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Transportation Problem (TP)

(special cases of Linear Programming)

Programme Educational Objectives

Our program will create graduates who:

1. *Will be recognized as a creative and an enterprising team leader.*
2. *Will be a flexible, adaptable and an ethical individual.*
3. *Will have a holistic approach to problem solving in the dynamic business environment.*

Operations Research Course Outcomes

- CO1-Given a verbal descriptive problem (management, industry or miscellaneous) with numerical data, the student manager will be able to define the variables, establish the inter-relationships between them, formulate the objective function and constraints and solve the problem graphically for optimization.
- CO2-Given/ specified the competition scenario between two players and their payoffs in advance, the student manager will be able to identify the saddle point and/ or determine the optimum strategies of both the players that would result in optimum payoff (gain or loss)to both the players.
- CO3-Given a set of limited resources, a set of limited activities and related cost/ profit matrix, the student manager will be able to assign one resource to one activity so as to maximize or minimize the given measure of effectiveness.

CO4-Given a business situation containing the transportation costs from n sources to m destinations, the student manager will be able to associate one source to one destination to minimize the cost of transportation.

CO5-In a decision making environment that is represented by numerical data, the student manager will be able to apply relevant operations research technique for managerial decision making and problem solving.

Syllabus

- Characteristics & Assumptions
- Steps involved in transportation problem,
- Initial feasible solution: NWCR, LCM, VAM
- Testing degeneracy, testing optimality: stepping stone,
- MODI, Maximization transportation problem

Unit Objectives

- To understand the concept of transportation, its characteristics and assumptions
- To understand the steps involved in transportation Problem
- To solve problems by North West Corner Method (NWCM), LCM, VAM

What is Transportation Problem?

- The transportation problem is a special type od LPP where the objective is to minimise the cost of distributing a product from a number of sources or origins to a number of destinations.
- Sources : Distributing any commodity from any group of supply centers
- Destinations: Sending to any group centers

Objective

- To find out optimum transportation schedule keeping in mind cost of transportation to be minimized.

Characteristics of Transportation Problems

- **The Requirements Assumption : –** Each source has a fixed supply of units, where this entire supply must be distributed to the destinations. – Each destination has a fixed demand for units, where this entire demand must be received from the sources.
- **The Feasible Solutions Property: –** A transportation problem will have feasible solutions if and only if the sum of its supplies equals the sum of its demands.
- **The Cost Assumption: –** The cost of distributing units from any particular source to any particular destination is directly proportional to the number of units distributed. – This cost is just the unit cost of distribution times the number of units distributed .

Assumptions of TP

- Transportation of commodity/terms: the model assumes that the commodities are being transported from the source to the destination very conveniently.
- The certainty of per unit transportation cost: obviously there is some transportation cost between the sources and destination.
- Independent per cost unit: per cost unit does not depend on the quantity being transported from source to destination.
- A number of units being transported are proportional to the transportation cost of any route.
- The objective is to minimize the transportation cost for transporting commodities between two places.

Initial feasible solution

- NWCM
- LCM
- VAM
- Stepping Stone
- MODI

North West Corner Method Example T1

Determine an initial feasible solution to the following transportation problem by using NWCM.

	D1	D2	D3	D4	Supply
S1	19	30	50	10	7
S2	70	30	40	60	9
S3	40	8	70	20	18
Demand	5	8	7	14	34

North West Corner Method Example T2

Determine an initial feasible solution to the following transportation problem by using NWCM.

	D1	D2	D3	D4	Supply
S1	11	13	17	14	250
S2	16	18	14	10	300
S3	21	24	13	10	400
Demand	200	225	275	250	

North West Corner Method Example T3

Determine an initial feasible solution to the following transportation problem by using NWCM.

	D1	D2	D3	D4	Supply
S1	21	16	15	3	11
S2	17	18	14	23	13
S3	32	27	18	41	19
Demand	6	10	12	15	

North West Corner Method Example T4

Determine an initial feasible solution to the following transportation problem by using NWCM.

	D1	D2	D3	D4	Supply
S1	1	2	1	4	30
S2	3	3	2	1	50
S3	4	2	5	9	20
Demand	20	40	30	10	

Least Cost Method (LCM) Example T5

Determine an initial feasible solution to the following transportation problem by using LCM.

	D1	D2	D3	D4	Supply
S1	19	30	50	10	7
S2	70	30	40	60	9
S3	40	8	70	20	18
Demand	5	8	7	14	34

North West Corner Method Example T6

Determine an initial feasible solution to the following transportation problem by using LCM.

	D1	D2	D3	D4	Supply
S1	11	13	17	14	250
S2	16	18	14	10	300
S3	21	24	13	10	400
Demand	200	225	275	250	

Vogel's Approximation Method Example T7

Determine an initial feasible solution to the following transportation problem by using NWCM.

	D1	D2	D3	D4	Supply
S1	**19**	**30**	**50**	**10**	**7**
S2	**70**	**30**	**40**	**60**	**9**
S3	**40**	**8**	**70**	**20**	**18**
Demand	**5**	**8**	**7**	**14**	**34**

T8

A dairy firm has three plants located in a state. The daily milk production at each plant is as follows:

Plant 1: 6 Million liters

Plant 2: 1 million liters

Plant 3: 10 million liters

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

Distribution centre 1: 7 million litres

Distribution centre 2: 5 million litres

Distribution centre 3: 3 million litres

Distribution centre 4: 2 million litres

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

	Distribution Centre				
Plant		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) NWCR b) LCM c) VAM

Example T9

A firm manufacturing a single product has three plants, I,II,III. They have produced 60, 35 and 40 units resp. during this month. The firm has made a commitment to sell 22 units to customer A, 45 units to customer B, 20 units to customer C, 18 units to customer D, 30 units to customer E. Find the minimum possible transportation cost of shifting the manufactured product to the five customers. The net cost of transporting the three plants to the five customers is given below:

	A	B	C	D	E
I	4	1	3	4	4
II	2	3	2	2	3
III	3	5	2	4	4

MODI Method

- The MODI (modified distribution) method allows us to compute improvement indices quickly for each unused square without drawing all of the closed paths. Because of this, it can often provide considerable time savings over other methods for solving transportation problems.
- MODI provides a new means of finding the unused route with the largest negative opportunity cost.
- Once the largest negative opportunity cost is identified, we are required to trace only one closed path. This path helps determine the maximum number of units that can be shipped via the best unused route.

- Steps in MODI method.

Reference Books

- Operations Research Theory and Applications by J.K. Sharma, Macmillan India Ltd.