Introduction to Transportation Problems in Operations Research

Transportation problems are an important class of optimization problems in operations research. They involve determining the optimal way to distribute goods or resources from a set of supply sources to a set of demand locations, with the goal of minimizing the total cost of transportation.

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Defining Transportation Problems

Objective

The objective in a transportation problem is to minimize the total cost of transporting goods from supply sources to demand locations.

Components

Transportation problems have three key components: supply sources, demand locations, and transportation costs between them.

Constraints

Constraints include the limited supply at each source and the required demand at each location.

Characteristics of Transportation Problems

1 Balanced vs. Unbalanced

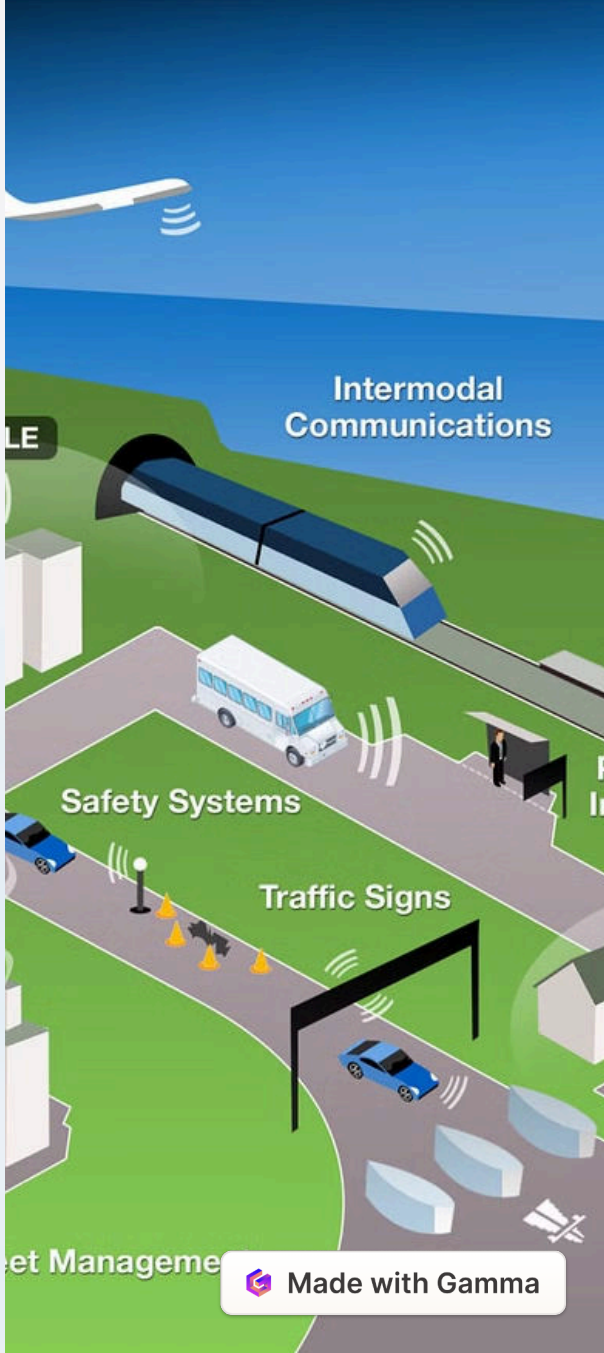
Transportation problems can be either balanced, where total supply equals total demand, or unbalanced.

2 Closed vs. Open

Closed problems have a finite set of supply sources and demand locations, while open problems have an infinite number.

3 Deterministic vs. Stochastic

Deterministic problems have known, fixed parameters, while stochastic problems have uncertain or random parameters.



Formulating Transportation Problems as Linear Programming Models

Decision Variables

The decision variables represent the amount of goods to be transported from each supply source to each demand location.

Objective Function

The objective function minimizes the total transportation cost, which is the sum of the products of the decision variables and their respective unit costs.

Constraints

The constraints ensure that the total supply from each source and the total demand at each location are satisfied.

Solving Transportation Problems Using the Simplex Method

1

Step 1

Formulate the transportation problem as a linear programming model.

2

Step 2

Use the simplex method to solve the linear programming model and find the optimal solution.

3

Step 3

Interpret the optimal solution, which provides the optimal distribution of goods from sources to destinations.

ple: Simplex Method

Simplex Tableau

		x_1	x_2	x_3	s_1	s_2	s_3	
s	c_B	12	18	10	0	0	0	
0		2	3	4	1	0	0	50
0		-1	1	1	0	1	0	0
0		0	-1	1.5	0	0	1	0
z_j		0	0	0	0	0	0	0
$- z_j$		12	18	10	0	0	0	

on 1

ep 1: Determine the Entering Variab

The most positive $c_j - z_j = 18$. Thus x

ng variable.

Applications of Transportation Problems in Real-World Scenarios

Manufacturing

Optimizing the distribution of raw materials and finished goods between production facilities and warehouses.

Logistics

Determining the most efficient routes for transporting goods from suppliers to customers.

Healthcare

Allocating medical supplies and equipment from central distribution centers to hospitals and clinics.

Test of Optimality

Optimal Solution

The optimal solution to a transportation problem must satisfy the complementary slackness conditions, which link the optimal dual variables to the optimal primal variables.

Optimality Test

The optimality test involves checking if the optimal dual variables (shadow prices) are non-negative and the optimal primal variables (shipment quantities) are non-zero only when the corresponding dual variables are zero.

Interpretation

The optimal solution represents the most cost-effective way to distribute goods from supply sources to demand locations, given the constraints of the problem.

Conclusion

Key Takeaways

Transportation problems are a fundamental class of optimization problems in operations research, with applications in various industries. Effective modeling and solving of these problems can lead to significant cost savings and operational efficiencies.