Transportation Optimization Project

Minimizing Logistics Costs through Linear Programming and Data-Driven Analysis

Rehema Amisi | January 2026

Project Overview

01 The primary objective is to **minimize total transportation costs** while satisfying all supply and demand constraints across the network.

02 The analysis employs a **two-step methodological approach**: starting with a deterministic model and extending it for scenario variation analysis.

03 **Linear programming** provides the mathematical foundation for optimizing shipment allocations from multiple origins to destinations.

04 This structured framework ensures **operational efficiency** and data-driven decision-making for complex logistical challenges.

Methodology: Model Formulation

Variables & Objective

$$\text{Minimize } Z = \sum \sum c_{ij} * x_{ij}$$

- **Decision Variables (x_{ij})**: Quantity transported from supply node i to demand node j.
- **Unit Costs (c_{ij})**: The cost of moving one unit of product along a specific route.

Operational Constraints

- **Supply Constraints**: Total shipments from each origin cannot exceed its maximum capacity (S_i).
- **Demand Constraints**: Each destination must receive its minimum required quantity (D_j).
- **Non-Negativity**: All shipment quantities must be greater than or equal to zero.
- **Balanced Problem**: Total Supply = Total Demand (2,300 units).

Key Findings: Cost Efficiency

$23,350

Total Optimized Cost

The minimum total transportation cost achieved while satisfying all operational constraints.

$13,373

Estimated Savings

Projected cost reduction compared to non-optimized average transportation benchmarks.

The optimization model successfully balanced **2,300 units** of total supply with **2,300 units** of total demand, achieving an average unit cost of **$10.15** across all active shipment routes.

Route Analysis: Efficiency & Volume

Efficiency Leaders

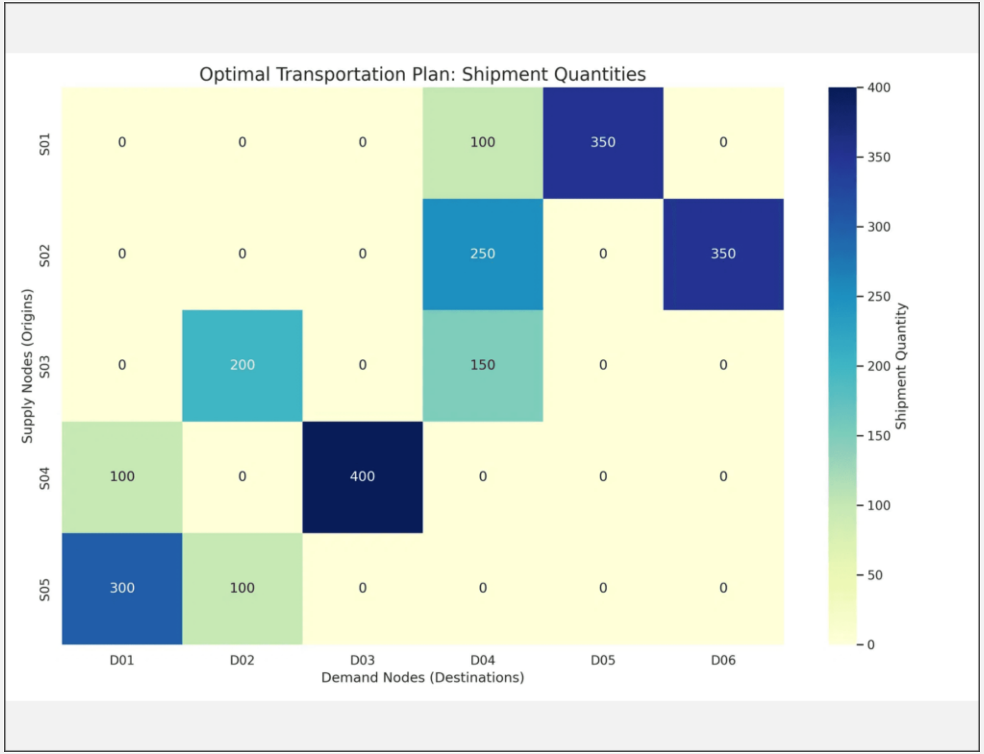
The model prioritized **S04 to D03**, moving 400 units at the lowest unit cost of **$5.00**.

High-Volume Corridors

Major flows were established from **S01 to D05** and **S02 to D06**, each handling 350 units.

Strategic Allocation

Higher-cost routes are only utilized when necessary to satisfy demand constraints, ensuring **maximum cost avoidance**.



Mapping Shipment Flow

Corridor Identification: The heatmap reveals the primary transportation corridors selected by the model to minimize total expenditure.

Cost Avoidance: High-cost routes are systematically bypassed, with shipments concentrated in the most efficient lanes.

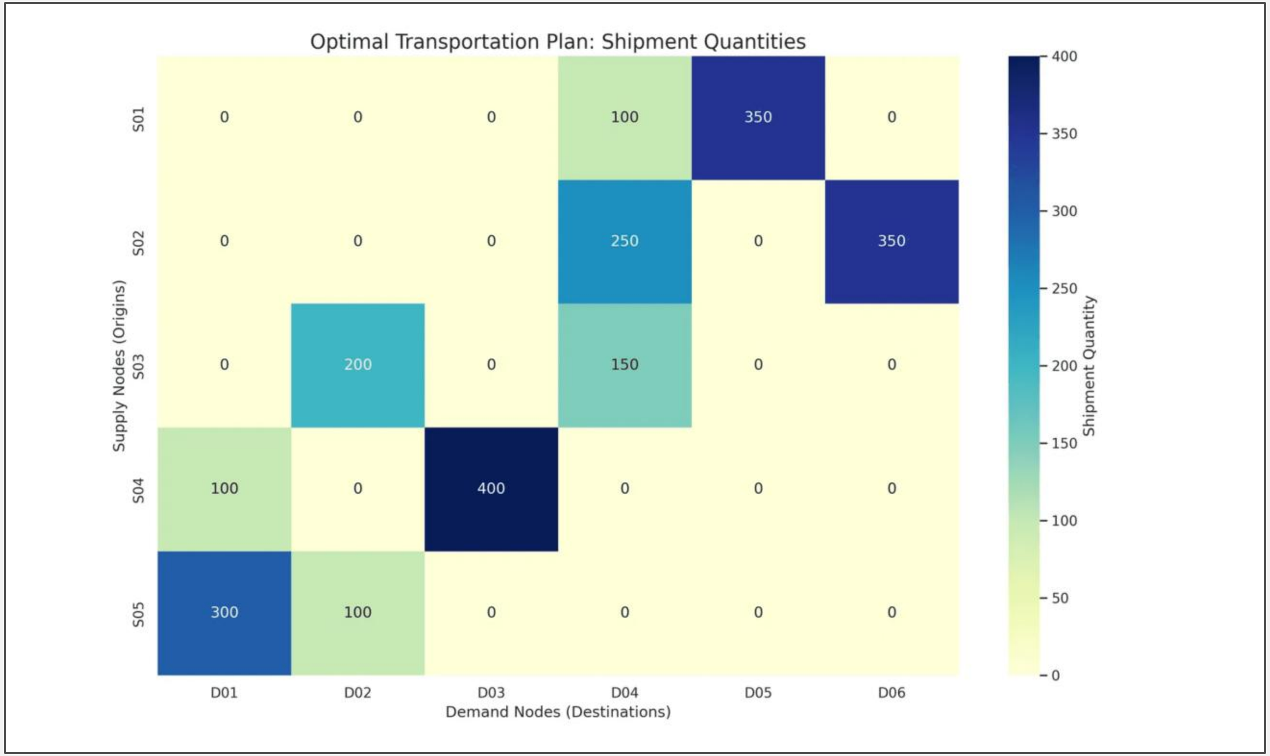


Figure 1.0: Optimal Shipment Distribution Heatmap

Utilization & Performance

Supply Capacity

Origin Node Efficiency

100%

Capacity Utilization Rate

Every supply node is leveraged to the maximum operational limit. The balanced model ensures that all 2,300 units of available capacity are actively contributing to the distribution network without waste.

Demand Fulfillment

Destination Satisfaction

100%

Requirement Fulfillment Rate

All destination requirements are met with precision. The optimization guarantees that each of the 6 demand nodes receives the exact specified quantity, maintaining service levels across the entire customer base.

Strategic Value of Optimization

Efficiency

Linear programming transforms complex logistical variables into a clear, cost-minimized operational plan.

Scalability

The framework is easily adaptable to include new supply nodes, changing demand, or fluctuating costs.

Savings

Data-driven allocation identifies hidden efficiencies, resulting in significant and measurable cost reductions.

Insight

Advanced visualization and analysis provide stakeholders with actionable intelligence for supply chain strategy.

Optimizing today for a more efficient tomorrow.