Module 07 – Maximal Flow

Exploratory Data Analysis

*In this section, you should perform some data analysis on the data provided to you. Please format your findings in a visually pleasing way and please be sure to include these cuts:*

* *Make a visual graph of your data like what we saw for the sample problem*

A diagram of a network

Description automatically generated

Model Formulation

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

Objective Function:

Equals the last “unit of flow” in my model because our end goal is to maximize the units of flow to go through the pump stations, then ultimately back to the oil field (0).

=B22

Decision Variables:  
Are represented by the “Units of Flow” column because we are using excel solver to help us find the maximized amount of molten chocolate to flow through our circuit.

(B6:B22)

Constraints:

Non-negativity constraint~ Units of Flow (>=) 0

Capacity~ Units of Flow (<=) Upper Bound

Balance of Flows~ Net Flow (=) Supply/Demand (also 0)

Model Optimized for Maximal Flow

*Implement your formulation into Excel, and be sure to make it neat. This section should include:*

* *A screenshot of your optimized final model (formatted nicely, of course)*
* *A text explanation of what your model is recommending, especially any identified bottlenecks*
* *Update your graph from the EDA section to bold/color the links being used (and show how much is going through that link)*

A screenshot of a computer

Description automatically generated

*This model demonstrates the flow of molten chocolate, encompassing the oil field (0-Cinnamon Swamp) through the Pump Stations (1-6) and ending back at the refinery (7-Vanilla Valley) and is transported back to the oil field to complete the network. My model maximized the amount of chocolate that can flow through this network, with the given constraints, based on the last value in the “Units of Flow” column. In this case, 662 units was the maximum optimization based on my constraints and given data. In the next section I will discuss bottlenecks and areas of improvement in this model.*

Model with Stipulation

*Please copy the tab of your original model before continuing with the next part to avoid messing up your original solution.*

* *Using a copy of the network, show how many units reach each node*



*Identify the edges that are underutilized and those that are at capacity with different colors (you can also color the nodes RED for underutilized and GREEN for at capacity)*

* *An edge is under-utilized if edges go to it that aren’t at capacity go to it*
* *An edge is at capacity when it has edges that are at capacity (especially if they are all at capacity)*
* *Write a brief statement on what would help increase the optimal solution.*

*A table with numbers and text

Description automatically generated with medium confidence*

Based on the model, although there are plenty of underutilized nodes, I believe a solid solution to combat the constraints would be reevaluating the network and increasing the capacity of the first three outflows. Ideally, increasing the capacity of connection 0🡪1 by 20, we would see the same increase of maximal flow from 662🡪682. In a perfect world we can reorganize and expand the capacity of any and all nodes, however, in reality, the infrastructure in which the molten chocolate flows may not allow for a total recall.