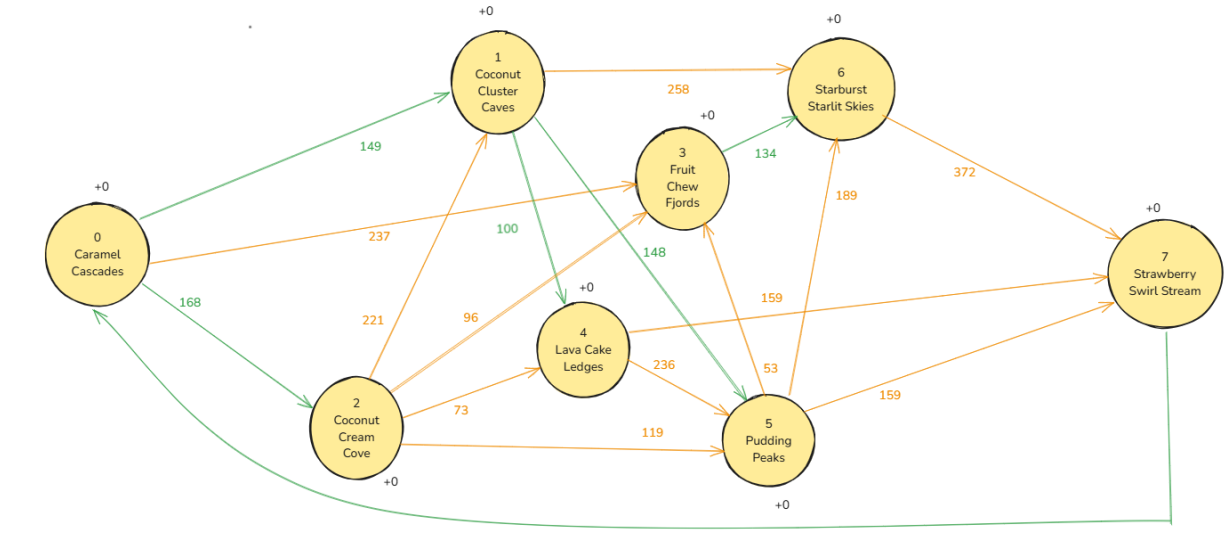
Arianna Ugolini

Module 07 – Maximal Flow

Exploratory Data Analysis



Model Formulation

Write the formulation of the model into here prior to implementing it in your Excel model. Be explicit with the definition of the decision variables, objective function, and constraints.

Objective function: maximal flow = units flow for the X71 link
Decision variables: Units Flow
Constraints:

- Units of flow <= Upper bound
- Units of flow >= 0
- Net Flow = Supply/Demand

MAX: X70

Subject to:
+ X70 -X01 – X02 – X03
+ X21+ X01 -X13 -X15
+ X02 – X21 - X24 – X25
+ X13 + X03 -X34 -X35 – X36
+ X24 + X34 – X47
+ X25 +X15 + X35 – X57
+ X35 – X67
+ X57 + X47 – X70

With the following bounds on the decision variables:
0 <= X01<= 193
0 <= X02<= 193
0 <= X03<= 144
0 <= X13<= 238
0 <= X15<= 76
0 <= X21<= 165
0 <= X24<= 163
0 <= X25<= 121
0 <= X34<= 241
0 <= X35<= 82
0 <= X36<= 162
0 <= X47<= 446
0 <= X57<= 232
0 <= X67<= 193
0 <= X71<= inf

Model Optimized for Maximal Flow

Maximal Flow -> 451

Units of Flow	Links From		Links To		Upper Bound
149	0	Caramel Cascades	1	Coconut Cluster Caves	149
168	0	Caramel Cascades	2	Coconut Cream Cove	168
134	0	Caramel Cascades	3	Fruit Chew Fjords	237
100	1	Coconut Cluster Caves	4	Lava Cake Ledges	100
148	1	Coconut Cluster Caves	5	Pudding Peaks	148
69	1	Coconut Cluster Caves	6	Starburst Starlit Skies	258
168	2	Coconut Cream Cove	1	Coconut Cluster Caves	221
0	2	Coconut Cream Cove	3	Fruit Chew Fjords	96
0	2	Coconut Cream Cove	4	Lava Cake Ledges	73
0	2	Coconut Cream Cove	5	Pudding Peaks	119
134	3	Fruit Chew Fjords	6	Starburst Starlit Skies	134
100	4	Lava Cake Ledges	7	Strawberry Swirl Stream	159
0	4	Lava Cake Ledges	5	Pudding Peaks	236
0	5	Pudding Peaks	7	Strawberry Swirl Stream	159
0	5	Pudding Peaks	3	Fruit Chew Fjords	53
148	5	Pudding Peaks	6	Starburst Starlit Skies	189
351	6	Starburst Starlit Skies	7	Strawberry Swirl Stream	372
451	7	Strawberry Swirl Stream	0	Caramel Cascades	9999

	Nodes	Inflow	Outflow	Net Flow	Supply / Demand
0	Caramel Cascades	451	451	0	**0**
1	Coconut Cluster Caves	317	317	0	**0**
2	Coconut Cream Cove	168	168	0	**0**
3	Fruit Chew Fjords	134	134	0	**0**
4	Lava Cake Ledges	100	100	0	**0**
5	Pudding Peaks	148	148	0	**0**
6	Starburst Starlit Skies	351	351	0	**0**
7	Strawberry Swirl Stream	451	451	0	**0**

The model successfully achieves a maximum flow of 451 units, ensuring a balanced network where each node's inflow matches its outflow. However, certain links, such as Caramel Cascades to Fruit Chew Fjords (237 units) and Starburst Starlit Skies to Strawberry Swirl Stream (372 units), operate near capacity and could become bottlenecks if demand increases. To improve efficiency, increasing capacity on these edges or redistributing flow could help alleviate constraints.

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Model with Stipulation

To increase the maximum flow beyond 451 units, capacity should be expanded on key bottleneck edges like Coconut Cluster Caves → Starburst Starlit Skies and Starburst Starlit Skies → Strawberry Swirl Stream, which are operating near their limits. Additionally, underutilized paths such as Coconut Cream Cove → Fruit Chew Fjords and Pudding Peaks → Strawberry Swirl Stream should be optimized to redistribute flow and reduce congestion. Introducing parallel routes could further enhance efficiency and maximize throughput.