

**Standard 12**  
**BUSINESS MATHEMATICS**

Maximum Marks: 90

Time Allowed: 2.30 Hrs.

- 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.

**Section - I**

20 x 1 = 20

Note : i) Answer all the questions.

ii) Choose the most suitable answer from the given four alternatives and write the option code and the corresponding answer.

1. If A is a scalar matrix with scalar  $k \neq 0$  of order 4, then  $A^{-1}$  is
  - a)  $\frac{1}{k^4}I$
  - b)  $\frac{1}{k}I$
  - c)  $kI$
  - d)  $\frac{1}{k^3}I$
2. The rank of an  $n \times n$  matrix each of whose elements is 2 is
  - a) 1
  - b) 2
  - c) n
  - d)  $n^2$
3. The distance between the foci of the ellipse  $4x^2 + 3y^2 = 12$  is
  - a) 4
  - b) 2
  - c) 8
  - d) 1
4. If a is a 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)  $\frac{a^2}{4}$
5. The slope of the line which is perpendicular to the tangent to the curve  $x^2 + y^2 = \sqrt{70}$  at (2,3) is
  - a)  $-\frac{2}{3}$
  - b)  $\frac{3}{2}$
  - c)  $-\frac{3}{2}$
  - d)  $\frac{2}{3}$
6. For the function  $y = 3x + 2$  the average rate of change of y when x increases from 1.5 to 1.6 is
  - a) 1
  - b) 0.5
  - c) 0.6
  - d) 3
7. If  $R = 5000$  units/year  $C_1 = 20$  paise,  $C_3 = \text{Rs.}20$  then EOQ is
  - a) 1000
  - b) 5000
  - c) 200
  - d) 100
8. If marginal revenue is Rs.25 and the elasticity of demand with respect to price is 2, then average revenue is
  - a) Rs.50
  - b) Rs.25
  - c) Rs.27
  - d) Rs.12.50
9.  $\int_{-2}^2 x^4 dx$  is
  - a)  $\frac{32}{5}$
  - b)  $\frac{64}{5}$
  - c)  $\frac{16}{5}$
  - d)  $\frac{8}{5}$
10. If the marginal cost function  $MC = 3e^{3x}$ , then the cost function is
  - a)  $\frac{e^{3x}}{3}$
  - b)  $e^{3x} + k$
  - c)  $9e^{3x}$
  - d)  $3e^{3x}$
11. Order and degree of  $\cos x (dx + dy) = \sin x (dx - dy)$ 
  - a) 1,1
  - b) 1,2
  - c) 2,1
  - d) 2,2
12. The solution of the equation of the type  $\frac{dx}{dy} + Px = Q$  (P and Q are functions of y) is
  - a)  $y = \int Qe^{\int P dx} dy + C$
  - b)  $ye^{\int P dx} = \int Qe^{\int P dx} dx + C$
  - c)  $xe^{\int P dy} = \int Qe^{\int P dy} dy + C$
  - d)  $xe^{\int P dy} = \int Qe^{\int P dx} dx + C$

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3. When  $h = 1$ ,  $\Delta(x^2) =$   
 a)  $3x^2 + 3x + 1$     b)  $(x+1)^2$     c)  $-3x^2 - 3x - 1$     d)  $x + 3h$
14. Five data relating to  $x$  and  $y$  are to be fit in a straight line. It is found that  $\Sigma x = 0$  and  $\Sigma y = 15$ . Then the  $y$  intercept of the line of best fit is  
 a) 1    b) 2    c) 3    d) 4
15. Given  $E(X+C) = 18$  and  $E(X-C) = 12$ , then the value of  $C$  is  
 a) -2    b) 4    c) 3    d) -3
16. If  $X \sim N(\mu, \sigma^2)$ , the points of inflection of normal distribution curve are  
 a)  $\pm \mu$     b)  $\mu \pm \sigma$     c)  $\sigma \pm \mu$     d)  $\mu \pm 2\sigma$
17. The theory of sampling is based on  
 a) sample size    b) sample unit  
 c) principle of statistical regularity    d) population size
18. Which of the following statements is true?  
 a) point estimate gives a range of values  
 b) sampling is done only to estimate a statistic  
 c) sampling is done to estimate the population parameter  
 d) sampling is not possible for an infinite population
19. In a regression line of  $Y$  on  $X$ , the variable  $X$  is known as  
 a) independent variable    b) dependent variable  
 c) both (a) and (b)    d) regression model
20. A time series consists of  
 a) two components    b) three components  
 c) four components    d) one component

Section - II

Answer any 7 questions: (Ques.No.27 is compulsory)

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21. The technology matrix of an economic system of two industries is  $\begin{pmatrix} 3/5 & 9/10 \\ 1/5 & 4/5 \end{pmatrix}$ . Test whether the system is viable as per Hawkins Simon conditions.
22. The centre of the ellipse is  $(2,3)$ . One of the foci is  $(3,3)$ , find the other focus.
23. Find the equilibrium price and equilibrium quantity for the following demand and supply functions  $q_d = 4 - 0.05P$  and  $q_s = 0.8 + 0.11P$
24. If the production of a firm is given by  $P = 3K^2L^2 - 2L^4 - K^4$ , prove that  $L \frac{\partial P}{\partial L} + K \frac{\partial P}{\partial K} = 4P$
25. Find the area of the region bounded by  $y = 2x + 1$ ,  $y = 3$ ,  $y = 5$  and  $y$ -axis.
26. Solve:  $\frac{dy}{dx} = \frac{2+y^2}{1+x^2}$
27. Find the missing term from the following data:
- |        |     |     |     |     |
|--------|-----|-----|-----|-----|
| $x$    | 1   | 2   | 3   | 4   |
| $f(x)$ | 200 | 225 | --- | 257 |
28. In a binomial distribution consisting of 5 independent trials probabilities of 1 and 2 success are 0.4096 and 0.2048 respectively. Find the parameter 'P' of the distribution.
29. A random sample of size 50 with mean 67.9 is drawn from a normal population. If it is known that the standard error of the sample mean is  $\sqrt{0.7}$ , find 95% confidence interval for the population mean.
30. From the following data, compute the correlation coefficient.  
 $N = 11$ ,  $\Sigma X = 117$ ,  $\Sigma Y = 260$ ,  $\Sigma X^2 = 1313$ ,  $\Sigma Y^2 = 6580$ ,  $\Sigma XY = 2627$ .

Section - III

Answer any 7 questions: (Ques.No.39 is compulsory)

7 x 3 = 21

31. Solve by Cramers' rule the equations  $6x - 7y = 16$ ,  $9x - 5y = 35$ .

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32. Find the equation to the hyperbola which has  $3x - 4y + 7 = 0$  and  $4x + 3y + 1 = 0$  for asymptotes and which passes through the origin.
33. For the cost function  $y = 2x \left( \frac{x+4}{x+3} \right) + 3$ , prove that the marginal cost falls continuously as the output  $x$  increases.
34. The relationship between profit  $P$  and advertising cost is given by  $P = \frac{200x}{150+x} - x$ . Find  $x$  which maximises  $P$ ?
35. If the marginal revenue of a commodity is given by  $MR = 9 - 2x + 4x^2$ . Find the demand function and revenue function.
36. Solve the following differential equation:  $\frac{dy}{dx} + y \cot x = 4x \operatorname{cosec} x$ , if  $y=0$  when  $x = \frac{\pi}{2}$
37. Using Gregory-Newton's formula, find  $y$  when  $x = 65$ .
- |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|
| $x$ | 50  | 60  | 70  | 80  | 90  | 100 |
| $y$ | 184 | 226 | 250 | 276 | 304 |     |
38. The following function is a probability mass-function - Verify  

$$f(x) = \begin{cases} \frac{1}{2} & \text{for } x = 1 \\ \frac{1}{4} & \text{for } x = 2 \\ 0 & \text{otherwise} \end{cases}$$
 Hence find the cumulative distribution function.
39. A random sample of 1000 oranges was taken from large consignment and 55% of them found to be bad. Find the limits at which bad oranges lie at 99% confidence level.
40. Calculate the cost of living index number using family budget method for the following data taking the base year as 1995.

COMMODITY	WEIGHT	PRICE (PER UNIT)	
		1995	1996
A	40	16.00	20.00
B	25	40.00	60.00
C	5	0.50	0.50
D	20	6.12	6.25
E	10	2.00	1.50

Section - IV

Answer all the questions:

7 x 5 = 35

41. In an economy of two companies P and Q following table gives the supply and demand positions in millions of rupees.

Producer	User		Final Demand	Total Output
	P	Q		
P	10	15	10	40
Q	20	25	15	50

Find out the output when the final demand changes to 20 for P.

(or)

- The mean weight of 500 male students in a certain college is 151 pounds and the standard deviation is 15 pounds. Assuming the weights are normally distributed, find how many students weigh: i) between 120 and 155 pounds, ii) more than 185 pounds

Z	2.26	2.06	0.26
Area	0.4881	0.4803	0.1026

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42. Find the centre, vertices, eccentricity, foci and latus rectum and directrices of the ellipse  $9x^2 + 16y^2 + 36x - 32y - 92 = 0$   
(or)

To test the conjecture of the management that 60 percent employees favour of new bonus scheme, a sample of 150 employees was drawn and their opinion was taken whether they favoured it or not. Only 55 employees out of 150 favoured the new bonus scheme. Test the conjecture at 1% level of significance.

43. The demand and supply curves are given by  $P_d = \frac{16}{x+4}$  and  $P_s = \frac{x}{2}$ . Find the consumers' surplus and Producers' surplus at the market equilibrium price.  
(or)

Solve the following using graphical method:

Maximize :  $Z = 3x_1 + 4x_2$

Subject to the constraints

$2x_1 + x_2 \leq 40$

$2x_1 + 5x_2 \leq 180$

$x_1, x_2 \geq 0$

44. The unit price,  $P$  of a product is related to the number of units sold  $x$ , by the demand equation  $P = 400 - \frac{x}{1000}$ . The cost of producing  $x$  units is given by  $c(x) = 50x + 16,000$ .

The number of units produced and sold,  $x$  is increasing at a rate of 200 units per week. When the number of units produced and sold is 10,000. Determine the instantaneous rate of change with respect to time,  $t$  (in weeks) of (i) revenue (ii) cost (iii) profit  
(or)

The following data is the number of hours which ten students studied for English and the scores obtained by them in the examinations.

Hours studied : $x$ :	4	9	10	12	14	22
Test Score : $y$ :	31	58	65	68	73	91

- i) Fit a straight line  $y = ax + b$   
ii) Predict the score of the student who studied for 17 hours.  
45. Find the mean and variance for the following probability distribution:

$$f(x) = \begin{cases} 2e^{-2x} & x \geq 0 \\ 0 & x < 0 \end{cases} \quad (or)$$

Evaluate using the properties of definite integral:  $\int_0^{\frac{\pi}{2}} \frac{a \sin x + b \cos x}{\sin x + \cos x} dx$

46. Find the equation of the tangent and normal to the curve  $y(x-2)(x-3) - x + 7 = 0$  at the point where it cuts the  $x$ -axis.  
(or)

Using four yearly moving averages, calculate the trend values.

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Production	464	515	518	467	502	540	557	571	586	612

47. Find the equation of the curve passing through  $(1, \frac{\pi}{2})$  and which has slope  $\frac{y}{x} + \tan \frac{y}{x}$  at  $(x, y)$   
(or)

Find the local maximum and minimum values of  $f(\theta) = \sin^2 \theta$ ,  $[0, \pi]$

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