29th August-2018 P.G.D.R.M-II - August-2018 A49 2018

Advance Linear Programming - II

WA-JP-Exam.-1st Half-2018-106

Con. 378–18. **AB-6578**

(3 Hours) **[Total Marks : 80**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **three** questions from question No. **2** to **5**.

1. (a) Fill in the blanks :– **10**

(i) In an LPP, the linear inequalities or restrictions on the variables are called __________.

(ii) In an LPP, the objective function is always __________.

(iii) If the feasible region for a LPP is ________, then the optimal value of the objective function $Z = ax + by$ may or may not exist.

(iv) In an LPP if the objective function $Z = ax + by$ has the same maximum value on two corner points of the feasible region, then every point on the line segment joining these two points give the same ________ value.

(v) A feasible region of a system of linear inequalities is said to be ________ if it can be enclosed within a circle.

(vi) A corner point of a feasible region is a point in the region which is the ________ of two boundary lines.

(vii) The feasible region for an LPP is always a ________ polygon.

(viii) ______ method is used to solve balanced assigement problem.

(ix) _______ variables may have a positive or a negative sign.

(x) If an artificial variable remains in the basis the solution to the LPP is _______.

(b) Match the Columns **A** with Column **B** : **10**

Column A	**Column B**
1. Integer Programming	a. Charnes, Cooper and Ferguson
2. Dynamic Programming	b. A. H. Land and A. G. Doig
3. Goal Programming	c. No change in feasible region
4. Kuhn-Tucker conditions	d. Transportation Problem
5. Discrete Programming Problems	e. Variables restricted as integers
6. Redundant Constraint	f. Ralph E. Gomory
7. Uncostrained optimization	g. multiple criteria decision making
8. Non Integer Linear Programming	h. Dijkstra's algorithm
9. Stepping Stone Method	i. No restriction on decision variable values
10. Multi-objective optimization	j. Generalization of the method of Lagrange multipliers

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2. (a) For the following transportation cost table answer the questions given below : **10**

		MARKETS				
		A	B	C	D	Supply
WAREHOUSES	I	6	3	5	4	22
	II	5	9	2	7	15
	III	5	7	8	6	8
	Requirement	7	12	17	9	

The shipping department has worked out the following schedule from experience :
(I->B-12. I->C-1, I->D-9, II->C-15, III->A-7, III->C-1)

(i) Find the optimal transportation cost and optimal schedule.

(ii) If the department is approached by a carrier of route III to B who offers to reduce the rate in the hope of getting some business, find the amount by which cost can be reduced to maintain the optimality.

(b) Solve the LPP using Simplex Method : **10**

Minimize $Z = 4X_1 + 3X_2 + 3X_3$

Subject to the constraints :

$2X_1 + 3X_2 + 2X_3 <= 440$

$4X_1 + 3X_3 <= 470$

$2X_1 + 5X_2 <= 430$

$X_1, X_2, X_3 >= 0$

OR

(c) Powerco has 3 electric power plants that supply the needs of 4 cities. Each power plant can supply the following numbers of kilowatt-hours (kwh) of electricity : plant 1 – 35 million; plant 2 – 50 million; plant 3 – 40 million. The peak power demands in these cities, which occur at the same time (2pm), are as follows (in kwh) : city 1 – 45 million; city 2 – 20 million; city 3 – 30 million; city 4 – 30 million. The costs of sending 1 million kwh of electricity from plant to city depend on the distance the electricity must travel. Formulate an LP to minimize the cost of meeting each city's peak power demand. **10**

Shipping Costs, Supply and Demand for Powerco

	To				**Supply**
From	**City 1**	**City 2**	**City 3**	**City 4**	(million kwh)
Plant 1	$8	$6	$10	$9	$35
Plant 2	$9	$12	$13	$7	$50
Plant 3	$14	$9	$16	$5	$40
Demand (million kwh)	45	20	30	30	

(d) Minimize $C = 2x + 5y$ subject to **10**

$$\begin{cases} x + 2y \geq 4 \\ 3x + 2y \geq 3 \\ x \geq 0,\ y \geq 0 \end{cases}$$

3. (a) Maximize $3X_1 + 4X_2$ **10**
Subject to the constraints

$$\frac{2}{5}x_1 + x_2 \leq 3$$
$$\frac{2}{5}x_1 - \frac{2}{5}x_2 \leq 1$$
$$x_1, x_2 \geq 0 \text{ and integer}$$

(b) Top Ad, a new advertising agency with 10 employees, has received a contract to promote a new product. The agency can advertise by radio and television. The following table gives the number of people reached by each type of advertisement and the cost and labor requirements. **10**

	Data/min advertisment	
	Radio	***Television***
Exposure (in millions of persons)	4	8
Cost (in thousands of dollars)	8	24
Assigned employees	1	2

The contract prohibits TopAd from using more than 6 minutes of radio advertisement. Additionally, radio and television advertisements need to reach at least 45 million people. TopAd has a budget goal of $100,000 for the project. How many minutes of radio and television advertisment should TopAd use ?

OR

(c) Maximize $Z = x_1 + 4x_2$ **10**
subject to $2x_1 + 4x_2 \leq 7$
$10x_1 + 3x_2 \leq 14$
$x_1, x_2 \geq 0$

(d) Five projects are being evaluated over a 3-year planning horizon. The followoing table gives the expected returns for each project and the associated yearly expenditurres. **10**

Project	Expenditures (million $)/yr			Returns (million $)
	1	2	3	
1	5	1	8	20
2	4	7	10	40
3	3	9	2	20
4	7	4	1	15
5	8	6	10	30
Available funds (million $)	25	25	25	

Which projects should be selected over the 3-year horizon ?

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4. (a) An amount of $1,000 is to be invested in three stocks. Let Si be the random variable representing the annual return on $1 invested in stock *i*. Thus if S*i* = 0.12, $1 invested in stock *i* at the beginning of a year was worth $1.12 at the end of the year. We are given the following information: *E*(S1) = 0.14, *E*(S2) = 0.11, *E*(S3) = 0.10, var S1 = 0.20, var = S2 = 0.08, var S3 = 0.18, cov (S1, S2) = 0.05, cov = S1, S3) = 0.02, cov = (S2, S3) = 0.03. Formulate a QPP that can be used to find the portfolio that attains an expected annual return of at least 12% and minimizes the variance of the annual dollar return on the portfolio. **10**

(b) The Dakota Furniture Company manufactures desks, tables and chairs. The manufacture of each type of furniture requires lumber and two types of skilled labor: finishing and carpentry. The amount of each resource needed to make each type of furniture is given in Table below. Currently, 48 board feet of lumber, 20 finishing hours and 8 carpentry hours are available. A desk sells for $60, a table for $30 and chair for $20. Dakota believes that demand for desks and chairs are unlimited, but at most five tables can be sold. Because the available resources have already been purchased, Dakota wants to maximize total revenue. Solve the problem using simplex algorithm. **10**

Resource Requirements for Dakota Furniture

Resource	Desk	Table	Chair
Lumber (board ft)	8	6	1
Finishing hours	4	2	1.5
Carpentry hours	2	1.5	0.5

OR

(c) Maximize $Z = x_1 + 4x_2$ **10**

Subject to $2x_1 + 4x_2 \leq 7$

$5x_1 + 3x_2 < 15$

x_1, x_2 are integers ≥ 0

(d) Explain any two softwares available for solving different Operations Research problems.

5. (a) Solve using the Graphical method the following problem : **10**

Maximize $Z = f(x, y) = 3x + 2y$

Subject to : $2x + y \leq 18$

$2x + 3y \leq 42$

$3x + y \leq 24$

$x \geq 0, \ y \geq 0$

(b) A salesman has to visit five cities A, B, C, D and E. The distances (in hundred kilometers) between the five cities are shown in Table : **10**

		To City				
		A	B	C	D	E
From City	A	–	1	6	8	4
	B	7	–	8	5	6
	C	6	8	–	9	7
	D	8	5	9	–	8
	E	4	6	7	8	–

If the salesman starts from city A and has to come back to city A, which route should he select so that total distance traveled become minimum ?

OR

(c) Minimize $Z = 200x_1 + 300x_2$ **10**

Subject to $2x_1 + 3x_2 \geq 1200$

$x_1 + x_2 \leq 400$

$2x_1 + 1.5x_2 \geq 900$

$x_1, x_2 \geq 0$

(d) Best-ride airlines that operates seven days a week has the following time-table. **10**

Flight No.	**Delhi - Mumbai**	
	Departure	**Arrival**
1	7.00 AM	8.00 AM
2	8.00 AM	9.00 AM
3	1.00 PM	2.00 PM
4	6.00 PM	7.00 PM

Flight No.	**Mumbai-Delhi**	
	Departure	**Arrival**
101	800 AM	9.00 AM
102	9.00 AM	10.00 AM
103	12.00 Noon	1.00 PM
104	5.00 PM	6.00 PM

Crews must have a minimum layover of 5 house between flights. Obtain the pairing of flights that minimizes layover time away from home. For any given pairing, the crew will be based at the city that results in the smaller layover. For each pair also mention the city where crew should be based.

P.GD.ORM. II - August-2018 [Aug 2018]

28th August-2018

Optimisation model. II

Con. 381-18. **AB-6294**

Duration : 3 Hours Total Marks : 80

1. **All** questions carry **20** marks.

2. **Q.1** is **compulsory** and attempt any **3** questions from **Q.2** to **Q.5**

3. **Figures** to the **right** indicate marks.

4. Use of **Non Programmable** calculator only is **allowed**.

5.Use of **Mobile** Phones in the Exam Hall is **prohibited**.

6. Support your answers with diagram/illustration wherever is **required**.

7. Refer **Statistical Table** if **required**.

Q. 1 Select the appropriate alternative and write the completed statements. [20]

(1) An assignment problem is considered as a particular case of a transportation problem, because

(a) the number of rows equals the number of columns.
(b) all $x_{ij} = 0$ or 1.
(c) all rim conditions are 1.
(d) all of the above.

(2) An assignment problem can be solved by
(a) simplex method.
(b) transportation method
(c) both (a) and (b)
(d) none of the above.

(3) The Hungarian method for solving an assignment problem can also be used to solve
(a) a transportation problem
(b) a travelling salesman problem
(c)both (a) and (b)
(d)none of the above.

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(4) The assignment problem
(a) requires that only one activity be assigned to each resource.
(b) is a special case of transportation problem.
(c) can be used to maximize resources.
(d) all of the above.

(5) The initial solution of a transportation problem can be obtained by applying any known method. However , the only condition is that
(a) the solution must be optimum
(b) the solution should be non- degenerate
(c)the rim conditions are satisfied.
(d)all of the above.

(6) While solving a transportation problem, the occurrence of degeneracy means that
(a) total supply equals total demand.
(b) the solution so obtained is not feasible.
(c)the few allocations become negative.
(d) none of the above.

(7) For a transhipment problem, choose the statement which is not correct:
(a) The problem allows for the shipment of goods from one source to another, and from one destination to another.
(b) There is no real distinction between sources and destinations.
(c)An 'm' source , 'n ' destination transportation problem, when written as a transhipment problem would have m + n sources and n destinations.
(d) A transhipment problem is not likely to involve a lower cost than a transportation problem, in a given situation.

(8)A Transportation problem is

(a) basically a Linear Programming problem
(b) a special type of Assignment problem
(c) both a and b
(d) none of the above

(9) The solution to a transportation problem with m-rows (supplies) and n-columns(destination) is feasible if number of positive allocations are
(a) m+n

(b) mxn
(c) m+n-1
(d) m+n+1

(10) During an iteration while moving from one solution to the next, degeneracy may occur when
(a) the closed path indicates a diagonal move.
(b) two or more occupied cells are on the closed path but neither of them represents a corner of the path
(c) two or more occupied cells on the closed path with minus sign are tied for lowest circled value.
(d) either of the above.

(11) A two person game is said to be zero-sum, if
(a) gain of one player is exactly matched by a loss to the other so that their sum is equal to zero.
(b) gain of one player does not match the loss to the other.
(c) both the players must have an equal number of strategies.
(d) diagonal entries of the pay- off matrix are zero.

(12) A game is said to be fair, if
(a) upper value is more than lower value of the game.
(b) upper and lower values of the game are not equal.
(c) upper and lower values of the game are same and zero.
(d) none of the above.

(13)When maximin and minimax values of the game are same, then
(a) there is a saddle point.
(b) solution does not exist.
(c) strategies are mixed.
(d) none of the above.

(14) Game theory models are classified by the
(a) number of players.
(b) sum of all payoffs.
(c) number of strategies.
(d) all of the above.

(15) Network models have advantage in terms of project

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(a) planning
(b) scheduling
(c) controlling
(d) all of the above

(16) Generally PERT technique deals with the project of
(a) repetitive nature
(b) non-repetitive nature
(c) deterministic nature
(d) none of the above

(17) The network diagram
(a) as far as possible should flow from left to right.
(b) as far as possible should flow from top to bottom.
(c) Should not have any dangling activity.
(d) Should satisfy All of the above conditions

(18) Time and Cost trade off
(a) is also crashing
(b) has cost slope equal to (Crash cost - Normal cost)/(Normal duration - Crash duration)
(c) has the range of crashing the project between the 2 limits set by the maximum project duration given by the normal duration minus the maximum project duration given by the crash duration.
(d) has all the above features

(19) Markov analysis is
(a) helpful in evaluating alternative maintenance policies in production department.
(b) used to determine the optimal course of action in a given problem.
(c) used in the situations involving multiple time periods.
(d) none of the above

(20) Which of the following is not correct?
(a) Transition probabilities can also be represented by a probability tree diagram.
(b) Each row of the transition matrix represents a one- step transition probability distribution over all states.
(c)In a system, recurrent states are those which are not transient.

(d) An absorbing state is one which once reached, allows transition to another state.

Q. 2. (a) Solve the following game by using the principle of dominance. [10]

Player B

Player A

	I	II	III	IV	V	VI
I	4	2	0	2	1	2
II	4	3	1	3	2	2
III	4	3	7	-5	1	2
IV	4	3	4	-1	2	2
V	4	3	3	-2	2	2

Q. 2. (b) A dairy firm has three plants located in a state. The dairy milk production at each plant is as follows : [10]

Plant : 1 2 3

Milk supply : 6 1 10

Each day, the firm must fulfill the needs of its four distribution centres. Minimum requirement at each centre is as follows :

Centre : 1 2 3 4

Milk supply : 7 5 3 2

Cost in hundreds of rupees of shipping one million litre from each distribution centre is given in the following table :

Plant	Distribution Centre			
	D1	D2	D3	D4
P1	2	3	11	7
P2	1	0	6	1
P3	5	8	15	9

Find initial basic feasible solution for given problem by using

(a) North - west corner rule
(b) Least cost method and
(c) Vogel's approximation method
if the object is to minimize the total transportation cost.

Q.3.(a) A small assembly plant assembles PCs through 9 interlinked stages according to adjoining precedence/ process. [10]

Stage from to	Duration (Hours)
1-2	4
1-3	12
1-4	10
2-4	8
2-5	6
3-6	8
4-6	10
5-7	10
6-7	0
6-8	8
7-8	10

8-9	6

(i) Draw the network diagram representing above assembly work.
(ii) Tabulate earliest start, earliest finish, latest start and latest finish time for all the stages.
(iii) Find the critical path and the assembly duration.
(iv) Tabulate total float , free float and independent float.

Q.3. (b) A city corporation has decided to carry out road repairs on main four arteries of the city. The government has agreed to make a special grant of Rs.50 lakh towards the cost with a condition that the repairs be done at the lowest cost and in the quickest time. If the conditions warrant a supplementary token grant will also be considered favourably. The corporations has floated tenders and five contractors have sent in their bids. In order to expedite work , one road will be awarded to only one contractor. [10]

Cost of Repairs (Rs. lakh)

		R1	R2	R3	R4
Contactors / Road	C1	9	14	19	15
	C2	7	17	20	19
	C3	9	18	21	18
	C4	10	12	18	19
	C 5	10	15	21	16

(a) Find the best way of assigning the repair work to the contractors and the costs.
(b) If it is necessary to seek supplementary grants , what should be the amount sought?
(c) Which of the five contractors will be unsuccessful in his bid?

Q . 4. (a) A company has three plants and four warehouses The supply and demand in units and the corresponding transportation costs are given. The table below has been taken from the solution procedure of the transportation problem : [10]

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Cost Table

Plant	Warehouse			
	I	II	III	IV
A	5	10	4	5
B	6	8	7	2
C	4	2	5	7

Assignment Table

Plant	Warehouse				Supply
	I	II	III	IV	
A	-	-	10	-	10
B	20	-	-	5	25
C	5	10	5	-	20
Demand	25	10	15	5	55

1. Is this solution feasible?
2. Is this solution degenerate?
3. Is this solution optimum?
4. Does this problem have more than one optimum solution? if so , show all of them.
5. If the cost for the route B - III is reduced from Rs. 7 to Rs.6 per unit , what will be the optimum solution ?

Q . 4. (b) Five salesman are to be assigned to five territories. Based on thc past performance , the following table shows the annual sales (in rupees lakhs) that can be generated by each salesman in each territory. Find the optimum assignment. [10]

Salesman	Territory				
	T1	T2	T3	T4	T5
S1	26	14	10	12	9
S2	31	27	30	14	16
S3	15	18	16	25	30
S4	17	12	21	30	25
S5	20	19	25	16	10

Q . 5 .(a) A military equipment is to be transported from three origins to four destinations. The supply at the origins, the demand at the destinations and time of shipment is shown in the table below. The units to be shipped as obtained by north - west corner rule are given in parentheses. Work out a transportation plan so that the total time required for shipment is minimum. [10]

Origin	Destinations				
	1	2	3	4	ai
1	10 (12)	0 (3)	20	11	15
2	1	7 (5)	9 (15)	20 (5)	25
3	12	14	16	18 (5)	5
bj	12	8	15	10	45(Total)

Q . 5 .(b) In a small town with three advocates , X , Y and Z, each advocate knows that some clients switch back and forth , depending on which advocate is available at the time the client needs one. There are no new clients in the current legal market , however , none of the old clients are leaving the area. During a slack period , the three advocates collected data which identified the number of

clients each advocate had seen during the preceding year. Table 1 summarises the results of this study, and Table 2 summarises the manner in which clients were gained or lost. Construct the state - transition matrix that describes the problem at hand.
[10]

Table 1 Flow of Customers

Advocate	Clients as of January 1, 2000	Change During Year Gain	Loss	Clients as of January 1, 2001
X	400	75	50	425
Y	500	50	150	400
Z	500	100	25	575

Table 2 Pattern of Gain and Loss

Advocate	Clients as of Jan 1, 2000	Gains From			Loss To			Clients as of Jan 1,2001
		X	Y	Z	X	Y	Z	
X	400	0	50	25	0	50	0	425
Y	500	50	0	0	50	0	100	400
Z	500	0	100	0	25	0	0	575

Aug-18

P.G.D.O.RM Sem (II)

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