

First year Diploma in Operations Research Management
 Paper - I - Business Mathematics

BB-8959

Con. 2320-08.

(3 Hours)

[Total Marks : 100

- N.B.** (1) Attempt any **five** questions.
 (2) **Figures** to the **right** indicate **full** marks.
 (3) **Necessary** explanations at **intermediate stages** must be given.
 (4) Use of **non-programmable Calculator, Statistical Tables** and **Log tables** is **permitted**.
 (5) Answers should be **brief** and to the **points**.
 (6) Assumptions, **required** in the questions, where **necessary** must be **explained**.

1. (a) 3 metal spheres whose radii are 3, 4 and 5 cm. melted and formed into one sphere. If volume of a sphere varies as the cube of its radius, find the radius of the new sphere. **10**
 (b) Solve for x, the equation **10**

$$\frac{\sqrt{x+2} + \sqrt{x-1}}{\sqrt{x+2} - \sqrt{x-1}} = 3$$

2. (a) Find the square root of **10**
 $12 + \sqrt{24} + \sqrt{56} + \sqrt{84}$
 (b) Solve for x and y : **10**
 $a^x = x^y$ and $a^y = x^x$.

3. (a) If a, b and c are any 3 consecutive positive integers, prove that— **10**
 $\log(1+ac) = 2 \log b$
 (b) Derive the equation of a common tangent to **10**
 $x^2 + y^2 = z$ and $y^2 = 8x$ and plot the graph.

4. (a) A contractor builds 3 types of houses. The raw materials needed are given in the form of a matrix A and the cost of buying and transporting each of the raw materials are also given in the form of a matrix B. Find AB and interpret the entries of (AB) **10**

$$A = \begin{matrix} \text{Type I} \\ \text{Type II} \\ \text{Type III} \end{matrix} \begin{bmatrix} \text{Cement} & \text{Wood} & \text{Steel} \\ 10 & 20 & 5 \\ 20 & 30 & 6 \\ 25 & 40 & 7 \end{bmatrix}, \quad B = \begin{matrix} \text{Cement} \\ \text{Wood} \\ \text{Steel} \end{matrix} \begin{bmatrix} \text{Purchase} & \text{Transport} \\ 15 & 1 \\ 10 & 2 \\ 20 & 3 \end{bmatrix}$$

- (b) A rectangular area of 1000 square feet is to be enclosed by a fence and then divided in the middle by another fence. **10**
 The fence drawn in the middle cost Rs. 0.70 per running foot and the other fence costs Rs. 2.00 per running foot.
 Find the minimum cost of fencing.
5. (a) Define (i) Consumer's surplus, and (ii) Producer's surplus. **10**
 (b) The demand function of the commodity is $p = 20 - 3x$ and the supply function is $p = 2x$ **10**
 Determine the equilibrium price and show that at this price,
 Consumer's surplus = 24
 and Producer's surplus = 16.

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6. (a) Evaluate—

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$$(i) \int \frac{dx}{x\sqrt{x^2 - a^2}} \quad (ii) \int \frac{dx}{(x+2)(x+1)} \quad \text{and} \quad (iii) \int \frac{dx}{2x^3 + 7x^2 + 8x + 3}$$

(b) If $Z = x^3 + 3x^2y + 6xy^2 - y^2$, show that when $x = 2, y = 3$,

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$$\frac{d^2z}{dx^2} = 30, \quad \frac{d^2z}{dy^2} = 6, \quad \text{and} \quad \frac{d^2z}{dxdy} = 48.$$

7. (a) Find the sum of n terms of the following series :

10

$$(i) \frac{1}{2 \cdot 5} + \frac{1}{5 \cdot 8} + \frac{1}{8 \cdot 11} + \frac{1}{11 \cdot 14}$$

$$(ii) 2 \cdot 5 + 5 \cdot 8 + 8 \cdot 11 + 11 \cdot 14 + \dots$$

(b) A rectangular box with a square base and open top is to be made from 1200 square material. Find volume of the largest box that can be made.

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8. (a) An Institute of Management uses aptitude test and group discussion for selecting candidates for its management course of those obtaining satisfactory grades in these tests and group discussion. 75% pass the management course examination while only 35% of those whose performance in aptitude test and group discussion was unsatisfactory, pass the management course examination. Can it be said that the aptitude test and group discussion are necessary before admission to the course.

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(b) If

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$$y = \frac{1}{3} - \frac{1}{2} \left(\frac{1}{3}\right)^2 + \frac{1}{3} \left(\frac{1}{3}\right)^3 - \frac{1}{4} \left(\frac{1}{3}\right)^4 + \dots$$

then find the sum of the following series :

$$y + \frac{y^2}{2!} + \frac{y^3}{3!} + \frac{y^4}{4!} + \dots$$

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Paper II - Statistics for Management

Con. 2250-08.

BB-8965

(3 Hours)

11/08 [Total Marks : 100

- N.B. :** (1) Attempt any **five** questions.
 (2) **All** questions carry **equal** marks.
 (3) Statistical **tables** and **graph** papers will be supplied on request.
 (4) Use of **non-programmable** calculator is **allowed**.

1. The daily profits in rupees of 100 shops are distributed as follows :-

Profit per shop	No. of shops
0 - 100	5
100 -	7
200 -	18
300 -	27
400 -	20
500 -	17
600 - 700	6
Total	100

Calculate the arithmetic mean, mode, the lower quartile and the standard deviation (s.d.) of the distribution.

2. (a) Explain with the help of suitable diagrams the concept of positive, negative and lack of correlation between two variables.
- (b) A firm believes that its annual profits (y) depend on its expenditure on research (x), in Rs. 1000. The following table presents the information for the preceding 6 years :

Year	2002	2003	2004	2005	2006	2007
x	2	3	5	4	6	10
y	20	25	34	30	31	40

- (i) Calculate the product moment correlation coefficient and comment on its value.
 (ii) Determine the equation of the appropriate line of regression and use it to estimate the annual profits when the expenditure on research is Rs. 7,000 in the year.
3. (a) State the probability density functions and the properties of the following statistical distribution :-
- Poisson
 - Normal and
 - Exponential.

Explain the 'forget fullness' property and the distribution for which it is applicable.

- (b) In a Restaurant, on a particular morning the amounts spent on breakfast by customers follow a normal distribution with average of Rs. 22.50 and s.d. of Rs. 2.
- Estimate the proportion of days on which customers spent between Rs. 20.50 and Rs. 24.50 on breakfast.
 - If on a given morning 540 customers spent Rs. 20 or more on breakfast, what is the total number of customers served ?

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4. (a) The number of articles produced on 55 old and 45 new machines gave the following results :-

Machines	No. of machines	Mean	S.D.
Old	55	60	10
New	45	50	6

- (i) Find the combined mean and coefficient of variation for both machines together.
 (ii) Determine whether the number of articles produced on new machines are more uniform than those on old machines.
- (b) Two random samples of sizes 10 and 20 are drawn from two normal populations. The sample variances are 25 and 36 respectively. Can we regard the two normal population variances to be equal ?
5. (a) The probability of an article being defective is given to be 0.2. What is the probability that a random sample of eight articles will have (i) 2 defectives (ii) fewer than 2 defectives?
 (b) The life of a certain type of electronic part is known to follow an exponential distribution with a mean of 3 weeks. What is the probability that a given part will have a life of more than 5 weeks ?
 (c) A chemist claims that his medicine is effective in curing 90% of the patients suffering from flu. To test the claim the medicine was given to 300 patients and 261 were cured. Test his claim at the 1% level of significance. Also determine the 99% confidence limits for the true percentage of the cured patients.

6. (a) The consumer preference for four brands of a product are given below :-

Brand	A	B	C	D	Total
No. of persons	30	20	40	10	100

- (i) Test the hypothesis that the consumer preferences are equal.
 (ii) Test the hypothesis that the brand C is preferred by as many persons as the other three brands examined.
 Use a 1% level of significance.
- (b) In a time-study, 10 timings of a particular element were as follows :-
 18, 16, 14, 19, 20, 15, 17, 16, 10, 13.
 Calculate 95% confidence limits for the true average time for this element.

7. (a) Describe briefly the utility of control charts in industry. Describe the working of the X and R charts.

- (b) The life in hours of three brands of electric bulbs is given below :-

Brand :

A	: 1200	1300	1350		
B	: 1200	1350	1400	1400	
C	: 1100	1200	1300	1400	1450

Test at the 5% level whether there is a significant difference among the means of the three brands.

8. Write short notes on any three :-

- (a) Measures of Skewness
 (b) Type I and Type II errors
 (c) Components of a time-series
 (d) Paired t-test.

Con. 2449-08.

BB-8968

(3 Hours)

[Total Marks : 100

- N.B. :** (1) In **Section I**, question No. **1** is **compulsory**. Attempt **two** questions from the rest.
(2) In **Section II**, question No. **6** is **compulsory**. Attempt **two** questions from the rest.
(3) **Figures** to the **right** indicate marks to a **sub-question**.
(4) Answers to the **both** the sections are to be written in the **same** answer-book.

Section I

1. (a) Define the following :- 6
(i) Demand
(ii) Cross elasticity of demand
(iii) Demand forecasting
- (b) Distinguish between the following :- 6
(i) Average production and marginal production.
(ii) Past costs and future costs
(iii) Direct costing and Absorption costing.
- (c) The Total Cost Function y of manufacturing x number of units is given by 6
 $y = 16,000 + 600x + 0.2x^2$.
Calculate -
(i) Average cost of producing 200 units.
(ii) If the company doubles the output will it halve its average cost ?
(iii) what is the average variable cost if no units are produced ?
2. (a) Explain the functions performed by a managerial economist, in the Indian context. 8
(b) Discuss the characteristics of Managerial Economics. 8
3. (a) Explain the business applications of price elasticity. 8
(b) Discuss the determinants of demand. 8
4. (a) Give a summary chart of the methods of demand forecasting. Discuss any two methods of demand forecasting. 8
(b) Explain the recent trends in demand forecasting. 8
5. (a) Discuss the diseconomies of scale. 8
(b) Distinguish between cost control and cost reduction. Discuss the factors essential for the success of a cost reduction program. 8

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Section II

6. (a) Define the following :- 6
- (i) Monopoly
 - (ii) Cost of retained earnings
 - (iii) Net present value.

- (b) Find using straight line method :- 6
- (i) depreciation during the year
 - (ii) depreciation at the end of the year
 - (iii) value of the asset at the end of the year given that
 - Cost of the Asset : Rs. 20,00,000
 - Rate of Depreciation : 12% p.a.
 - Life of an asset : 5 years.

- (c) A company is manufacturing five products. The accounts department has supplied the following data :- 6

Product	Price Rs	Variable Cost Per Unit	% Share of each Product to total sales
A	5	4	10
B	5	3	15
C	10	6	20
D	10	7	25
E	10	8	30

The capacity of the firm in terms of rupees is Rs. 10,00,000 and the fixed costs per year are Rs. 2,00,000. Calculate the BEP.

7. (a) Explain the Rent Theory of Profits. 8
- (b) Explain the features, causes and disadvantages of monopoly. 8
8. (a) Distinguish between perfect competition and monopolistic competition. 4
- (b) Explain outlet differentiation. 4
- (c) Discuss the general principles of Oligopoly pricing. 8
9. (a) Explain the advantages of price leadership situation. 8
- (b) What are economic indicators ? Discuss external economic indicators. 8
10. (a) What is a Master Budget ? What are its components ? 8
- (b) What are the components of the feasibility report in project planning ? 8

First Year Diploma in Operations Research for Management

Paper IV - Basics of operations Research I

Con. 2439-08. BB-9343

(3 Hours)

[Total Marks : 100

19/5/2008

- N.B. :** (1) Attempt any **three** questions from **each** section.
 (2) Answers to **each** section should be written in **separate** books.
 (3) **Figures** to the **right** indicate **full** marks.
 (4) **Necessary** explanations at intermediate stages must be given.
 (5) Assumptions, wherever **necessary** must be stated **clearly**.
 (6) Use of **ordinary** calculator and statistical table is **allowed**.

Section I

1. (a) Solve the following LPP :- 8
 Maximise $Z = 30x_1 + 16x_2 + 25x_3$
 Subject to $8x_1 + 4x_2 + 5x_3 \leq 1000$
 $5x_1 + 3x_2 + 3x_3 \leq 650$
 $3x_1 + 2x_2 + 3x_3 \leq 420$
 $x_1, x_2, x_3 \geq 0$

- (b) Write down the Dual problem of the following LPP and find out the optimum solutions of both primal and dual problems. 8

2. Solve the following problem graphically - 20
 Maximise $Z = 20x_1 + 10x_2$
 Subject to $x_1 + 2x_2 \leq 40$
 $3x_1 + x_2 \leq 30$
 $4x_1 + 3x_2 \geq 60$
 $x_1, x_2 \geq 0$

- (a) If the objective function coefficients (20, 10) change to (10, 20), what will be the optimal solution.
 (b) If the RHS coefficient change from (40, 30, 60) to (50, 50, 50) respectively find the new optimal solution.
 (c) A new constraint $x_1 + x_2 < 45$, be added find the new optimal solution if the present optimal solution is affected.
 (d) If product x_3 with cost 5 and resource requirements (3, 2, 5) respectively be introduced, find the Optimal solution.

3. (a) Goods are transported from factories F_1, F_2 and F_3 to the warehouse W_1, W_2, W_3 and W_4 cost of transportation, in Rs. from each factory to each warehouse, in Rs. given in the table below. Also number of demand units and supply units are given- 10

	W_1	W_2	W_3	W_4	Supply (units)
F_1	3	5	2	4	100
F_2	6	3	7	2	80
F_3	9	4	2	5	40
Demand	70	50	40	60	

Determine how many units from each factory to each warehouse should be transported so as to minimize the to transportation cost.

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(b) Solve the following game –

6

		B		
		4	3	3
A	1	7	1	
	-2	-2	12	

4. The following table gives completion time, in hours for each worker for each job.

16

	J ₁	J ₂	J ₃	J ₄
W ₁	3	5	2	4
W ₂	6	3	7	2
W ₃	9	4	2	5
W ₄	8	3	2	5

- (a) Determine the optimum assign on solution.
- (b) Suppose the completion time of J₄ by W₂ change from 9 hours to 5 hours, obtain the optimum assignment solution.

Section II

5. A project consists of 8 activities.

16

A(3), B(4), C(2), D(3), E(5), F(7), G(8), H(2).

Figures, in brackets, denote durations in days of the activities. The following relationship amongst the activities hold.

- (a) A, B and C are the starting activities of the project.
- (b) A precedes D, B precedes E and F and C precedes G.
- (c) D and F precedes H and
- (d) C and F control G
- (e) G and H are ending activities.

Draw a network diagram. Find EST, LFT, LST for each activity and determine the critical path and project duration. For each activity find the total float, Free float, Interference float and Independent Float.

6. (a) The following table gives, for each activity of a project. Normal Duration (ND), Crash Duration (CD) in days, Normal Cost (NC), Cost Cash (CC), in Rs. Indirect Cost is Rs. 50 per days :-

8

Activity	1-2	1-3	2-4	2-5	3-4	4-5
ND	7	3	2	9	6	3
CD	5	1	1	4	2	2
NC	100	150	50	100	100	80
CC	200	350	90	400	200	100

- (i) Determine the minimum project duration and the corresponding Project Cost,
- (ii) Determine the minimum project cost and the corresponding project duration.

- (b) In a municipal hospital, patients arrivals are to be considered as Poisson with an average of interarrival time 10 minutes. The doctor's time for examination plus time of dispensing medicine is distributed negative exponentially with an average of 6 minutes. 8
- (i) What are the chances that a new patient will see the doctor without having to wait ?
 - (ii) For what percentage of time, the doctor will remain idle ?
 - (iii) Find the average queue length, average number of patients in the system, average waiting time and average time spent in the system.

7. (a) The following table gives the optimistic, most likely and pessimistic project activity duration, in days. 10
 Find the mean time and variance for each activity of the project.
 What is the probability that, the project will be completed in 4 days later than expected duration ?

Activity	1-2	1-3	2-4	2-5	3-4	4-5
Optimistic	3	5	1	1	4	4
Most Likely	4	6	3	4	8	5
Pessimistic	5	7	5	7	12	6

- (b) A 2 x 2 pay-off matrix for player A is given below. Then will be a riddle point only if- 6

5	6
p	q

- (i) $p \leq q, p \geq 5$
- (ii) $p \geq q, p \leq 5$
- (iii) neither of the outer (i) and (ii)

8. (a) For an LPP, the optimum simplex table is as follows :- 10

Basic	C	X_1	X_2	X_3	S_1	S_2	S_3	b
X_2	-	1/2	1	0	1/3	-1/3	-	-1
X_3	-	5/6	0	1	-1/6	2/3	-	21
S_3	-	-5/3	0	0	-2/3	-1/6	-	15
	Δ	25/2	0	0	15/2	10	0	105

- (i) Find the missing numbers.
 - (ii) Find the original LPP.
- (b) Write short notes on :- 6
- (i) Alternative optima in a LPP.
 - (ii) Saddle Point in a game.
 - (iii) unbounded solution.