

**STATISTICS FOR BUSINESS SYSTEM
(MTH2205)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) If X and Y are two independent random variables and $Z = X + Y$ then the moment generating function of Z , i.e., $M_Z(t)$ is
 (a) $M_X(t)M_Y(t)$. (b) $M_X(t) + M_Y(t)$.
 (c) $M_X(t)$. (d) $M_Y(t)$.
- (ii) Let X be a binomially distributed random variable with parameters 8 and $\frac{1}{2}$. Then the value of $\text{Var}(-3X - 5)$ is
 (a) -6 . (b) -18 .
 (c) 18 . (d) 6 .
- (iii) A random variable X has Poisson distribution such that $P(1) = P(2)$, Then $P(0) =$
 (a) $\frac{1}{e}$ (b) e^2
 (c) $\frac{1}{e^2}$ (d) e^0 .
- (iv) If two bivariate (x, y) and (u, v) are such that $x = -2u + 4$ and $y = 3v - 6$ then
 (a) $r_{xy} = r_{uv}$. (b) $r_{xy} = -r_{uv}$.
 (c) $r_{xy} = 6r_{uv}$. (d) $r_{xy} = -6r_{uv}$.
- (v) If $r_{xy} = 0.6, \sigma_x = 3, \sigma_y = 4, \bar{x} = 13, \bar{y} = 17$, then the regression line of "x on y" is
 (a) $40x - 18y = 214$. (b) $8x - 10y + 66 = 0$.
 (c) $18x - 40y = 214$. (d) $10x - 8y + 66 = 0$.
- (vi) According to the central limit theorem, the sampling distribution of the sample mean can be approximated by the normal distribution as the
 (a) number of samples are large enough. (b) sample size is large enough.
 (c) population size is large enough. (d) population standard deviation is large enough.
- (vii) If $H_1: \mu < 60$ be an alternative hypothesis, then the null hypothesis is
 (a) $H_0: \mu > 60$. (b) $H_0: \mu \geq 60$.
 (c) $H_0: \mu = 60$. (d) $H_0: \mu \neq 60$.
- (viii) The student's t – test is typically used
 (a) in comparing two groups to see if their means differ.
 (b) in comparing multiple groups to see if their means differ.
 (c) in analysis of variance.
 (d) in testing the goodness of fit of a model.
- (ix) Goodness of Fit of a distribution is tested by
 (a) Z –test. (b) t –test.
 (c) F –test. (d) χ^2 –test.
- (x) In a Two-Way ANOVA with r rows and c columns, what is the degrees of freedom for the Error Sum of Squares (SSE)?
 (a). $(r - 1)(c - 1)$. (b). $r - 1$.
 (c). $c - 1$. (d). $rc - 1$.

Fill in the blanks with the correct word

- (xi) The moment generating function ($M_x(t)$) of Poisson distribution with mean 2 is _____.
- (xii) If $x + 5u = 2, 2y + v = 7$ and the correlation coefficient of x and y is 0.25, then the correlation coefficient of u and v is _____.
- (xiii) If the population standard deviations σ_1 and σ_2 are unknown and sample sizes $n_1, n_2 \geq 30$, the $100(1 - \alpha)\%$ confidence interval for $(\mu_1 - \mu_2)$ is _____.
- (xiv) If X and Y are independent random variables then the correlation coefficient between X and Y (r_{xy}) is _____.
- (xv) If $n = 8$ and $\sum d^2 = 28$, then the rank correlation coefficient is _____.

Group - B

2. (a) Show by Chebyshev's inequality that 2000 throws with a coin, the probability that the number of heads lies between 900 and 1100 is at least $19/20$. [(MTH2205.1)(Apply/IOCQ)]
- (b) The joint distribution of X and Y is given by
- $$f(x, y) = \begin{cases} e^{-(x+y)}, & x \geq 0, y \geq 0 \\ 0, & \text{otherwise} \end{cases}$$
- (i) Find the marginal density function of X and Y .
- (ii) Calculate $P(X \geq 1)$ and $P(X \leq Y)$. [(MTH2205.1)(Evaluate/HOCQ)]

6 + 6 = 12

3. (a) Let X_1, X_2 and X_3 be three mutually independent random variables having the same discrete distribution with probability function

$$P(X = x) = \begin{cases} 0.25, & x = -1 \\ 0.50, & x = 0 \\ 0.25, & x = 1 \\ 0.00, & \text{elsewhere} \end{cases}$$

Determine the moment generating function, $M(t)$ of $Y = X_1 + X_2 + X_3$. [(MTH2205.1)(Apply/IOCQ)]

- (b) The bivariate probability distribution of the random variables X and Y is given below:

$\begin{matrix} \text{Y} \\ \text{X} \end{matrix}$	1	2	3	4	5	6
0	0	0	$\frac{1}{32}$	$\frac{2}{32}$	$\frac{2}{32}$	$\frac{3}{32}$
1	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$
2	$\frac{1}{32}$	$\frac{1}{32}$	$\frac{1}{64}$	$\frac{1}{64}$	0	$\frac{2}{64}$

Find

- (i) the marginal probability mass functions of the random variables X and Y ,
- (ii) $P(X \leq 1)$, and
- (iii) $P(Y \leq 3)$. [(MTH2205.1)(Analyse/IOCQ)]

6 + 6 = 12

Group - C

4. (a) Use the method of least squares to obtain the equations of the regression lines from the following data.

X	22	26	29	30	31	31	34	35
Y	20	20	21	29	27	24	27	31

[(MTH2205.1, MTH2205.2, MTH2205.4)(Evaluate/HOCQ)]

- (b) Marks obtained in Statistics and Physics by 10 B.Tech. students are given below:

Students:	A	B	C	D	E	F	G	H	I	J
Statistics:	61	38	49	57	42	34	93	87	46	35
Physics:	31	38	28	35	19	42	45	48	22	25

Calculate Rank Correlation and interpret the result. [(MTH2205.1, MTH2205.2, MTH2205.4)(Analyse/IOCQ)]

6 + 6 = 12

5. (a) If $x = 4y + 5$ and $y = kx + 4$ be two regression lines of ' x on y ' and ' y on x ' respectively, then find the interval in which k lies. Also, if $k = 1/16$, then find the mean of x , mean of y and correlation coefficient, r_{xy} . [(MTH2205.1, MTH2205.2, MTH2205.4)(Evaluate/HOCQ)]

- (b) A sample survey of 5 families was taken and figures were obtained with respect to their annual savings x_1 (Rs. in 100's), annual income x_2 (Rs. in 1000's), and family size x_3 . The data is summarized in the table below:

Family	Annual savings (x_1)	Annual income (x_2)	Family size (x_3)
1	10	16	3
2	5	13	6
3	10	21	4
4	4	10	5
5	8	13	3

- (i) Find the least-squares regression equations of x_1 on x_2 and x_3 .
- (ii) Estimate the annual savings of a family whose size is 4 and annual income is Rs. 16,000. [(MTH2205.1, MTH2205.2, MTH2205.4)(Apply/IOCQ)]

6 + 6 = 12

Group - D

6. (a) A statistics professor has taken five tests. A student scored 70, 75, 65, 80, and 95 respectively in five tests. The professor decides to determine his grade by randomly selecting a sample of three test scores. Construct the sampling distribution for this process. Determine the mean and variance of the sampling distribution. Clearly state the theorem or property you used. [(MTH2205.4, MTH2205.5)(Understand/LOCQ)]
- (b) Let $X_1, X_2, \dots, X_{11}$ be a random sample of size 11 from a normal distribution with unknown mean μ and variance $\sigma^2 = 9.9$. If $\sum_{i=1}^{11} x_i = 132$, then what is the 95% confidence interval for μ ? [(MTH2205.4, MTH2205.5)(Analyse/IOCQ)]
- 6 + 6 = 12**
7. (a) The life of an electronic device is normally distributed with mean 4 and variance 6. Ten devices are drawn at random in different ways. Find the probability that sample variance lies between 1.995 and 10.146. Also find the mean of the sampling distribution of sample variance. [(MTH2205.4, MTH2205.5)(Understand/LOCQ)]
- (b) Let p denotes the probability of getting a head when a given coin is tossed once. Suppose that the hypothesis $H_0: p = 0.5$ is rejected in favour of $H_1: p = 0.6$ if 10 trials result in 7 or more heads. Calculate the probabilities of Type-I and Type-II error. [(MTH2205.4, MTH2205.5)(Analyse/IOCQ)]
- 6 + 6 = 12**

Group - E

8. (a) A research was conducted to understand whether women have a greater variation in attitude on political issues than men. Two independent samples of 31 men and 41 women were used for the study. The sample variances so calculated were 120 for women and 80 for men. Test whether the difference in attitude toward political issues is significant at 5 per cent level of significance. [(MTH2205.1, MTH2205.3, MTH2205.4, MTH2205.6)(Analyse/IOCQ)]
- (b) To test the significance of variation in the retail prices of a commodity in three principal cities, Mumbai, Kolkata, and Delhi, four shops were chosen at random in each city and the prices who lack confidence in their mathematical ability observed in rupees were as follows:

Mumbai:	16	8	12	14
Kolkata:	14	10	10	6
Delhi:	4	10	8	8

Do the data indicate that the price in the three cities are significantly different?

[(MTH2205.1, MTH2205.3, MTH2205.4, MTH2205.6)(Evaluate/HOCQ)]

6 + 6 = 12

9. (a) A toy manufacturer wants to get batteries for toys. A team collected 41 samples from supplier X and the variance was 110 hours. The team also collected 21 samples from supplier Y with a variance of 65 hours. At a 0.05 α level determine if there is a difference in the variances. [(MTH2205.1, MTH2205.3, MTH2205.4, MTH2205.6)(Analyse/IOCQ)]
- (b) A virus-related illness in the city has raised concerns among restaurant inspectors, as it contradicts their evaluations of the sanitation standards in local restaurants. To explore this further, the director assigns five inspectors to evaluate the cleanliness of three restaurants. Their findings are presented below.

Restaurants →	I	II	III
Inspectors ↓			
1	71	55	84
2	65	57	86
3	70	65	77
4	72	69	70
5	76	64	85

Carry out two-way ANOVA at 5% level of significance.

[(MTH2205.1, MTH2205.3, MTH2205.4, MTH2205.6)(Evaluate/HOCQ)]

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	12.5	56.25	31.25

