**SCM518 Team Final Project**

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**Introduction:**

Nestled in the lively suburbs of India, "Rangrez" emerges as a beacon of sartorial elegance. As you step into the store, a kaleidoscope of colors greets you—each Casual Shirt and Formal Pant a testament to Arjun's legacy as a third-generation clothier. Despite the allure, Rangrez faces a crucial challenge in today’s competitive market. We are at a juncture where the store's future hinges on strategic optimization. The key issues we aim to address are:

a. **Inventory Accuracy**: Aligning stock levels precisely with fluctuating market demands to prevent overstock and understock scenarios.

b. **Cost Efficiency**: Crafting a cost-effective approach that minimizes expenses on inventory holding and reduces wastage.

c. **Pricing Dynamics**: Developing a pricing strategy that reflects the quality of Rangrez's offerings while enticing a cost-conscious customer base.

d. **Demand Forecasting**: Utilizing historical data to anticipate future sales trends, enabling proactive inventory management.

e. **Operational Sustainability**: Ensuring that the solutions we implement are sustainable, keeping Rangrez's operations agile and responsive to the market's pulse.

**Problem Statement:**

Rangrez is grappling with outdated inventory practices and static pricing in a dynamic market, leading to overstock, understock, and missed sales opportunities. We aim to:

* Implement a dynamic inventory management system that aligns stock levels with real-time demand.
* Develop a responsive pricing model that maximizes margins while remaining attractive to customers.
* Utilize predictive analytics to anticipate market trends and adjust inventory proactively.
* Craft strategic operations that minimize waste and cost, optimizing Rangrez's financial health.
* Ensure the store's offerings and operations reflect the evolving market, preserving Rangrez's reputation for quality and customer satisfaction.

**Details:**

The data at Arjun's disposal—a year's worth of sales and inventory records—holds the potential to revolutionize his store's operations. However, this data has yet to be stitched into the fabric of Rangrez's decision-making process.



**Approach:**

To address this challenge, Arjun plans to employ linear programming—a mathematical optimization approach. The goal is to develop an Inventory Control System that can predict the ideal stock levels for each month, aligning with customer demand while minimizing the associated costs of inventory mismanagement.

**Base Model:**

The linear programming model will take into account:

* The monthly budget for purchasing new inventory.
* The storage capacity of the store.
* Seasonal and trend-based variations in market demand.
* A balance in the offering of Casual Shirts and Formal Pants to maintain variety.

**Model Solving and Results:**

The model will be solved using the historical data, with the objective of minimizing the total cost, which includes purchase costs, holding costs, and costs associated with stockouts. The output will be the optimal order quantities for Casual Shirts and Formal Pants, along with the recommended pricing strategy to maximize the store's profitability.

**Description of the problem:**

Rangrez has been recording the demand data along with the holding cost as well as unit of purchasing for the past year. The corresponding data has been provided in the excel file attached with the project. The company has a starting budget of Rs. 50000 at the start of 1st month. On the basis of the prior 12 months data, Rangrez wants to effectively manage their inventory in such a way that they are operationally sustainable.

**Input Parameters**

**Indices:**

𝑖∈{1,2,3,…,12}: index to represent each 12 different month

𝑗∈{1,2}: index to represent shirts or pants

**Parameters:**

U𝑖𝑗: Unit cost of product 𝑗 on month 𝑖

H𝑖𝑗: Holding cost of product 𝑗 on month 𝑖

F𝑖𝑗: Forecasted demand of product 𝑗 on month 𝑖

S𝑖𝑗: Selling price of product 𝑗 on month 𝑖

S𝑖: Budget available at the start of month *I* (S1 = Rs. 50000)

E𝑖𝑗: Ending inventory of product 𝑗 on month 𝑖

**Decision Variables**

(𝑥𝑖𝑗): The integer number of purchased product 𝑗 on month 𝑖 (𝑖∈{1,2,3,…,12}, 𝑗∈{1,2})

(𝑖𝑗): The integer number of sales of product 𝑗 on month 𝑖 (𝑖∈{1,2,3,…,12}, 𝑗∈{1,2})

**Objective Function**

Maximize the total profit:

Max𝑥𝑖𝑗∑𝑖(∑𝑗(𝑖𝑗 ∗ S𝑖𝑗- 𝑥𝑖𝑗∗ U𝑖𝑗- E𝑖𝑗 ∗ H𝑖𝑗) , for 𝑖∈{1,2,3,…,12}, 𝑗∈{1,2}

**Constraints**

1.The spending in each month should be less or equal to the budget available in that month:

∑j𝑥i𝑗∗ Ui𝑗 + ∑𝑗 E𝑖𝑗 ∗ Hi𝑗 Si, for i∈{1,2,3,…,12}

2.60:40 ratio of Casual Shirts to Formal Pants in terms of units. This balance can be adjusted based on seasonal demand variations:

(Ei2 + 𝑥𝑖2) , for 𝑖∈{1,2,3,…,12}

3.The total number of sold product in each month for every category should meet or exceed the forecasted demand:

∑𝑖∑𝑗 Y𝑖𝑗 F𝑖𝑗, for 𝑖∈{1,2,3,…,12}, 𝑗∈{1,2}

4.Non-negative constraints:

𝑥𝑖𝑗 0, for 𝑖∈{1,2,3,…,12}, 𝑗∈{1,2}

𝑖𝑗 0, for 𝑖∈{1,2,3,…,12}, 𝑗∈{1,2}

5. Inventory balancing

∑𝑖∑𝑗 E*ij* = Ei-1j + Xij – Yij), 𝑖∈{1,2,3,…,12}, 𝑗∈{1,2}

6. Ending inventory should be greater than or equal to zero.

E*ij* 0, for 𝑖∈{1,2,3,…,12}, 𝑗∈{1,2}

7. Budget balancing equation

Si = Si-1 + ∑j𝑥*i-1*𝑗∗ U*i-1*𝑗 + ∑𝑗 E*𝑖-1*𝑗 ∗ H*i-1𝑗* for i∈{2,3,…,12}

**Result obtained:**

The yearly profit estimated is Rs. 95376.

**Ideas to improved the project:**

Machine Learning in Dynamic Pricing

Incorporating machine learning into Rangrez’s pricing strategy reflects a forward-thinking approach to retail management, where empirical data is leveraged to enhance decision-making processes. The dynamic pricing system meticulously compiles and analyzes historical sales data, inclusive of inventory fluctuations and previous pricing structures, while concurrently assessing the competitive pricing environment. This comprehensive analysis enables the identification of key trends and demand patterns.

Utilizing sophisticated predictive models, the system is capable of forecasting future consumer demand with a notable degree of accuracy. This facilitates the strategic calibration of product pricing, optimizing for revenue maximization and profit margin enhancement within the competitive landscape of the retail market. The agility of the system allows for real-time responsiveness to evolving market dynamics and competitor pricing strategies, ensuring that Rangrez’s offerings remain compellingly priced.

The iterative learning capabilities of the model are of particular note; it employs adaptive algorithms that refine pricing recommendations based on real-time sales data, enhancing precision over time. To validate the model’s recommendations, a phased implementation strategy is employed, which serves to empirically test the efficacy of the system’s pricing suggestions against actual sales performance. This careful, data-informed approach mitigates risk and bolsters confidence in the system’s output.

A centralized dashboard interface provides a visualization of the insights generated by the system, granting stakeholders the ability to oversee and intervene in the pricing process as needed. The result of implementing such a dynamic pricing tool is a robust, data-driven strategy that not only augments Rangrez’s immediate financial performance but also strengthens its strategic market positioning. This methodical integration of analytical rigor with pragmatic retail strategy ensures that Rangrez can navigate the complexities of market conditions while sustaining the intrinsic value proposition of its product offerings.