

Date
24/09/2024

Time: 2 ½ Hours

Marks: 75

- Note: 1. All questions are compulsory. (Subject to internal Choice)
 2. Figures to the right indicate full marks.
 3. Use non-programmable calculator is allowed
 4. Normal distribution table is printed on the last page for reference.
 5. Support your answers with diagrams/illustrations,

Q.1A) State whether the following statements are True or False: (Attempt any 8) (8)

1. A linear programming model is consists of only decision variables and constraints.
2. The limitation imposed on a LPP are called as Decision Variable.
3. In LLP, graphical method can be used only for a two variables problem.
4. Slack represents unutilized resources.
5. Key column indicates the incoming variable in a LPP simplex solution.
6. NWCR is the most efficient method of finding IFS in a Transportation problem.
7. A Transportation problem is called Balanced if Total Demand is equal to Total Supply.
8. A Dummy is used to solve a Prohibited Assignment problem.
9. All floats for any critical activity is always zero.
10. A mixed strategy game is the one in which saddle point is variable.

Q.1 B) Match the right and closely related answer from Column Y with the text/term given in Column X. (Attempt Any 7) (7)

Column A	Column B
1. Maximum capacity	a. No feasible solution is visible
2. Cost data	b. Prohibited problem
3. Infeasible solution	c. Completely utilized resource
4. Key row	d. Degenerate solution
5. Scarce resources	e. Less than or equal to constraint
6. VAM	f. Imaginary activity
7. Epsilon	g. Minimization problem
8. Cost or time problem	h. Max.Z
9. Restricted assignment	i. Method of penalties
10. Dummy activity	j. Outgoing variable in simplex

Q.2 A) A Company produces three products A,B, C.
 For manufacturing three raw materials P,Q,R are used.
 Profit per unit A Rs. 5 , B Rs. 3 and C Rs. 4
 Resource requirements/units

Products	Raw material		
	P	Q	R
A	-	20	50
B	20	30	-
C	30	20	

Maximum Raw material Available P= 80 Units, Q - 100 units and R = 150 units
Formulate LPP

(8)

Q.2 B) Solve following LPP by Simplex method .

(7)

Maximize $Z = 3x_1 + 7x_2$

Subject to Constraints

$2x_1 + 5x_2 \leq 20$

$x_1 + 2x_2 \leq 4$

$x_1, x_2 \geq 0$

OR

Q.2 C) Solve following LPP by Graphical method.

(7)

Maximize (profit) $Z = 30x_1 + 30x_2$

Subject to Constraints

$3x_1 + x_2 \leq 30,000$

$x_1 \leq 8,000$

$x_2 \leq 12,000$

$x_1, x_2 \geq 0$

Q.2 D) A Sales manager has to assign salesmen to four territories and their profit performance (In Rs. Lakhs) are given below

Salesman	Territory			
	T1	T2	T3	T4
S1	35	27	28	37
S2	28	34	29	40
S3	35	24	32	33
S4	24	32	25	28

Assign the salesmen to sales territories so as to maximize profit

(8)

Q. 3. A) From the following Project of Shyam Ltd.

Activity	Time (Days)
A (1-2)	3
B (1-3)	4
C (1-4)	6
D (2-5)	5
E (3-6)	6
F (4-7)	5
G (5-8)	4
H (6-8)	7
I (7-8)	4

(i) Construct a network diagram, find critical path and project completion time.

(3)

(ii) Tabulate/Calculate Earliest Start and Finish Time, Latest Start and Finish Time.

(5)

Q.3 B) A company is transporting its units from three factories F_1, F_2, F_3 with the production capacities of 11, 13 and 19 units (in thousands). It has four warehouses W_1, W_2, W_3 and W_4 . With demands of 6, 10, 12 and 15 units (in thousands)

Units cost of transportation is given from each factory to each warehouse.

	W1	W2	W3	W4
F1	42	32	50	26
F2	34	36	28	46
F3	64	54	36	82

Construct a Transportation table and Find Initial feasible solution by VAM method

(7)

OR

Q.3 C) The following table shows details of a project. Indirect cost is Rs. 200 per day. Assume a total normal cost of Rs.4050 for the entire project.

Activity	Normal time (Days)	Crash time (Days)	Crash slope
1-2	4	3	200
1-3	2	2	-
1-4	5	4	150
2-3	7	5	100
2-5	7	6	200
3-5	2	1	150
4-5	5	4	200

- (a) Construct a network diagram. (2)
- (b) Identify the critical path, normal duration and corresponding project cost? (2)
- (c) Find the optimal project cost and additional cost require to reach the optimal time. (2)
- (d) What is the minimum project duration and total cost require to each this duration? (2)

Q. 3. D) Five jobs I, II, III, IV and V are to be processed on two machine A and B in order AB

Jobs	Processing Time (Min)	
	Machine A	Machine B
I	16	6
II	8	4
III	2	10
IV	8	12
V	10	14

- (i) Find the sequence that minimizes the total elapsed time (2)
- (ii) Calculate the total elapsed time (3)
- (iii) Idle time on for each Machine (3)

Q,4 A) There are 3 machines A, B and C on which 5 jobs I, II, III, IV, V are to be processed in the order A - B - C. The following table gives their processing times in minutes for each of the six jobs.

Jobs	Machine A (in minutes)	Machine B (in minutes)	Machine C (in minutes)
I	22	21	23
II	25	22	24
III	23	19	22
IV	22	20	25
V	24	19	20

- (i) Find the sequence that minimizes the total elapsed time required to complete the jobs. (2)
- (ii) Calculate the total elapsed time. (3)
- (iii) Find idle time on machine A, B and C. (3)

Q.4 B) Following is the Pay-off (Profit in Rs.) matrix in respect of Two-Person-Zero – Sum Game as follows

Player A	Player B		
	B1	B2	B3
A1	130	100	105
A2	-50	-20	120
A3	200	80	-10

- (i) Find the Maximin Strategy. (3)
- (ii) Find the Minimax Strategy. (3)
- (iii) What is the value of the Game? (1)

OR

Q.4 C) A company is transporting its units from three factories F_1, F_2, F_3 to four warehouses W_1, W_2, W_3 and W_4 . The supply and demand of units with transportation cost per unit (in Rs.) are given below with feasible solution (The numbers which are in circle indicates number of units transported from Factory to warehouse).

Plants	Warehouses				Supply in Units
	W_1	W_2	W_3	W_4	
F_1	9	7 (6)	6	11	6
F_2	11	12	5 (5)	9 (2)	7
F_3	7 (8)	9 (1)	11	13 (4)	13
Demand in Units	8	7	5	6	26

- i. Test the solution for optimality (3)
- ii. If solution is not optimal find optimal solution. (5)

Q.4 D) A Project which is planned using PERT technique has following details of Average Expected Times calculated using the formula, $t_e = (a + 4m + b) / 6$ and the details of standard deviation.

Activity	Node	Average Expected Time in weeks (t_e)	Standard Deviation
A	1-2	6	4/6
B	2-3	8	10/6
C	2-4	8	8/6
D	3-5	18	16/6
E	4-6	10	8/6
F	5-7	8	8/6
G	6-7	2	2/6

H	7-8	7	2/6
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- i) Construct the network diagram of PERT network and find expected completion time of the project. (3)
- iii) Determine the probability of completing the project in 55 Days (4)

- Q.5 A) Define operation Research and What are the limitations of Operation research techniques? (8)
- B) Explain Objective of Project Crashing of Network analysis (7)

OR

- Q.5 C) Write a Short notes on Any Three (15)
 - i) Assumption in LPP
 - ii) Basis and non-basis variable in simplex table
 - iii) Three time estimates in PERT
 - iv) Project crashing
 - v) Dummy activity in network analysis

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NORMAL DISTRIBUTION TABLE

Area Under the Standard Normal Distribution

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2518	0.2549
0.7	0.2580	0.2612	0.2642	0.2673	0.2705	0.2734	0.2764	0.2797	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4464	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857	0.4857
2.2	0.4861	0.4866	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.7893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4820	0.4922	0.4925	0.4927	0.4931	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4958	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4988	0.4986
3.0	0.49865	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4996
4.0	0.49968									

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