $A \cap B \neq \phi$.

Q2) Answer the following (any 5):**[5 X 2 = 10]**

- a) Explain Binomial distribution with a real life situation.
 b) For the following probability distribution of X :

X	-1	0	1	2	3
P(X = x)	4k	3k	k	2k	6k

Calculate: I) the value of k.

II) $P(X \leq 2)$.

- c) If A and B are independent events with probability 0.7 & 0.3 respectively then
 Find I) $P(A \cap B)$
 II) $P(A|B)$.
- d) Define Maximum Likelihood Estimator (M.L.E.).
- e) A pair of fair dice is rolled. If the sum of 10 has appeared, find the probability that one of the dice shows 5.
- f) State expectation of a discrete random variable.
- g) Explain stochastic process with a real life example.

Q3) Answer the following (any 5):**[5 X 3 = 15]**

- a) Define cumulative distribution function (c.d.f) of a discrete r.v. and state its important properties.
- b) State Central Limit Theorem (CLT) for independent and identically distributed random variables.
- c) $X \sim N(5, 4)$ Find (i) $P(X > 6)$ (ii) $P(X < 9)$ (iii) $P(X > 1)$
- d) State distribution of sample proportion.
- e) Define Uniform random variable over and interval [a, b]. State its mean and variance.
- f) A small bakery receives an average of 4 customers every 30 minutes.
 I) What is the probability that exactly 2 customers will arrive in the next 30 minutes?
 II) What is the probability that no customers will arrive in the next 30 minutes?
- g) Suppose the life of a tube light in hours is a continuous random variable X with p.m.f.

$$f(x) = \frac{25000}{x^3}; x \geq 100$$

Find expected life $\{E(X)\}$ in hours of the tube light.

Q4) Answer the following (any 3):**[3 X 5 = 15]**

- a) Various investigations were made for testing the incidence of heavy infection of Dengue parasite plasmodium falciparum in groups of children with heterozygotes and group of children with the normal homozygotes. The findings in the investigation were as follows;

Group of children	Heavy infections	Non-infected
Children with heterozygotes	16	48
Children with the normal homozygotes	60	125

Test whether the heterozygotes are better protected than normal homozygotes from malarial infection. ($\chi^2_{0.05, 1} = 3.841$)

- b) State De Moivre theorem on normal approximation to binomial distribution.
- c) An ambulance service claims that it take on an average 10 minutes to reach its destination in emergency calls. To check this claim agency, which licenses ambulance service, has confirmed on 60 emergency calls getting man of 10.3 minutes and S.D. of 1.4 minutes. What agency concludes at level of significance 5%? ($Z_{\text{table value}} = 1.96$)
- d) The following information ababout two variables X and Y is given.
 $n=10, \sum x_i^2 = 385, \sum y_i^2 = 192, \bar{x} = 5.5, \bar{y} = 4, \sum x_i y_i = 185$.
 Find regression line of y on x.
- e) State additive property of Binomial distribution.
 If $X \sim B(n_1=10, p=0.5)$ and $Y \sim B(n_2=8, p=0.5)$. Find the distribution of $X+Y$.

Q5) Answer the following (any 2):

[2 X 5 = 10]

- a) Suppose A and B are two events defined on sample space Ω . If $P(A) = 0.8$,
 $P(A \cup B) = 0.9$ and $P(B) = x$, find the value of x if A and B are
 I) Independent
 II) Mutually exclusive.
- b) The hours of sleep for 10 patients before and after giving a new drug and recorded Test, whether there is a significant difference in the average hours of sleep at 5% level of significance.

Patient No.	1	2	3	4	5	6	7	8	9	10
Hours of sleep (before)	6	5	7	7	8	9	6	6	7	8
Hours of sleep (after)	7	8	7.5	9	7	6.5	7	8	8.5	7

- c) Using least square method derive the expression for regression line Y on X.
- d) Data on value of exports and imports (in crores of Rs.) are given below:

Year	2001	2002	2003	2004
Export	26	32	35	52
Import	35	40	48	50

Represent the above data by multiple bar diagram.
