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### Part III — BUSINESS MATHEMATICS

( English Version )

Time Allowed : 3 Hours ]

[ Maximum Marks : 200

#### SECTION - A

- N. B. :
- i) Answer all the 40 questions.
  - ii) Each question carries one mark.
  - iii) Choose and write the correct answer from the four choices given.
- 40 × 1 = 40

1. The adjoint of  $\begin{pmatrix} 0 & 2 \\ 2 & 0 \end{pmatrix}$  is

a)  $\begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$

b)  $\begin{pmatrix} 0 & -2 \\ -2 & 0 \end{pmatrix}$

c)  $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$

d)  $\begin{pmatrix} 0 & 2 \\ 2 & 0 \end{pmatrix}$

2. For what value of K the matrix A where  $A = \begin{pmatrix} 2 & K \\ 3 & 5 \end{pmatrix}$  has no inverse ?

a)  $\frac{3}{10}$

b)  $\frac{10}{3}$

c) 3

d) 10.

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3. The rank of a zero matrix is

a) 0

b) 1

c) -1

d)  $\infty$ .

4. The equation  $AX = B$  can be solved by Cramer's rule only when

a)  $|A| = 0$

b)  $|A| \neq 0$

c)  $A = B$

d)  $A \neq B$ .

5. If  $T = \begin{matrix} & A & B \\ A & \begin{pmatrix} 0.7 & 0.3 \\ x & 0.8 \end{pmatrix} \end{matrix}$  is a transition probability matrix, then the value of  $x$  is

a) 0.3

b) 0.2

c) 0.8

d) 0.7.

6. The eccentricity of a parabola is

a) 1

b) 0

c) 2

d) -1.

7. Latus rectum of an ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  ( $a > b$ ) is

a)  $\frac{2a^2}{b}$

b)  $\frac{a^2}{2b}$

c)  $\frac{2b^2}{a}$

d)  $\frac{b^2}{2a}$ .

8. Eccentricity of the hyperbola  $\frac{x^2}{4} - \frac{y^2}{5} = 1$  is
- a)  $\frac{3}{2}$                                                  b)  $\frac{9}{4}$   
c)  $\frac{5}{4}$                                                  d) 4.
9. If  $a$  is the length of the semi-transverse axis of rectangular hyperbola  $xy = c^2$ , then the value of  $c^2$  is
- a)  $a^2$                                                  b)  $2a^2$   
c)  $\frac{a^2}{2}$                                                  d)  $\frac{a^2}{4}$ .
10. For the cost function  $C = \frac{1}{10}e^{2x}$ , the marginal cost is
- a)  $\frac{1}{10}$                                                  b)  $\frac{1}{5}e^{2x}$   
c)  $\frac{1}{10}e^{2x}$                                                  d)  $\frac{1}{10}e^x$ .
11. If  $y = 2x^2 + 3x$  the instantaneous rate of change of  $y$  at  $x = 4$  is
- a) 16                                                 b) 19  
c) 30                                                 d) 4.
12. The slope of the tangent at (2, 8) on the curve  $y = x^3$  is
- a) 3                                                 b) 12  
c) 6                                                 d) 8.

13. The slope of the tangent to the curve  $y = \cos t$ ,  $x = \sin t$  at  $t = \frac{\pi}{4}$  is

- a) 1  
b) 0  
c)  $\frac{1}{\sqrt{2}}$   
d) -1.

14. The slope of the curve  $x = y^2 - 6y$  at the point where it crosses the  $y$ -axis is

- a) 5  
b) -5  
c)  $\frac{1}{6}$   
d)  $-\frac{1}{16}$ .

15. The maximum value of  $f(x) = \cos x$  is

- a) 0  
b)  $\frac{\sqrt{3}}{2}$   
c)  $\frac{1}{2}$   
d) 1.

16. The elasticity of demand when marginal revenue is zero, is

- a) 1  
b) 2  
c) -5  
d) 0.

17. If  $q_1 = 2000 + 8p_1 - p_2$ , then  $\frac{\partial q_1}{\partial p_1}$  is

- a) 8  
b) -1  
c) 2000  
d) 0.



24. The integrating factor of  $x \frac{dy}{dx} - y = e^x$  is

a)  $\log x$

b)  $e^{-\frac{1}{x}}$

c)  $\frac{1}{x}$

d)  $-\frac{1}{x}$

25. The particular integral of the differential equation  $\frac{d^2 y}{dx^2} - 6 \frac{dy}{dx} + 9y = e^{3x}$  is

a)  $\frac{e^{3x}}{2!}$

b)  $\frac{x^2 e^{3x}}{2!}$

c)  $\frac{x e^{3x}}{2!}$

d)  $9 e^{3x}$

26.  $E =$

a)  $1 + \Delta$

b)  $1 - \Delta$

c)  $\nabla + 1$

d)  $\nabla - 1$

27. In a line of best fit  $y = 5.8(x - 1994) + 41.6$ , the value of  $y$  when  $x = 1997$  is

a) 50

b) 54

c) 59

d) 60

28. If the probability density function of a variable  $X$  is defined as  $f(x) = cx(2-x)$   $0 < x < 2$  then the value of  $c$  is

a)  $\frac{4}{3}$

b)  $\frac{6}{4}$

c)  $\frac{3}{4}$

d)  $\frac{3}{5}$

29. The standard deviation of a Poisson variate is 2. The mean of the Poisson variate is

a) 2

b) 4

c)  $\sqrt{2}$

d)  $\frac{1}{\sqrt{2}}$

30. The mean and variance of a Binomial distribution are 8 and 4 respectively. Then  $P(X = 1)$  is equal to

a)  $\frac{1}{2^{12}}$

b)  $\frac{1}{2^4}$

c)  $\frac{1}{2^8}$

d)  $\frac{1}{2^{10}}$

31. If  $X \sim N(8, 64)$  the standard normal variate  $Z$  will be

a)  $\frac{X-64}{8}$

b)  $\frac{X-8}{64}$

c)  $\frac{X-8}{8}$

d)  $\frac{X-8}{\sqrt{8}}$

32. If a random sample of size 64 is taken from a population whose standard deviation is equal to 32, then the standard error of the mean is

a) 0.5

b) 2

c) 4

d) 32.

33. The Z-value that is used to establish a 95% confidence interval for the estimation of a population parameter is

a) 1.28

b) 1.65

c) 1.96

d) 2.58.

[ Turn over

34. Probability of rejecting the null hypothesis, when it is true, is

- a) Type I error
- b) Type II error
- c) Sampling error
- d) Standard error.

35. The number of ways in which one can select 2 customers out of 10 customers is

- a) 90
- b) 60
- c) 45
- d) 50.

36. A time series consists of

- a) two components
- b) three components
- c) four components
- d) none of these.

37. Index number is expressed

- a) in percentages
- b) in ratios
- c) in terms of absolute value
- d) all of these.

38. The weights used in Paasche's formula belong to

- a) the base period
- b) the current period
- c) any arbitrary chosen period
- d) none of these.

39. The range of correlation co-efficient is

- a) 0 to  $\infty$
- b)  $-\infty$  to  $\infty$
- c) -1 to 1
- d) none of these.



40. The lines of regression intersect at the point

a)  $(X, Y)$

b)  $(\bar{X}, \bar{Y})$

c)  $(0, 0)$

d) none of these.

### SECTION - B

N. B. : i) Answer any *ten* out of *fifteen* questions given.

ii) Each question carries *six* marks.

$$10 \times 6 = 60$$

41. Find the inverse of  $A = \begin{pmatrix} -1 & 2 & 1 \\ 0 & 2 & 3 \\ 1 & 1 & 4 \end{pmatrix}$ .

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

43. Find the equation of the ellipse, whose focus is  $(1, 2)$ , directrix is  $2x - 3y + 6 = 0$ , and eccentricity is  $\frac{2}{3}$ .

44. The cost function for the production of  $x$  units of an item is given by  $C = \frac{1}{10}x^3 - 4x^2 + 20x + 5$ . Find

i) the average cost

ii) the marginal cost

iii) the marginal average cost.

[ Turn over

45. A metal cylinder is heated and expands so that its radius increases at a rate of 0.4 cm per minute and its height increases at a rate of 0.3 cm per minute retaining its shape. Determine the rate of change of the surface area of the cylinder, when its radius is 20 cm and height is 40 cm.
46. Find EOQ for the data given below. Also verify that carrying cost is equal to ordering costs at EOQ :
- Monthly requirements 9000
- Ordering cost per unit Rs. 200
- Carrying cost per unit Rs. 3.60
47. Find the area of one loop of the curve  $y^2 = x^2(1 - x^2)$  between  $x = 0$  and  $x = 1$ .
48. The slope of a curve at any point is the reciprocal of twice the ordinate of the point. The curve also passes through the point (4,3). Find the equation of the curve.
49. Solve the differential equation  $\frac{dy}{dx} + y \cot x = 4x \operatorname{cosec} x$  if  $y = 0$  when  $x = \frac{\pi}{2}$ .
50. Find the missing term from the following data :

$x :$	0	5	10	15	20	25
$y :$	7	11	14	-	24	32

51. Fit a straight line for the following data:

$x :$	0	1	2	3	4
$y :$	1	1	3	4	6

52. Ten coins are thrown simultaneously. Find the probability of getting at least 7 heads .

53. A random sample of 500 apples was taken from large consignment and 45 of them were found to be bad. Find the limits at which the bad apples lie at 99% confidence level.

54. From the data given below, find the correlation co-efficient :

$X :$	46	54	56	56	58	60	62
$Y :$	36	40	44	54	42	58	54

55. Construct the cost of living index number for 2003 on the basis of 2000 from the following data using family budget method :

Items	Price		Weight
	2000	2003	
Food	200	280	30
Rent	100	200	20
Clothing	150	120	20
Fuel and lighting	50	100	10
Miscellaneous	100	200	20

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## SECTION - C

N. B. : i) Answer any *ten* questions out of *fifteen* questions given.

ii) Each question carries *ten* marks.

10 × 10 = 100

56. Solve by Cramer's rule the equations  $2x + 2y - z - 1 = 0$ ,  $x + y - z = 0$ ,  
 $3x + 2y - 3z = 1$ .

57. In an economy there are two industries  $P$  and  $Q$  and the following table gives the supply and demand positions in crores of rupees :

Producer	User		Final demand	Total output
	P	Q		
P	10	25	15	50
Q	20	30	10	60

Determine the outputs when the final demand changes to 35 for  $P$  and 42 for  $Q$ .

58. Find the centre, vertices, eccentricity, foci and latus rectum and directrices of the ellipse

$$9x^2 + 16y^2 + 36x - 32y - 92 = 0.$$

59. Find the equation of the tangent and normal at the point  $(a \sec \theta, b \tan \theta)$  on the hyperbola  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

60. Investigate the maxima and minima of the function  $2x^3 + 3x^2 - 36x + 10$ .

61. A demand for a quantity  $A$  is  $q_1 = 16 - 3p_1 - 2p_2^2$ . Find

i) the partial elasticities  $\frac{E q_1}{E p_1}$ ,  $\frac{E q_1}{E p_2}$

ii) the partial elasticities for  $p_1 = 2$  and  $p_2 = 1$

62. Evaluate :  $\int_{\pi/6}^{\pi/3} \frac{dx}{1 + \sqrt{\cot x}}$

63. The demand and supply functions under pure competition are  $p_d = 16 - x^2$  and  $p_s = 2x^2 + 4$ . Find the consumers' surplus and producers' surplus at the market equilibrium price.

64. Suppose that  $Q_d = 30 - 5p + 2 \frac{dp}{dt} + \frac{d^2p}{dt^2}$  and  $Q_s = 6 + 3p$ . Find the equilibrium price for market clearance. [Where  $Q_d$  = Quantity of demand,  $Q_s$  = Quantity of supply and  $p$  = Price]

65. From the following data, find the number of students whose height in between 80 cm and 90 cm :

<b>Height in cm <math>x</math> :</b>	40-60	60-80	80-100	100-120	120-140
<b>No. of students <math>y</math> :</b>	250	120	100	70	50

66. A continuous random variable has the following p.d.f. :

$$f(x) = kx^2 \quad 0 \leq x \leq 10$$

$$= 0 \quad \text{otherwise.}$$

Determine  $k$  and evaluate (i)  $p(0.2 \leq x \leq 0.5)$  (ii)  $p(x \leq 3)$ .

[ Turn over

67. The I.Q. (Intelligence Quotient) of a group of 1000 schoolchildren has mean 96 and the standard deviation 12. Assuming that the distribution of I.Q. among schoolchildren is normal, find approximately the number of schoolchildren having I.Q.

(i) less than 72, (ii) between 80 and 120.

[Given  $P(0 \leq z \leq 2) = 0.4772$ ,  $P(0 \leq z \leq 1.33) = 0.4082$ ]

68. The income distribution of the population of a village has a mean of Rs. 6,000 and a variance of Rs. 32,400. Could a sample of 64 persons with a mean income of Rs. 5,950 belong to this population?

(Test at both 5% and 1% levels of significance)

69. Solve graphically :

Minimize  $Z = 20x_1 + 40x_2$

subject to  $36x_1 + 6x_2 \geq 108$

$3x_1 + 12x_2 \geq 36$

$20x_1 + 10x_2 \geq 100$

$x_1, x_2 \geq 0.$

70. Calculate the seasonal indices by the method of Simple average for the following

data :

Year	I-quarter	II-quarter	III-quarter	IV-quarter
1985	65	60	61	63
1986	68	55	66	61
1987	68	60	63	67

