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For more information, contact
MIT Global SCALE Network

Postal Address:
Massachusetts Institute of Technology 77
Massachusetts Avenue, Cambridge, MA 02139 (USA)

Location:
Building E40, Room 267
1 Amherst St.

Access:
Tel: +1 617-253-5320
Fax: +1 617-253-4560

Email: scale@mit.edu
Website: scale.mit.edu

Demand Management for Substitute Products Based on Inventory Levels
Eleni-Serafeimia Tsana

MIT Global Scale Network
For Full Thesis Version Please Contact:
Marta Romero
ZLOG Director
Zaragoza Logistics Center (ZLC) Edificio
Náyade 5, C/Bari 55 – PLAZA 50197
Zaragoza, SPAIN
Email: mromero@zlc.edu.es
Telephone: +34 976 077 605
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EXECUTIVE SUMMARY

For the past two decades, the business environment has allowed the penetration of Demand Management practices in different areas and under various guises, starting from the airline industry under the name of Yield Management. The common denominator of all such policies is the dynamic pricing of the same product or service over time, with the goal of minimizing costs and/or maximizing profits. The differentiators are the goals, the means, and of course, the industry. Indeed, business opportunities encourage the interest in this field, because of two major tendencies:

- **Customer demand** is satisfied by a handful of giant firms (e.g., Procter and Gamble, Wal-Mart, Amazon, etc.) that offer slightly differentiated product brands that belong to the same (product) class, namely substitute products.

- **Pricing changes** are facilitated through the introduction and expansion of direct sales channels (the Internet), and in general, the automation of such processes through coherent information systems.

The question that this thesis examined is how two substitute products can be priced dynamically in order to drive demand away from one of them to its substitute, and subsequently, to minimize the inventory-related costs of both. Two models are developed and compared in this thesis. The first is the traditional policy \((s,S)\) where, for both products, at the reorder point, an order is placed. In the second policy \((s,S,p)\), pricing and inventory decisions are made simultaneously, and at the reorder point, an order is placed and the option of increasing the product’s price and to what percentage is examined.

The results of the research show that the traditional policy performs better in all scenarios examined. The percentage difference in the total costs between the two policies is from 14% to 1%, with an average of 5.5%. Summarizing the results reveals the following observations:

- The price-changing policy performed slightly worse, and it was seen as having the traditional policy as an upper bound, with the best results consisting of the narrowest gap between the two policies.

- The percent change remained the lower bound specified, implying a resistance from the model towards the price changes.
• Backorder costs and lead time had a great effect on the results, which implies that this was the heart of the problem. We concluded that, under the present structure of the model, the change in the price and the consequent shift in demand destabilizes the performance of the product towards which the demand is shifted. Higher backorder costs and lead times act in a multiplying way.

The following improvements in the model were identified:

• Relax the assumption of the present model of constant revenues before and after the price adjustments, and set the maximization of profits as the objective.

• Consider different numbers for the cross elasticities, in order to categorize products and provide an even more realistic model.

• Improve the condition under which the switching in prices occurs in order to avoid the destabilization of the inventory of the product towards which demand is shifted after each price adjustment.

• Choose continuous instead of discrete values for the percentage change of the price. Experiments not mentioned in the present thesis implied lower resulting costs for continuous values.

Problems or issues to which this model can also be applied and expanded are the following:

• **Substitutable locations**: This thesis examined the option of two substitute products in the same location. Similarly, the possibility of the same product available in two substitute locations could be examined. The price adjustment under this policy will be intended to drive demand away from one location and towards another.

• **Families of products**: Very often two families of products are substituted instead of two products. For example, washing powder and washing liquid are substitute products. Yet, one company might have more than one brand of washing powder and liquid. Numerous combinations could be generated from such a policy, possibly better manipulating inventories by matching the different consumer preferences more efficiently.

Even though the results gathered from the present research were not those expected, they contributed to various observations and insightful approaches that might lead to significant improvement in future results. The path of research towards improvement and ultimately, advancement of knowledge is neither straightforward nor painless. Continuing scientific inquiry, however, will yield its own rewards.