Optimization and Markdown Management: Exploring Best Practices to Drive Better Decisions

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EXECUTIVE OVERVIEW

In today's complex retail environment, managers are faced with thousands of daily decisions—and they must rely on a myriad of processes and conflicting data to make those decisions. Some of these decisions are small and routine, but they are so frequent that they can add up to significant financial consequences. Other decisions are occasional, but the choices made can have even greater financial impact. For example, do any of these types of decisions sound familiar?

- Do you move that flat screen into clearance this week, or wait another week?
- Should you add a $24 tee to the assortment?
- For the first time, a hypermart announces plans to open a new store a block away from one of your auto parts stores. How do you respond in terms of assortment and pricing?
- It is 12 weeks before Christmas. How should you reallocate your inventory investments?
- By how much should prices differ for blind grocery items between your suburban and downtown stores?

No one would dispute that managers making these decisions should base their choices on factual information. But there are significant challenges in acquiring relevant factual data and understanding how that information bears on the decisions at hand. Because these types of decisions are typically forward-looking, an additional challenge is projecting today's information as far into the future as is relevant.

TECHNOLOGY TO SUPPORT DECISION-MAKING

Technology can play a variety of roles in supporting managers' decision-making processes. One role is facilitating collaboration. Many decisions ought to be made on the basis of information that is held by different owners in the processes. For example, determining which items to promote on the weekly circular may require knowledge of the lifecycle plans of candidate items, advertising schedules, overall thematic elements, and any vendor support that is available.

Another role that technology can play is supporting analysis. Many decisions require assembling different facts in order to draw comparisons, derive metrics, and understand relationships. For example, decisions regarding space allocation within a class of merchandise may require fairly precise information regarding sales growth trends by geography.

Yet another technology capability that is in increasing demand is to recommend specific actions based on the optimization of mathematical models of the decision problem. The decision problem is reduced to a precise model, and various solution methods are applied to identify the best action to take. For example, deciding the cadence and depth of discounts across all stores, in order to clear a specific item, can be supported by forecasting the rate of sale in each store for any allowable discount, and using an optimization model to pick the best discounts for each item by store and week.

Academics who have studied the 35-year evolution of decision support systems (DSS), have offered a classification scheme for such tools.[1] In this scheme, a DSS that facilitates collaboration is labeled communication-driven DSS. It is described as "an interactive system intended to facilitate the solution of problems by decision-makers working together as a group." A DSS that supports analysis is labeled data-driven DSS, and is characterized as providing "access to and manipulation of large databases of structured data…especially a time-series of internal company data and sometimes external data." Finally, an optimization DSS is labeled model-driven DSS, and this DSS is important because its "statistical and analytic tools…data and parameters…aid [decision-makers] in analyzing a situation."

What is noteworthy in these studies is that there is no preferred status accorded to optimization. It is just one of several means of providing technology-enabled decision support to managers.

OPTIMIZATION

Merriam-Webster defines optimization as "the mathematical procedures involved in the act, process or methodology of making something as fully perfect, or effective as possible."

This definition makes clear the appeal of optimization to a retailer. Using scientific or mathematical procedures to arrive at the perfect or most effective decision offers the possibility of dramatically improving performance. In practice, optimization has come to mean packaged software applications that postulate a model of consumer demand, estimate various parameters that govern the behavior of the demand model for each specific instance (say, an item in a location), and then apply a mathematical technique to determine the best value for variables under management control. Techniques can include linear and nonlinear programming, dynamic programming, and Monte Carlo simulation.

But it is also possible to find the best or most effective alternative without using complex mathematical procedures. This may be done in practice by combining

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[1] **D.J Power "Supporting Decision-Makers: An Expanded Framework," www.DSSResources.com.**

facts, perhaps supplied by a data-driven type DSS, and expert judgment, perhaps supported by a communication-driven DSS, to arrive at the optimum decision.

MATHEMATICAL OPTIMIZATION VERSUS ALTERNATIVE DECISION SUPPORT TOOLS

The strengths of mathematical optimization include the ability to consistently evaluate far more alternatives than a human can, and the faculty to highlight and account for the complex trade-offs that are inherent in many decisions. It also provides the decision-maker access to thousands of human-years of academic research and development spent in the service of making better decisions.

Especially when the decision to be made is repeated many times and across many locations, such applications provide an effective means to support the decision-making process. The optimization can provide finely textured decisions, reflecting differences across individual cases that could never be realized without automated analysis.

When mathematical optimization is implemented in software technology, its greatest weaknesses are that it requires the decision problem to be highly structured and the relationships among moving parts in the problem must be quantified. When these variables are difficult—or controversial for the business to define and quantify—a less structured approach to decision support is preferable.

Examples of retailers' decision problems that are well suited to the mathematical optimization approach include:

- Transportation planning—to assign shipments to resources (modes, carriers, own trucks, and so on) to minimize transportation costs and maximize availability of merchandise where and when demand is realized.
- Replenishment strategies—to choose from a finite set of replenishment strategies or rules to minimize inventory investment while maximizing the stores ability to match demand with available merchandise (such as service level).
- Clearance pricing—to choose markdown prices in order to liquidate the inventory of "end of life" merchandise while minimizing the margin reductions (markdown cost).

Examples of retailer decisions that are less well-suited to the mathematical optimization approach include:

- Pricing strategy (EDLP versus HiLo)—to choose the strategy that best exploits the retailer's assets, competencies, and consumer perceptions. Each strategy (or combination) has broad-ranging and deeply interconnected implications for inter alia, supply chain management, procurement, pricing and promotions, communications, and employee training.
- Changing Locations or Channels—to increase sales (or reduce costs) by moving into new (or out of existing) markets.

Any such change has complex operational implications and costs, as well as implications for customer service, cannibalization, and competitive response.

Then there are other decision problems where mathematical optimization may be valuable, but where there are multiple objectives, or constraints and trade-offs that are difficult to make explicit or quantify. For these decision problems, the optimization approach may be employed, but it is important to understand its limitations and couple it with other decision-support methods. These include:

- Maintaining shelf or regular prices—to change shelf prices in response to marketplace or internal (cost, assortment) changes, so that the shelf prices maximize profitability without violating business rules (price endings, frequency of changes) or strategic considerations (price image, price relationships amongst brands).
- Promotions planning—to choose which items to promote when and what tactics to employ in the promotions. Considerations include cannibalization and halo effects on nonpromoted items, trade-offs between traffic and profit objectives, potential vendor support, and fit within annual promotions calendars, inventory, and stocking.

CONCLUSION

Mathematical optimization is a powerful and valuable method for supporting some decisions. However, the temptation to apply optimization methods to unstructured and only marginally quantifiable decisions should be resisted. Optimization should be viewed as one of several means to reach the end of high-quality decision-making.

Optimization-based decision support is a key weapon in a retailer’s arsenal. Oracle Retail solutions include optimization-based tools for choosing replenishment strategies, and for setting clearance price trajectories. Oracle has extensive experience in regular price optimization and assortment optimization. This experience provides knowledge about both the power and limitations of using optimization to support these decisions. We have found that, for all retail decision support, the key to success is a deep knowledge of the retailing business coupled with a clear-eyed appraisal of the strengths and weaknesses of optimization as one of many available tools.

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