OPTIMIZATION PROJECT

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PROBLEM STATEMENT

Multi Modal Transport Optimisation:

MULTI-MODAL TRANSPORTATION OPTIMIZATION ADDRESSES THE CHALLENGES OF IMPROVING EFFICIENCY IN LOGISTICS NETWORKS. IT BALANCES COSTS, DELIVERY TIMES, AND RESOURCES TO MAXIMIZE RETURNS THROUGH THE INNOVATIVE USE OF MATHEMATICAL PROGRAMMING TECHNIQUES.

INTRODUCTION

- Logistics plays a key role in supply chains, and route optimization can significantly reduce operational costs.
- To optimize the delivery of goods from multiple origins to various destinations while minimizing costs, considering factors like delivery time, route capacity, and deadlines.
- The goal is to minimize costs and improve efficiency in transportation.

PROBLEM OVERVIEW

In our case there are 3 goods and 4 cities

1. **Cities**:Visakhapatnam,Shangai,Tokyo,Dubai.
2. The 3 goods originate from different cities and have different destinations. Each city/country has 4 ports,the airport,railway station,seaport and warehouse.
3. There are in different routes connecting different ports.Each route has a specific transportation tool,transportation cost.

TASK: Determining optimized delivery routes for all goods that minimize overall costs by considering factors such as transportation expenses, vehicle capacity, delivery constraints, and route efficiency.

CONSTRAINTS & ASSUMPTIONS

- Overall cost is restricted to transportation cost.
- The delivery process is deterministic, no random effect will appear on delivery time and cost etc.
- There is only one transportation tool available between each two ports. For instance, we can only directly go from one airport to the other airport in different cities by flight, while direct journey by ship or railway or truck is infeasible.
- Goods must start and end at specified locations only.
- Deliveries must be made within set of tmeframes.
- Volume or capacity limits on transport routes .

OPTIMIZATION MODEL

THIS TABLE SUMMARIZES ESSENTIAL COMPONENTS OF THE LINEAR PROGRAMMING MODEL FOR TRANSPORTATION COST OPTIMIZATION.

COMPONENT	DESCRIPTION	Parameters
Objective Function	Minimize total transportation cost	$Z = \sum \text{cost}(i,j) * xij$ where $(i,j) \in R$
Decision Variables	Binary variables for route selection	xij={1 if selected, 0 if not}
Constraints	Ensure solution feasibility with strict rules	Origin-Destination, Deadline, Capacity

GOODS CHARACTERISTICS

HERE WE SEE KEY DETAILS ABOUT EACH GOOD, INCLUDING ITS ORIGIN, DESTINATION, VOLUME, AND DEADLINES. THIS DATA IS VITAL FOR ROUTING DECISIONS.

Goods	Origin	Destination	Volume	Deadline
Seafood	Visakhapatnam_seaport	Tokyo_Seaport	500 Units	7 weeks
Medicine	Shanghai_Warehouse	Visakhapatnam_Airport	400 **Units**	6 Weeks
Crude Oil	Dubai_Seaport	Visakhapatnam_Airport	350 **Units**	8 Weeks

APPROACH

- Utilizing Linear Programming and the PuLP library, a structured approach is taken. The model is solved using Mixed-Integer Linear Programming (MILP) techniques.
- The CBC MILP Solver is used to find the optimal solution by minimizing the total transportation cost.
- The solver works by iterating over the possible combinations of selected routes and selecting the one with the lowest total cost, while satisfying all constraints.

```
# FEASIBLE ROUTES
ROUTES = {

('VISAKHAPATNAM_SEAPORT', 'SINGAPORE_SEAPORT'): {'COST': 500, 'TIME': 3},
('SINGAPORE_SEAPORT', 'TOKYO_SEAPORT'): {'COST': 800, 'TIME': 4},
('VISAKHAPATNAM_SEAPORT', 'TOKYO_SEAPORT'): {'COST': 1000, 'TIME': 6},
('SHANGHAI_WAREHOUSE', 'SHANGHAI_AIRPORT'): {'COST': 250, 'TIME': 1},
('SHANGHAI_AIRPORT', 'VISAKHAPATNAM_AIRPORT'): {'COST': 500, 'TIME': 1},
('SHANGHAI_AIRPORT', 'SINGAPORE_AIRPORT'): {'COST': 500, 'TIME': 1},
('SINGAPORE_AIRPORT', 'SINGAPORE_SEAPORT'): {'COST': 250, 'TIME': 1},
('SINGAPORE_SEAPORT', 'TOKYO_SEAPORT'): {'COST': 550, 'TIME': 3},
('TOKYO_SEAPORT', 'TOKYO_WAREHOUSE'): {'COST': 300, 'TIME': 1},
('SHANGHAI_AIRPORT', 'TOKYO AIRPORT'): {'COST': 600, 'TIME': 1},
('TOKYO_AIRPORT', 'TOKYO WAREHOUSE'): {'COST': 200, 'TIME': 1},
('DUBAI_SEAPORT', 'SINGAPORE_SEAPORT'): {'COST': 600, 'TIME': 5},
('SINGAPORE_SEAPORT', 'VISAKHAPATNAM_SEAPORT'): {'COST': 600, 'TIME': 3},
('DUBAI_SEAPORT', 'VISAKHAPATNAM_SEAPORT'): {'COST': 1300, 'TIME': 8},
}
```

OUTPUT

STATUS: 1
OPTIMAL COST: 2950.0
ROUTE SELECTION: FOR GOOD 1 (SEAFOOD):
GOOD 1 (SEAFOOD) TRAVELS FROM VISAKHAPATNAM_SEAPORT TO TOKYO_SEAPORT ON THIS ROUTE

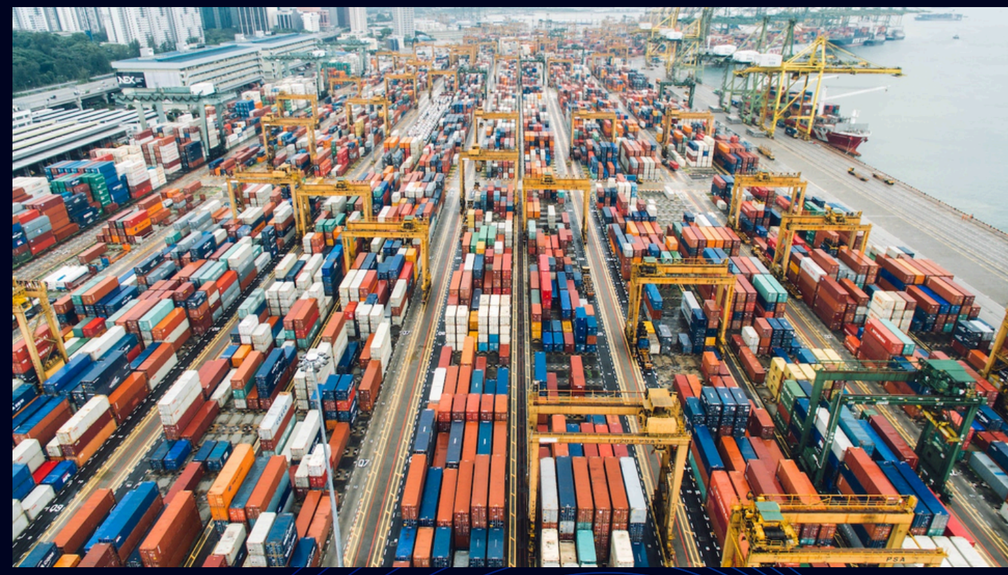
FOR GOOD 2 (MEDICINES):
GOOD 2 (MEDICINES) TRAVELS FROM SHANGHAI_WAREHOUSE TO SHANGHAI_AIRPORT ON THIS ROUTE
GOOD 2 (MEDICINES) TRAVELS FROM SHANGHAI_AIRPORT TO VISAKHAPATNAM_AIRPORT ON THIS ROUTE

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

FUTURE IMPROVEMENTS

THE PROJECT CAN BE EXTENDED BY CONSIDERING ALL TYPE OF COSTS LIKE TRANSPORTATION, WAREHOUSE, AND TARIFF EXPENSES. ALSO MULTIPLE GOODS, CITIES, AND ROUTES CAN BE ADDED WHILE ADHERING TO CONSTRAINTS LIKE DEADLINES, CAPACITIES, AND TARIFFS. THE MODEL ENSURES EFFICIENT, COST-EFFECTIVE DELIVERY IN A COMPLEX, GLOBAL SUPPLY CHAIN NETWORK...!!!

DEVELOPING WEBSITE OF THE SAME MODEL GIVING USER'S THE ACCESS TO GIVE DATA INPUT OF GOODS AND ROUTES.



CONCLUSION

- **Enhance Efficiency:** Streamlined delivery routes reduced fuel consumption and travel time, leading to significant cost savings.
- **Optimize Resource Utilization:** Maximized vehicle capacity usage ensured that resources were allocated efficiently, minimizing idle times and reducing the number of trips required.
- **Meet Delivery Constraints:** Addressed critical constraints such as delivery time windows and vehicle limitations, ensuring reliable and timely deliveries.
- **Increase Profitability:** Lower operational costs directly contributed to improved profitability and competitive advantage.

THANK YOU

Presented by Bharath And Jayanth