Name : Kanika Yadav

Email ID : [kadik@stevens.edu](mailto:kadik@stevens.edu)

Course number : BIA 650 A

Instructors name : Prof. Edward Stohr

**BIA 650A Optimization and Process Innovation Fall 2022**

**Developing a Decision Support System for a Major Retail Company using Simplex Algorithm**

I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination. I further pledge that I have not copied any material from a book, article, the Internet or any other source except where I have expressly cited the source.

**Name : Kanika Yadav**

**Signature : Kanika Yadav Date: 22th November 2022**

======================================================

**Proposal Objective and Criteria –**

For the given dataset, we have the initial launch of the product style line and their unit cost with price we could deduce the profit margin for the product line for the Clothing retailer. Here we are given an objective to do the pricing and cost analysis, to target sale of complete available inventory within 36 weeks from the date of launch of the product line.

If we look at the data set, we have weekly data as well as dataset collected on 03/29/2015, where we can see there was a sale of approximate 500-800 units of each style with profit margin of 55- 75% which varies across the product line. Here we will figure the best optimal solution by checking the Demand – Pricing Strategy by determining if the Demand Curve is linear or non-linear.

**Objective** – To maximize the Profit Margin with given constraint of 36 week time span to sell the complete inventory.

**Understand the Data –**

Currently the data set given is as follows–

1. Initial Product style, cost and price, their respective revenue and profit margin.
2. Sale data for 19.42 weeks - Profit Margin attained by 03/29/2015 since product launch on 11/13/2014.
3. A week sale data - Number of items sold in a week from 03/29/2015 to 04/04/2015.

It is observed that the given dataset has issues as follows–

* Non-linear objective since the values are not clearly stated for Weekly data but a part of it.
* Unbounded set of possibilities to improve based on various factors that can be considered for final build of the problem solution.

**Assumption-** Since the number of units are already available, we restrict and put a constraint based on 36 Weeks to sell off all the inventory. This will help us to define the target selloff within stipulated time and with maximum Profit Margin. But the data is not linear to define a specific linearity in the application to apply for a Simplex LP Problem. Hence, we further make a few more assumption about the Demands, Price to make a linear Demand Curve that will help define a proper strategy to meet the demanding needs of the products and make the most profit out of the product styles. We try to make it linear by introducing Demand curve.

Linear Demand Curve will be computed based on Quantity of Demand (Q) and general effects on quantity of demand based on other factors than price(C), the slope of the effect of price changes on demand (b) and the Price (P).

Hence the equation looks like – Q = a – b\*P

Where,   
- Q is the [quantity of demand](https://www.vcalc.com/wiki/Linear-Demand-Curve)  
- a is the effect of all influences on demand other than price  
- b is the slope of the demand in relationship to the price (P)  
- P is the price

Based on above relationship we derive a sample execution of single product style as shared in the excel sheet.

**Model Development-**

For the current given problem statement, we have constraint to find an optimal solution following up ahead. Based on given dataset values, we are left with 110 days (i.e. 15.72 weeks) of 36 weeks to sell of the Inventory of stock for each product style. Although by Pareto principle there are 20% factors that affect the 80% of sell of Clothing which is rightly applicable in this case, we try to stick with our strict stringent lines of sales based on our Simplex Linear programming to solve this problem.

**Constraints**

* Sell off all inventory of all styles within 36 Weeks of Launch date
* Make Maximum Profit Margin
* Build a Time constraint-based Model system
* Assuming that we are in the middle of selling of the product styles at the clothing center we would consider the remaining inventory to be sold before the end of given time constraint of 36 Week. So, this number will be the maximum number of sales to be done for each style.

**Objective function**

* To maximize Profit Margin

A screenshot of a computer

Description automatically generated with medium confidence

**Conclusion and DSS Proposal –**

Based on above results through the Linear Simplex algorithm implication it is clear to us that–

1. The given values of dataset price and specify product style varies a lot and is not linear to the weekly sell off since the launch date that is 13/11/2014. There was a statistics collection of sales data on 3/29/2015 which should have been tracked earlier to manage a better plan to execution
2. Based on the current dataset given it is tough to ensure a linear way of product sellout due to the varying factors like likeability, weather, buying patterns, motivation towards purchasing a product for the customers particularly for a clothing store. There is a likability of imposition of various factors out of the usual ones to build a solid plan of execution to maximize the Profit margin.
3. There are various factors based on the style preference and popularity among the customers.
4. Sales optimization is not a one-day goal to achieve but a process to improve over the time to build a strong model that can encourage the company towards profit goals. It requires a lot of evaluation and recalibration of the values like Selling Price in this case which impacts both the Revenue generation and ultimately the Profit Margin for that product style. There is a need of regular refinement of the process for growth of the company.
5. Based on PED – Price Elasticity of Demand we can define the Demand function for our problem statement as –

Initial Price (PI) = 26.5, New Price (PN) = 23,

Initial Quantity (QI) = 1948, New Quantity (QN) = 1450

PED = ((QN − QI) / (QN + QI) / 2 ) / ( (PN - PI) / (PN + PI) / 2 )

PED = ((1450-1948)/(1948+1450)/2)/((23-26.5)/(23+26.5)/2)

PED = -0.0733 / -0.0354

= 2.0727

Since |PED| > 1 – Demand is elastic. Hence, we can build our own DSS system over this.

An example of single style improvement using demand curve is solved as follows –

Graphical user interface, chart

Description automatically generated

**Decision Support System Proposal for the problem statement –**

A typical Decision Support System helps to ease the problem of the Store manager or the problem statement to optimize their sales in this case and has a Frontend as well as a backend.

Given that if this problem was to solve for the store manager the front end will have a facility to –

1. Enter the Weekly details from when-to-when sales happened
2. Number of units sold
3. Selling Price

At the backend we will have all the logical action happening to recommend the store manager to help him building the best possible price value for his styles to maximize their profit margin.

Backend will generate –

1. Production Cost
2. Inventory update
3. Revenue Generated
4. Current Cumulative Profit Margin

Based on initial input fed to the system, the optimization model attempts to maximize the profit margins itself based on the revenues and cost per product style. We set the changing cell for decision variable as selling price and will set the margin profit as maximizing objective. Hence, in building a Decision Support system, we can define the decision variables based on which we can make profits for future sales.

Since the DSS will help in building a profitable model in the middle of sales of various product styles we need to setup an input system where we can record the number of products sold and their respective selling prices these can be used to analyze further sales plan and help to build a next target each week until we hit the final target 36th week for this system.

Not only the Selling prices and sold quantity we need to also keep a track of the constraints like said earlier based on the given timeframe to sell all the units in the inventory for the product styles. For future this can be a great reference for the store manager to keep a track of his incoming new products and can be used to extend his capacity to wider range of styles and analyze the profitability based on style.

Hence Adding a DSS for a non-technical person like a store manager can be of great benefits if they are provided with an optimization model like this one to maximize their profit margin.

**References**

* Practical Management Science, 4th edition, by Winston and Albright