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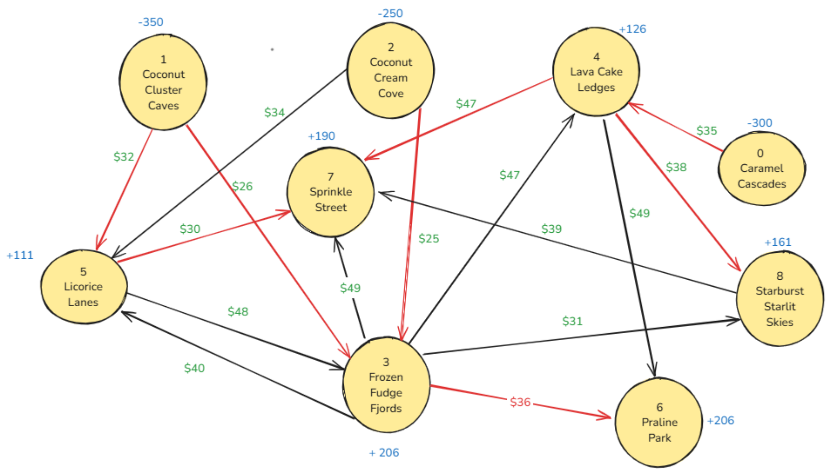
Module 06 – Transshipment Problem

Exploratory Data Analysis



Model Formulation
Decision Variables: Shipment Quantity
Objective Function: Total Transportation Cost

MIN (Total Shipping):

$$35X04+26X13+32X15+25X23+34X25+47X34+40X35+36X36+49X37+31X38+49X46+47X47+38X48+48X53+30X57+39X87$$

Constraints

0. $-X04 >= -300$
1. $-X15-X13 >= -350$
2. $-X25-X23 >= -250$
3. $X53+X13+X23-X35-X37-X34-X38-X36 >= 206$
4. $X04+X34-X47-X48-X46 >= 126$
5. $X15+X25+X35-X53-X57>=111$
6. $X46+X36>=206$
7. $X47+X87+X37+X57>=190$
8. $X48+X38-X87>=161$

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Model Optimized for Minimal Transportation Cost

Total Transportation Cost ->	$ 43,433.00

Ship	From		To		Unit Cost
300	0	Caramel Cascades	4	Lava Cake Ledges	$ 35
162	1	Coconut Cluster Caves	3	Frozen Fudge Fjords	$ 26
188	1	Coconut Cluster Caves	5	Licorice Lanes	$ 32
250	2	Coconut Cream Cove	3	Frozen Fudge Fjords	$ 25
0	2	Coconut Cream Cove	5	Licorice Lanes	$ 34
0	3	Frozen Fudge Fjords	4	Lava Cake Ledges	$ 47
0	3	Frozen Fudge Fjords	5	Licorice Lanes	$ 40
206	3	Frozen Fudge Fjords	6	Praline Park	$ 36
0	3	Frozen Fudge Fjords	7	Sprinkle Street	$ 49
0	3	Frozen Fudge Fjords	8	Starburst Starlit Skies	$ 31
0	4	Lava Cake Ledges	6	Praline Park	$ 49
13	4	Lava Cake Ledges	7	Sprinkle Street	$ 47
161	4	Lava Cake Ledges	8	Starburst Starlit Skies	$ 38
0	5	Licorice Lanes	3	Frozen Fudge Fjords	$ 48
77	5	Licorice Lanes	7	Sprinkle Street	$ 30
0	8	Starburst Starlit Skies	7	Sprinkle Street	$ 39

Nodes		Inflow	Outflow	Net Flow	Supply/Demand
0	Caramel Cascades	0	300	-300	-300
1	Coconut Cluster Caves	0	350	-350	-350
2	Coconut Cream Cove	0	250	-250	-250
3	Frozen Fudge Fjords	412	206	206	206
4	Lava Cake Ledges	300	174	126	126
5	Licorice Lanes	188	77	111	111
6	Praline Park	206	0	206	206
7	Sprinkle Street	90	0	90	190
8	Starburst Starlit Skies	161	0	161	161

The model is optimizing transportation costs for distributing goods from various supply nodes (sources) to demand nodes (destinations) while ensuring supply and demand constraints are met. The goal is to minimize total transportation costs, which the model achieves with a final total transportation cost of $43,433.00.

- **Shipments and Routing:**
  The model assigns shipments from supply locations (Caramel Cascades, Coconut Cluster Caves, Coconut Cream Cove, etc.) to demand locations (Lava Cake Ledges, Licorice Lanes, Praline Park, etc.).
- **Cost Minimization:**
  By selecting routes with lower unit costs and balancing supply flow efficiently, the model avoids unnecessary high-cost routes.
- **Balanced Flow:**
  Each node maintains a net balance where supply meets demand, as shown in the inflow and outflow calculations.

Model with Stipulation

<u>Describe the necessity of the Balance-of-Flow for this problem type</u>

The Balance-of-Flow ensures that:

1. Supply is not exceeded at source nodes.
2. Demand is fully met at destination nodes.
3. No accumulation or loss occurs at intermediate nodes.

This prevents unrealistic solutions like excess inventory or unmet demand. In Excel, it's enforced with constraints ensuring total inflow = total outflow at each node.

<u>What happens when you change your model to make Total Supply > Total Demand (i.e. add 115 units to one of the sources)</u>

When Total Supply exceeds Total Demand, the total shipping cost increases because the model must account for the excess inventory, often leading to inefficient distribution. Since demand is already satisfied, the additional supply may be forced into more expensive or unnecessary routes, increasing overall costs.

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<u>What happens when you rerun your model?</u>
The Total shipping Cost increases

<u>What do you need to change to make your model work again?</u>
Increase demand at one or more destination nodes to match the new supply, ensuring all units are used efficiently.