| SECOND REVISION EXAMINATION - 2023 | Reg. No. | | | | | | | |
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# XII - BUSINESS MATHEMATICS & STATISTICS

Time Allowed : 3.00 Hrs.     Maximum Marks: 90

INSTRUCTIONS : 1.   Check the question paper for fairness of printing.
If there is any lack of fairness, inform the Hall Supervisor immediately.

2.   Use **Blue** or **Black** ink to write and underline
and **Pencil** to draw diagrams.

## PART - I

**Note**   i)   **Answer all the questions**

ii)   **Choose the most appropriat answer from the given four alternatives and write the option code and the corresponding answer.**   **(20×1=20)**

1. If $T = \begin{array}{c} A \\ B \end{array}\begin{bmatrix} 0.7 & 0.3 \\ 0.6 & x \end{bmatrix}$ (with columns A B) is a tansition probability matrix, then the value of x is

   a) 0.2     b) 0.3     c) 0.4     d) 0.7

2. The system has a unique solution when two lines,
   a)   $L_1$ and $L_2$ intersect exactly at one point
   b)   $L_1$ and $L_2$ coincides
   c)   $L_1$ and $L_2$ Are parallel and distinct
   d)   both a and b

3. $\int 2^x \, dx$ is

   a) $2^x + c$     b) $\dfrac{2^x}{\log 2} + c$     c) $\dfrac{\log 2}{2^x} + c$     d) $2^x \log 2 + c$

4. $\int\limits_0^\infty e^{-2x} dx$ is     a) 0     b) 1     c) 2     d) 1/2

5. The demand and supply functions are given by $D(x) = 16-x^2$ and $S(x) = 2x^2 + 4$ are under perfect competition, then the equilibrium price x is
   a) 2     b) 3     c) 4     d) 5

6. If $p(x) = 1/10$, x = 10 then E(x) is
   a) zero     b) 1/4     c) 1     d) -1

7. Which of the following is not possible in probability distribution?
   a) $\sum p(x) \geq 0$     b) $\sum p(x) = 1$     c) $\sum xp(x) = 2$     d) p(x) = -0.5

8. A finite subset of statistical individuals in a population is called _____
   a) a sample     b) a population     c) universe     d) census

9. The standard error of sample mean is
   a) $\dfrac{\sigma}{\sqrt{2n}}$     b) $\dfrac{\sigma}{n}$     c) $\dfrac{\sigma}{\sqrt{n}}$     d) $\dfrac{\sigma^2}{\sqrt{n}}$

10. The value of 'b' in the trend line y = a + bx is:
    a) Either positive or negative     b) Always positive
    c) Zero     d) Always negative

11. The order and degree of the differential equation
    $\left(\dfrac{d^2y}{dx^2}\right)^{3/2} - \sqrt{\left(\dfrac{dy}{dx}\right)} - 4 = 0$ are respectively

    a) 2 and 6     b) 3 and 6     c) 1 and 4     d) 2 and 4

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12. The P.I of $(3D^2 + D - 14)y = 13e^{2x}$ is

   a) $\frac{x}{2}e^{2x}$   b) $xe^{2x}$   c) $\frac{x}{2}e^{2x}$   d) $13xe^{2x}$

13. $\Delta^2 y_0 =$   a) $y_2 - 2y_1 + y_0$   b) $y_2 + 2y_1 - y_0$
   c) $y_2 + 2y_1 + y_0$   d) $y_2 + y_1 + 2y_0$

14. $\nabla f(a) =$   a) $f(a) + f(a - h)$   b) $f(a) - f(a+h)$   c) $f(a) - f(a - h)$   d) $f(a)$

15. The producer's surplus when the supply function for a commodity is
   $P = 3 + x$ and $x_0 = 3$ is _____
   a) 3/2   b) 5/2   c) 7/2   d) 9/2

16. Which of the following index number satisfy the time reversal test?
   a) Paasche's Index number   b) Fisher index number
   c) Laspeyre's Index number   d) All of them

17. In a binomial distribution, the probability of success is twice as that of failure.
   Then out of 4 trials, the probability of no success is _____
   a) 16/81   b) 1/16   c) 2/27   d) 1/81

18. The parameters of the normal distribution $f(x) = \left(\frac{1}{\sqrt{72\pi}}\right)\frac{e^{-(x-10)^2}}{72}$, $-\infty < x < \infty$
   a) (10, 6)   b) (10, 36)   c) (6, 10)   d) (36, 10)

19. Solution for transportation problem using _____ method is nearer to an optimal solution.
   a) NWCM   b) LCM   c) VAM   d) Row Minima

20. In an assignment problem involving four workers and three jobs, total number of assignments possible are
   a) 4   b) 3   c) 7   d) 12

## PART - II

*Answer any seven questions. Question Number 30 is compulsory.* **(7x2=14)**

21. Find the rank of the matrix $A = \begin{pmatrix} 5 & 3 & 0 \\ 1 & 2 & -4 \\ -2 & -4 & 8 \end{pmatrix}$

22. Evaluate : $\int \sin^2 x \, dx$

23. Find the area bounded by the line $y = x$, the x-axis and the ordinates $x = 1$, $x = 2$

24. Solve : $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 8y = 0$

25. Find : $\Delta \log x$

26. The following information is the probability distribution of successes

| No.of successes | 0 | 1 | 2 |
|---|---|---|---|
| Probability | 6/11 | 9/22 | 1/22 |

27. The mean of Binomial distribution is 20 and variance is 16. Find "p" and "n".

28. Mention two branches of statistical Inference.

29. Consider the following pay-off matrix

| Alternative | Pay offs (Conditional events) | | | |
|---|---|---|---|---|
| | $A_1$ | $A_2$ | $A_3$ | $A_4$ |
| $E_1$ | 7 | 12 | 20 | 27 |
| $E_2$ | 10 | 9 | 10 | 25 |
| $E_3$ | 23 | 20 | 14 | 23 |
| $E_4$ | 32 | 24 | 21 | 17 |

   Using Minimax, Principle determine the best alternative.

30. Mention the two causes of variation which affects the quality of a product.

## PART - III

*Answer any seven questions. Question Number 40 is compulsory.*

(7x3=21)

31. Suppose the probability mass function of the discrete random variable is

| X = x | 0 | 1 | 2 | 3 |
|-------|-----|-----|-----|-----|
| P(x) | 0.2 | 0.1 | 0.4 | 0.3 |

What is the value of $E(3x + 2x^2)$

32. Show that the equations $2x + y = 5$, $4x + 2y = 10$ are consistent and solve them.

33. Evaluate : $\int \frac{5 + 5e^{2x}}{e^x + e^{-x}} dx$

34. The marginal cost function of a firm is given by $C'(x) = 5 + 0.13x$, the marginal revenue is given by $R'(x) = 18$ and the fixed cost is Rs.120. Find the profit function.

35. Find the differential equation corresponding to $y = ae^{4x} + be^{-x}$ where a, b are arbitrary constants.

36. Evaluate $\Delta^2 \left( \frac{1}{x} \right)$ by taking "1" as the interval of differencing.

37. Write the conditions for which the Poisson distribution is a limiting case of binomial distribution.

38. A wholesaler in apples claims that only 4% of the apples supplied by him are defective. A random sample of 600 apples contained 36 defective apples calculate the standard error concerning of good apples.

39. Calculate three-yearly moving averages of number of students studying in a higher secondary school in a particular village from the following data.

| Year | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|------|------|------|------|------|------|------|------|------|------|------|
| No.of Students | 332 | 317 | 357 | 392 | 402 | 405 | 410 | 427 | 435 | 438 |

40. Construct the cost of living index number for 2011 on the basis of 2007 from the given data using Family Budget method.

| Commodities | Price | | |
|-------------|-------|-------|---------|
| | 2007 | 2011 | Weights |
| A | 350 | 400 | 40 |
| B | 170 | 250 | 35 |
| C | 100 | 115 | 15 |
| D | 75 | 105 | 20 |
| E | 60 | 80 | 25 |

## PART - IV

**Answer all the questions.** (7x5=35)

41. a. An amount of Rs.5000/- is to be deposited in three different bonds bearing 6%, 7% and 8% per year respectively. Total annual income is Rs.358. If the income from first two investments is Rs.70 more than the income from the third, then find the investment in each bond by rank method.

**(OR)**

b. A random variable x has the following probability function.

| Values of x | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|-------------|---|---|----|----|----|-----|-----|-------|
| P(x) | 0 | a | 2a | 2a | 3a | $a^2$ | $2a^2$ | $7a^2+a$ |

i) Find a, Evaluate    ii) P(x < 3)    iii) P(x > 2) and iv) $P(2 < x \le 5)$

42. a. The population of a city in a censes taken once in 10 years is given below. Estimate the population in the year 1955.

| Year | 1951 | 1961 | 1971 | 1981 |
|------|------|------|------|------|
| Population in lakhs | 35 | 42 | 58 | 84 |

**(OR)**

b. The slope of the tangent to a curve at any point (x, y) on it is given by $(y^3 - 2yx^2)dx + (2xy^2 - x^3)dy = 0$ and the curve passes through (1, 2). Find the equation of the curve.

43. a. A machine produces a component of a product with a standard deviation of 1.6cm in length. A random sample of 64 components was selected from the output and this sample has a mean length of 90cm. The customer will reject the part if it is either less than 88cm or more than 92cm. Does the 95% confidence interval for the true mean length of all the components produced ensure acceptance by the customer? $[|z_a| = 1.96]$ **(OR)**

b. Compute (i) Laspeyre's ii) Paasche's iii) Fisher's Index number for the year 2010 from the following data.

| Commodity | Price | | Quantity | |
|---|---|---|---|---|
| | 2000 | 2010 | 2000 | 2010 |
| A | 12 | 14 | 18 | 16 |
| B | 15 | 16 | 20 | 15 |
| C | 14 | 15 | 24 | 20 |
| D | 12 | 12 | 29 | 23 |

44. a. Evaluate : $\int_{2}^{5} \dfrac{\sqrt{x}}{\sqrt{x} + \sqrt{7-x}} dx$ **(OR)**

b. Using Lagrange's interpolation formula find a polynomial which passes through the points (0, -12), (1, 0), (3, 6) and (4, 12)

45. a. Under perfect competition for a commodity the demand and supply laws are $P_d = \dfrac{8}{x+1} - 2$ and $P_s = \dfrac{x+3}{2}$ respectively. Find the consumer's and producer's surplus. **(OR)**

b. The following data shows the value of sample mean $\bar{x}$ and the range R for ten samples of size 5 each. Calculate the values for central line and control limits for mean chart and range chart and determine whether the process is in control.

| Sample No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean $\bar{x}$ | 11.2 | 11.8 | 10.8 | 11.6 | 11.0 | 9.6 | 10.4 | 9.6 | 10.6 | 10.0 |
| Range (R) | 7 | 4 | 8 | 5 | 7 | 4 | 8 | 4 | 7 | 9 |

(Given for n = 5, $A_2$ = 0.577, $D_3$ = 0, $D_4$ = 2.115)

46. a. Obtain an initial basic feasible solution to the following transportation problem using least cost method.

| | $D_1$ | $D_2$ | $D_3$ | $D_4$ | Supply |
|---|---|---|---|---|---|
| $O_1$ | 1 | 2 | 3 | 4 | 6 |
| $O_2$ | 4 | 3 | 2 | 5 | 8 |
| $O_3$ | 5 | 2 | 2 | 1 | 10 |
| Demand | 4 | 6 | 8 | 6 | |

**(OR)**

b. The average number of customers, who appear in counter of a certain bank per minute is two. Find the probability that during a given minute i) No customer appears ii) three or more customers appear. $[e^{-2} = 0.1353]$

47. a. Let x be a continuous random variable with probability density function
$$f(x) = \begin{cases} \dfrac{3}{x^4}, & x \geq 1 \\ 0, & \text{otherwise} \end{cases}$$
. Find the mean and variance of x. **(OR)**

b. Solve the following assignment problem.

| | Men | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| Task P | 9 | 26 | 15 |
| Task Q | 13 | 27 | 6 |
| Task R | 35 | 20 | 15 |
| Task S | 18 | 30 | 20 |