

FIRST MID-TERM TEST - 2022

Reg. No.

XI - BUSINESS MATHEMATICS & STATISTICS

Time Allowed : 1:30 Hrs.

Maximum Marks: 50

PART - I

- Note**
- Answer all the questions
 - Choose the most appropriate answer from the given four alternatives and write the option code and the corresponding answer. (10×1=10)

- The value of x if $\begin{vmatrix} 0 & 1 & 0 \\ x & 2 & x \\ 1 & 3 & x \end{vmatrix} = 0$ is _____
 a) 0, -1 b) 0, 1 c) -1, 1 d) -1, -1
- The number of Hawkins - Simon conditions for the viability of an input-output analysis is _____
 a) 1 b) 3 c) 4 d) 2
- $\text{adj}(AB)$ is equal to _____
 a) $\text{adj}A \text{adj}B$ b) $\text{adj}A^T \text{adj}B^T$ c) $\text{adj}B \text{adj}A$ d) $\text{adj}B^T \text{adj}A^T$
- If A is 3×3 matrix and $|A| = 4$ then $|A^{-1}|$ is equal to _____
 a) $1/4$ b) $1/16$ c) 2 d) 4
- If any three rows or columns of a determinant are identical then the value of the determinant is _____
 a) 0 b) 2 c) 1 d) 3
- If $nC_3 = nC_2$ then the value of nC_4 is _____
 a) 2 b) 3 c) 4 d) 5
- The number of ways selecting 4 players out of 5 is _____
 a) $4!$ b) 20 c) 25 d) 5
- If n is a positive integer, then the number of terms in the expansion of $(x + a)^n$ is _____
 a) n b) $n+1$ c) $n-1$ d) $2n$
- The number of ways to arrange the letters of the word "CHEESE" is _____
 a) 120 b) 240 c) 720 d) 6
- Sum of the binomial coefficients is _____
 a) 2^n b) n^2 c) $2n$ d) $n+17$

PART - II

Answer any five questions. Question Number 17 is compulsory. (5×2=10)

- Evaluate : $\begin{vmatrix} 2 & 4 \\ -1 & 4 \end{vmatrix}$
- If, $A = \begin{bmatrix} -2 & 6 \\ 3 & -9 \end{bmatrix}$ then, find A^{-1}
- Find the adjoint of the matrix $A = \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix}$
- Show that $\begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix}$ is a singular matrix
- Rewrite $7!$ in terms of $5!$
- Evaluate i) $8P_3$ ii) $5P_4$
- If $15C_{3r} = 15C_{r+3}$ find r .

PART - III

Answer any five questions. Question no. 24 is compulsory.

(5x3=15)

18. Evaluate : $\begin{vmatrix} 3 & -2 & 4 \\ 2 & 0 & 1 \\ 1 & 2 & 3 \end{vmatrix}$
19. Solve : $\begin{vmatrix} x-1 & x & x-2 \\ 0 & x-2 & x-3 \\ 0 & 0 & x-3 \end{vmatrix} = 0$
20. The technology matrix of an economic system of two industries is $\begin{bmatrix} 0.50 & 0.30 \\ 0.41 & 0.33 \end{bmatrix}$. Test whether the system is viable as per Hawkins-Simon conditions.
21. Find the values of A and B if $\frac{1}{x^2-1} = \frac{A}{x-1} + \frac{B}{x+1}$
22. Evaluate the following : i) $\frac{7!}{6!}$ ii) $\frac{9!}{6!3!}$
23. Find the number of arrangements that can be made out of the letters of the word "ASSASSINATION".
24. Using binomial theorem, expand $\left(x^2 + \frac{1}{x^2}\right)^4$

PART - IV

Answer all the questions.

(3x5=15)

25. a. Prove that $\begin{vmatrix} -a^2 & ab & ac \\ ab & -b^2 & bc \\ ac & bc & -c^2 \end{vmatrix} = 4a^2b^2c^2$ (OR)
- b. If $A = \begin{bmatrix} 3 & 7 \\ 2 & 5 \end{bmatrix}$ and $B = \begin{bmatrix} 6 & 8 \\ 7 & 9 \end{bmatrix}$ then, verify that $(AB)^{-1} = B^{-1}A^{-1}$
26. a. Solve by using matrix inversion method: $2x + 5y = 1$, $3x + 2y = 7$
(OR)
- b. Suppose the inter-industry flow of the product of two sectors X and Y are given as under.

Production Sector	Consumption Sector		Domestic demand	Gross Output
	X	Y		
X	15	10	10	35
Y	20	30	15	65

Find the gross output when the domestic demand changes to 12 for X and 18 for Y.

27. a. Find n, if $\frac{1}{9!} + \frac{1}{10!} = \frac{n}{11!}$ (OR)
- b. Using mathematical induction method prove that

$$1 + 2 + 3 + \dots + n = \frac{n(n+1)}{2}, n \in \mathbb{N}$$

First Mid Term - 2022 - Trichy Dt.

Std: 11

Business maths - key

Part - I

1. (b) 011
2. (d) 2
3. (c) (adj B) (adj A)
4. (a) $\frac{1}{4}$
5. (a) 0
6. (d) 5
7. (d) 5
8. (b) $n+1$
9. (a) 120
10. (a) 2^n

$$\begin{aligned} \textcircled{16} \text{ (i)} \quad 8P_3 &= \frac{8!}{(8-3)!} = \frac{8!}{5!} \\ &= \frac{8 \times 7 \times 6 \times 5!}{5!} \\ 8P_3 &= 336 \\ \text{(ii)} \quad 5P_4 &= \frac{5!}{(5-4)!} = \frac{5!}{1!} = 120 \end{aligned}$$

$$\begin{aligned} \textcircled{17} \quad 15C_{3r} &= 15C_{r+3} \\ \Rightarrow 3r + r + 3 &= 15 \\ 4r + 3 &= 15 \\ 4r &= 12 \\ r &= 3 \end{aligned}$$

Part - II

$$\textcircled{11} \quad \begin{vmatrix} 2 & 4 \\ -1 & 4 \end{vmatrix} = 8 + 4 = 12$$

$$\textcircled{12} \quad |A| = \begin{vmatrix} -2 & 6 \\ 3 & -9 \end{vmatrix} = 18 - 18 = 0$$

$\therefore A^{-1}$ does not exist.

$$\textcircled{13} \quad \text{adj } A = \begin{pmatrix} 4 & -3 \\ -1 & 2 \end{pmatrix}$$

$$\textcircled{14} \quad |A| = \begin{vmatrix} 1 & 2 \\ 2 & 4 \end{vmatrix} = 4 - 4 = 0$$

$\therefore A$ is singular

$$\textcircled{15} \quad 7! = 7 \times 6 \times 5! = 42 \times 5!$$

Part - III

$$\begin{aligned} \textcircled{18} \quad \Delta &= \begin{vmatrix} 3 & -2 & 4 \\ 2 & 0 & 1 \\ 1 & 2 & 3 \end{vmatrix} \\ &= 3(0-2) + 2(6-1) + 4(4-0) \\ &= -6 + 10 + 16 \\ \Delta &= 20 \end{aligned}$$

$$\begin{aligned} \textcircled{19} \quad (x-1)(x-2)(x-3) &= 0 \\ \Rightarrow x &= 1, 2, 3 \end{aligned}$$

$$\begin{aligned} \textcircled{20} \quad B &= \begin{pmatrix} 0.50 & 0.30 \\ 0.41 & 0.33 \end{pmatrix} \\ I - B &= \begin{pmatrix} 0.50 & -0.30 \\ -0.41 & 0.67 \end{pmatrix} \end{aligned}$$

$$\therefore |I+B| = \begin{vmatrix} 0.50 & -0.30 \\ -0.41 & 0.67 \end{vmatrix}$$

$$= 0.335 - 0.123$$

$$|I-B| = 0.212, \text{ +ve}$$

\(\therefore\) The system is viable.

$$(21) A(x+1) + B(x-1) = 1$$

$$\text{Put } x=1, 2A=1 \Rightarrow A = \frac{1}{2}$$

$$\text{Put } x=-1, -2B=1 \Rightarrow B = -\frac{1}{2}$$

$$(22) (i) \frac{7!}{6!} = \frac{7 \times 6!}{6!} = 7$$

$$(ii) \frac{9!}{6!3!} = \frac{9 \times 8 \times 7 \times 6!}{6! \times 3 \times 2 \times 1}$$

$$= 84$$

$$(23) \text{ Total no. of arrangements} = \frac{13!}{3!4!2!2!}$$

$$(24) (x+a)^n = nC_0 x^n + nC_1 x^{n-1} a + \dots + nC_n a^n$$

$$\left(x + \frac{1}{x^2}\right)^4 = 4C_0 (x^2)^4 + 4C_1 (x^2)^3 \left(\frac{1}{x^2}\right)$$

$$+ 4C_2 (x^2)^2 \left(\frac{1}{x^2}\right)^2 + 4C_3 (x^2) \left(\frac{1}{x^2}\right)^3$$

$$+ 4C_4 \left(\frac{1}{x^2}\right)^4$$

$$\Rightarrow \left(x^2 + \frac{1}{x^2}\right)^4 = x^8 + 4x^4 + 6 + \frac{4}{x^2} + \frac{4}{x^4} + \frac{1}{x^8}$$

Part - IV

(25) (a)

$$\text{LHS} = \begin{vmatrix} -a^2 & ab & ac \\ ab & -b^2 & bc \\ ac & bc & -c^2 \end{vmatrix}$$

Take a, b, c in R_1, R_2, R_3 respectively.

$$= abc \begin{vmatrix} -a & b & c \\ a & -b & c \\ a & b & -c \end{vmatrix}$$

Take a, b, c in C_1, C_2, C_3 respectively

$$= a^2 b^2 c^2 \begin{vmatrix} -1 & 1 & 1 \\ 1 & -1 & 1 \\ 1 & 1 & -1 \end{vmatrix}$$

$$= a^2 b^2 c^2 (A)$$

$$= 4a^2 b^2 c^2 = \text{RHS.}$$

(25) (b)

$$AB = \begin{pmatrix} 67 & 87 \\ 47 & 61 \end{pmatrix}$$

$$|AB| = -2 \neq 0$$

$$\text{adj}(AB) = \begin{pmatrix} 61 & -87 \\ -47 & 67 \end{pmatrix}$$

$$(AB)^{-1} = \frac{1}{-2} \begin{pmatrix} -61 & 87 \\ 47 & -67 \end{pmatrix} \rightarrow \text{Ⓜ}$$

$$|B| = -2 \neq 0$$

$$\text{adj } B = \begin{pmatrix} 9 & -8 \\ -7 & 6 \end{pmatrix}$$

$$B^{-1} = \frac{1}{-2} \begin{pmatrix} 9 & -8 \\ -7 & 6 \end{pmatrix}$$

$$|A| = 1 \quad \text{adj } A = \begin{pmatrix} 5 & -7 \\ -2 & 3 \end{pmatrix}$$

$$A^{-1} = \frac{1}{1} \begin{pmatrix} 5 & -7 \\ -2 & 3 \end{pmatrix}$$

$$\therefore B^{-1} A^{-1} = \frac{1}{2} \begin{pmatrix} -61 & 87 \\ 47 & -67 \end{pmatrix}$$

$$(26) (a) \quad AX = B$$

$$\begin{pmatrix} 2 & 5 \\ 3 & 2 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1 \\ 7 \end{pmatrix}$$

$$A = \begin{pmatrix} 2 & 5 \\ 3 & 2 \end{pmatrix} \therefore |A| = -11 \neq 0$$

$$\text{adj } A = \begin{pmatrix} 2 & -5 \\ -3 & 2 \end{pmatrix}$$

$$A^{-1} = \frac{1}{-11} \begin{pmatrix} 2 & -5 \\ -3 & 2 \end{pmatrix}$$

$$\therefore X = A^{-1} \cdot B$$

$$= \frac{1}{-11} \begin{pmatrix} 2 & -5 \\ -3 & 2 \end{pmatrix} \begin{pmatrix} 1 \\ 7 \end{pmatrix}$$

$$= \frac{-1}{11} \begin{pmatrix} -33 \\ 11 \end{pmatrix}$$

$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 3 \\ -1 \end{pmatrix}$$

$$(26) (b) \quad B = \begin{pmatrix} \frac{3}{7} & \frac{2}{13} \\ \frac{4}{7} & \frac{6}{13} \end{pmatrix}$$

$$I - B = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} - \begin{pmatrix} \frac{3}{7} & \frac{2}{13} \\ \frac{4}{7} & \frac{6}{13} \end{pmatrix}$$

$$I - B = \begin{pmatrix} \frac{4}{7} & -\frac{2}{13} \\ -\frac{4}{7} & \frac{7}{13} \end{pmatrix} \therefore |I - B| = \frac{20}{91}$$

$$\text{adj}(I - B) = \begin{pmatrix} \frac{7}{13} & \frac{2}{13} \\ \frac{4}{7} & \frac{4}{7} \end{pmatrix}$$

$$(I - B)^{-1} = \frac{1}{\left(\frac{20}{91}\right)} \begin{pmatrix} \frac{7}{13} & \frac{2}{13} \\ \frac{4}{7} & \frac{4}{7} \end{pmatrix}$$

$$X = (I - B)^{-1} \cdot B = \frac{91}{20} \begin{pmatrix} \frac{7}{13} & \frac{2}{13} \\ \frac{4}{7} & \frac{4}{7} \end{pmatrix} \begin{pmatrix} 12 \\ 18 \end{pmatrix}$$

$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 42 \\ 78 \end{pmatrix}$$

$$(27) (a) \quad \frac{1}{9!} + \frac{1}{10 \times 9!} = \frac{n}{11 \times 10 \times 9!}$$

$$\frac{1}{9!} \left[1 + \frac{1}{10} \right] = \frac{n}{110 \times 9!}$$

$$\frac{11}{10} = \frac{n}{110}$$

$$110 \times \frac{11}{10} = n$$

$$\Rightarrow n = 121$$

$$(27) (b)$$

$$P(n) : 1 + 2 + \dots + n = \frac{n(n+1)}{2}$$

$$\text{put } n=1, \quad \text{LHS } P(1) = 1$$

$$\text{RHS } \frac{1(1+1)}{2} = 1$$

$$\therefore \text{LHS} = \text{RHS}$$

$$\therefore P(1) \text{ is true.}$$

Let us assume $P(k)$ is true

$$\therefore 1+2+3+\dots+k = \frac{k(k+1)}{2}$$

To prove : $P(k+1)$ is true

$$P(k+1) = 1+2+\dots+k+(k+1)$$

$$= \frac{k(k+1)}{2} + (k+1)$$

$$= \frac{(k+1)(k+2)}{2}$$

$\therefore P(k+1)$ is true.

$\therefore P(n)$ is true $\forall n \in \mathbb{N}$.

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