# Optimization Project Report

**Problem Statement Title:** Multi-Modal Transportation Optimization for E-Commerce Logistics

**Overview:**

**1. Introduction:**

This project focuses on optimizing the transportation of goods across multiple routes to minimize overall costs while meeting specific delivery deadlines. The problem arises in logistics and supply chain management, where efficient resource utilization and cost reduction are critical objectives. The project scenario involves transporting three goods through a network of predefined routes with varying costs and constraints.

**2. Problem Statement**

The transportation network consists of three goods: Good 1, Good 2 and Good 3.
Predefined routes: Each route has specific costs, transit times, and constraints.
Source and destination cities: Goods must be transported from their source cities to their destination cities.

The objective is to minimize total transportation costs while ensuring:
1. All goods reach their destinations.
2. Delivery deadlines are respected.
3. Routes selected satisfy all constraints.

**3. Assumptions:**

1. The delivery process is deterministic.
2. Goods are transported in standardized containers.
3. Each route has a predefined cost and transit time.
4. Every route has a fixed capacity or volume.

**4. Implementation:**
The problem is implemented in Python using the PuLP library, a popular tool for solving linear programming problems.

**Steps Involved:**
**1. Data Preparation:**
Input data includes costs, routes, and constraints, structured as dictionaries.

**2. Model Definition:**
Decision variables: Binary values (0 or 1) indicating route selection by each good .
Objective function: Minimization of total cost.
Constraints: Delivery requirements and route availability.

**3. Solver Integration:**
The CBC solver (default with PuLP) is used to compute the optimal solution.

**4. Results**
The optimal transportation plan achieves a total cost of 2050 units. The selected routes are:
All constraints were satisfied, ensuring efficient and timely delivery.
Route Selection:

For Good 1 (Seafood):
Good 1 (Seafood) travels from Visakhapatnam_Seaport to Tokyo_Seaport on this route

For Good 2 (Medicines):
Good 2 (Medicines) travels from Shanghai_Warehouse to Shanghai_Airport on this route
Good 2 (Medicines) travels from Shanghai_Airport to Visakhapatnam_Airport on this route

For Good 3 (Crude Oil):
Good 3 (Crude Oil) travels from Dubai_Seaport to Singapore_Seaport on this route
Good 3 (Crude Oil) travels from Singapore_Seaport to Visakhapatnam_Seaport on this route

**5. Conclusion:**
The project successfully optimized goods transportation, achieving cost savings and operational efficiency.

**Detailed Work and Future Progress**

Reference:
https://github.com/hzjken/multimodal-transportation-optimization.git

After extensive analysis, we thought to work on above git repo and began its implementation. After trying to work, it became challenging due to its complexity involving the use of libraries like DOcplex and CVXPY.

However, with a deeper understanding of these concepts, we developed the current project, which also aims at optimizing. So we simplifed the problem, by limiting the number of routes and cities, focusing on building a foundational model.

This foundational approach will later be extended to accommodate a larger dataset, including more routes, cities, and additional costs along with transportation expenses also try to incorporate multi-modal transportation scenarios for greater applicability.

**Thank you!!**