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PART - III

BUSINESS MATHEMATICS AND STATISTICS

(English Version)

Time Allowed : 3.00 Hours]

[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) All questions are compulsory.

20 x 1=20

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

1. If $\rho(A) = r$ then which of the following is correct?

- all the minors of order r which does not vanish
- A has at least one $(r + 1)$ order minor which vanishes
- A has at least one minor of order r which does not vanish
- all $(r + 1)$ and higher order minors should not vanish

2. If $|A| = 13$ and $|\text{adj}A| = \begin{vmatrix} 4 & x \\ 5 & 7 \end{vmatrix}$ then the value of x is

- 3
- 4
- 2
- 5

[Turn over

3. $\int e^{2x}(2x^2 + 2x)dx$

- (a) $xe^{2x} + c$ (b) $e^{2x}x^2 + c$ (c) $2x^2e^2 + c$ (d) $\frac{x^2e^x}{2} + c$

4. $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin x dx$ is

- (a) 1 (b) $-\cos x + c$ (c) 2 (d) 0

5. The demand function for the marginal function $MR = 100 - 9x^2$ is

- (a) $100x - 9x^2$ (b) $100x - 3x^2$ (c) $100 - 3x^2$ (d) $100 + 9x^2$

6. The area bounded by $y = x$ between the lines $x = -1$ and $x = 2$ with x axis is

- (a) $\frac{5}{2}$ sq.units (b) $\frac{3}{2}$ sq.units (c) $\frac{-5}{2}$ sq.units (d) $\frac{-3}{2}$ sq.units

7. The variable separable form of $\frac{dy}{dx} = \frac{y(x-y)}{x(x+y)}$ by taking $y = vx$ and $\frac{dy}{dx} = v + x \frac{dv}{dx}$ is

- (a) $\frac{2v^2}{1+v} dv = \frac{dx}{x}$ (b) $\frac{2v^2}{1+v} dv = -\frac{dx}{x}$
 (c) $\frac{1+v}{2v^2} dv = -\frac{dx}{x}$ (d) $\frac{2v^2}{1-v} dv = \frac{dx}{x}$

8. The degree of the differential equation $\sqrt{1 + \left(\frac{dy}{dx}\right)^3} = \frac{d^2y}{dx^2}$

- (a) 1 (b) 2 (c) 3 (d) 6

9. If 'n' is a positive integer $\Delta^n [\Delta^{-n} f(x)]$

- (a) $f(2x)$ (b) $f(x)$ (c) $f(x+h)$ (d) $\Delta f(x)$

[Turn over

10. In Newton's Gregory interpolation the first three terms will be

- (a) parabolic interpolation (b) linear interpolation
 (c) hyperbolic interpolation (d) elliptical interpolation

11. The height of persons in a country is a random variable of the type

- (a) continuous random variable (b) discrete random variable
 (c) both (a) and (b) (d) neither (a) and (b)

12. A random variable X has the following probability distribution

x	0	1	2	3	4	5
P (X = x)	$\frac{1}{4}$	2a	3a	4a	5a	$\frac{1}{4}$

then $P(1 \leq x \leq 4)$ is

- (a) $\frac{10}{21}$ (b) $\frac{1}{2}$ (c) $\frac{1}{14}$ (d) $\frac{2}{7}$

13. In turning out certain toys in a manufacturing company, the average number of defectives is 1 % the probability that the sample of 100 toys there will be 3 defectives is

- (a) 0.613 (b) 0.3913 (c) 0.00613 (d) 0.0613

14. Number of printing mistakes per page in a text book is under

- (a) continuous distribution (b) binomial distribution
 (c) discrete distribution (d) none of these

15. An estimator is said to be _____ if it contains all the information in the data about the parameter it estimates

- (a) sufficient (b) efficient (c) unbiased (d) consistent

16. Which method distributes the sample more evenly over the entire listed Population

- (a) simple random sample (b) systematic sample
 (c) stratified random sample (d) both (b) and (c)

[Turn over

17. The components of a time series which is attached to short term fluctuation is

- (a) cyclic variation (b) irregular variation
(c) secular trend (d) seasonal variations

18. The Laspeyre's price index number for the following data is

Commodities	Price		Quantity	
	2022	2032	2022	2032
Rice	75	90	3	2
Milk	80	120	2	1
Fuel	107	78	1.01	2.50

- (a) 83.74 (b) 83.73 (c) 119.41 (d) 119

19. In a degenerate solution number of allocations is

- (a) equal to $m + n - 1$ (b) not equal to $m + n - 1$
(c) greater than $m + n - 1$ (d) less than $m + n - 1$

20. A pessimistic decision criterion is

- (a) maximin (b) minimax
(c) maximax (d) decision making under certainty

PART - II

Note : (i) Answer any seven questions.
(ii) Question number 30 is compulsory.

7x2=14

21. Find the rank of the matrix $\begin{pmatrix} 1 & 4 \\ 2 & 8 \end{pmatrix}$

22. Evaluate $\int \left(e^x + \frac{1}{e^x} \right)^2 dx$

23. For the marginal revenue function $MR = 35 + 7x - 3x^2$ find the revenue function and demand function.

24. Find the differential equation of $xy = c^2$

[Turn over

25. Prove that (i) $(1 + \Delta)(1 - \nabla) = 1$

(ii) $E\nabla = \nabla E$

26. prove that if $E(X) = 0$ then $V(X) = E(X^2)$

27. Write down the conditions for which the binomial distribution can be used.

28. Using the following Tippett's random number table

2952	6641	3992	9792	7969	5911	3170	5624
4167	9524	1545	1396	7203	5356	1300	2693
2670	7483	3408	2762	3563	1089	6913	7991
560	5246	1112	6107	6008	8125	4233	8776
2754	9143	1405	9025	7002	6111	8816	6446

Draw a sample of 15 houses in Cauvery Street which has 83 houses in total.

29. Define Factor Reversal Test.

30. Find the initial basic feasible solution to the following problem by North - west corner rule

		To			Supply
		2	7	4	5
		3	3	1	8
		5	4	7	7
		1	6	2	14
From					
	Demand	7	9	18	

PART - III

Note : (i) Answer any seven questions.

(ii) Question number 40 is compulsory.

7x3=21

31. Show that the equations are inconsistent

$$x - 4y + 7z = 14, \quad 3x + 8y - 2z = 13, \quad 7x - 8y + 26z = 5$$

32. Integrate $x^5 e^{x^2}$ with respect to x

33. Using integration find the area of the region bounded between the line $x = 4$ and the parabola $y^2 = 8x$

34. Solve $(1 - x)dy - (1 + y)dx = 0$

[Turn over

35. By constructing a difference table and using the second order differences as constant, find the sixth term of the series 8, 12, 19, 29, 42 . . .

36. A continuous random variable X has the following distribution function

$$F(x) = \begin{cases} 0, & \text{if } x \leq 1 \\ k(x-1)^4, & \text{if } 1 < x \leq 3 \\ 1, & \text{if } x > 3 \end{cases}$$

Find (i) k (ii) the probability density function

37. Assuming one in 80 births is a case of twins, calculate the probability of 2 or more sets of twins on a day when 30 births occur.

38. In a sample of 400 population from a village 230 are found to be eaters of vegetarian items and the rest non - vegetarian items. Compute the standard error assuming that both vegetarian and non - vegetarian foods are equally popular in that village?

39. Calculate the cost of living index by aggregate expenditure method for the following Ration shop details in Perumanallur.

Commodity	Weights 2018	Price (Rs.)	
		2018	2021
Rice	20	20	60
Sugar	2	53	75
Pulses	2	50	68
Palm Oil	1	37	46
Wheat	3	28	32

40. The following pay -off matrix for three alternatives and four states of nature.

Alternatives	States of nature (product demand)			
	High (Rs.)	Moderate (Rs.)	Low (Rs.)	Nil (Rs.)
Expand	50,000	25,000	- 25,000	- 45,000
Construct	70,000	30,000	- 40,000	- 80,000
Subcontract	30,000	15,000	-1,000	-10,000

Select the best alternative by Maximin principle.

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PART - IV

Note : Answer all the questions.

7x5=35

41. (a) Show that the equations $2x + y + z = 5$, $x + y + z = 4$, $x - y + 2z = 1$ are consistent and hence solve them.

(OR)

(b) Evaluate $\int \frac{x^3 + 3x^2 - 7x + 11}{x+5} dx$

42. (a) Elasticity of a function $\frac{Ey}{Ex}$ is given by $\frac{Ey}{Ex} = \frac{-7x}{(1-2x)(2+3x)}$. Find the function when $x = 2$, $y = \frac{3}{8}$

(OR)

- (b) Find the particular solution of the differential equation $x^2 dy + y(x+y)dx = 0$ given that $x = 1$, $y = 1$

43. (a) From the following data find y at $x = 43$ and $x = 84$

x	40	50	60	70	80	90
y	184	204	226	250	276	304

(OR)

- (b) Determine the mean and variance of a discrete random variable given its distribution as follows

X=x	1	2	3	4	5	6
F(x)	$\frac{1}{6}$	$\frac{2}{6}$	$\frac{3}{6}$	$\frac{4}{6}$	$\frac{5}{6}$	1

44. (a) Derive mean and variance of Poisson distribution.

(OR)

- (b) (i) What is sample?
 (ii) State any two demerits of systematic random sampling.
 (iii) Mention two branches of statistical inference.
 (iv) What is confidence interval?

[Turn over

45. (a)) If $u_0 = 560, u_1 = 556, u_2 = 520, u_4 = 385$, show that $u_3 = 465$

(OR)

(b) The probability density function of a random variable X is

$$f(x) = ke^{-|x|}, -\infty < x < \infty$$

Find the value of k and also find mean and variance of a random variable.

46. (a) Calculate the seasonal index for the monthly sales of a product using the method of simple averages.

Months	Year		
	2001	2002	2003
Jan	15	20	18
Feb	41	21	16
Mar	25	27	20
Apr	31	19	28
May	29	17	24
June	47	25	25
July	41	29	30
Aug	19	31	34
Sep	35	35	30
Oct	38	39	38
Nov	40	30	37
Dec	30	44	39

(OR)

(b) Determine how much quantity should be shipped from factory to various destinations for the following transportation problem using the least cost method

	Destination				Capacity
	C	H	K	P	
T	6	8	8	5	30
B	5	11	9	7	40
M	8	9	7	13	50
Demand	35	28	32	25	

Cost are expressed in terms of rupees per unit shipped.

[Turn over

47. (a) Given below are the data relating to the sales of a product in a district. Fit a straight line trend by the method of least squares and tabulate the trend values

Year	1995	1996	1997	1998	1999	2000	2001	2002
Sales	6.7	5.3	4.3	6.1	5.6	7.9	5.8	6.1

(OR)

- (b) Obtain an initial basic feasible solution to the following transportation problem using vogel's approximation method

		Stores (destinations)						Surplus (supply)
		1	2	3	4	5	6	
Ware houses (origins)	1	9	12	9	6	9	10	5
	2	7	3	7	7	5	5	6
	3	6	5	9	11	3	11	2
	4	6	8	11	2	2	10	9
Requirement (demand)		4	4	6	2	4	2	

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