Industrial and Systems Engineering Seminar

When Data Analytics Meets Promotion Planning

Wednesday, April 29

3:15 PM – Refreshments before the Seminar

3:30 PM – Graduate Seminar

Mechanical Engineering Room 4125 A & B

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In many important settings, promotions are a key instrument for driving sales and profits. Important examples include promotions in grocery retail among others. The Promotion Optimization Problem (POP) is a challenging problem as the retailer needs to decide which products to promote, what is the depth of price discounts, when to schedule the promotions and how to promote the product. In this talk we discuss our ongoing collaboration over the past few years with Oracle RGBU where we introduce and discuss how optimization can play a key role in determining promotion planning and capture several important business requirements for grocery retail.

An important consumer behavior that is a direct consequence of promotions in grocery retail is that consumers stockpile the products on promotion and then experience promotion fatigue after the promotion ends. Therefore, as a first step, we propose and study two general classes of demand functions that capture this effect and can be directly estimated from data. Using these demand functions, we model and study the promotion planning problem. Unfortunately, the underlying formulation even for a single product is NP-hard and highly nonlinear (with neither a concave nor a convex objective). We propose a linear approximation and by showing the integrality of the feasible region in the formulation, we are able to solve the problem efficiently as a linear programming (LP) problem. For the classes of demand we introduce, we develop analytical bounds on the accuracy of the LP relative to the optimal (but intractable) POP solution. We also consider a graphical representation of the problem which allows us to employ a Dynamic Programming (DP) solution approach as an alternative. We discuss the tradeoffs between the two approaches (LP vs DP).

Together with our industry collaborators from Oracle Retail, our framework allows us to develop a tool which can help supermarket managers to better understand promotions by testing various strategies and business constraints. We show that the formulation we propose solves fast in practice using actual data from a grocery retailer and that the accuracy is high. We calibrate our models using actual data and determine that they can improve profits by 3% just by optimizing the promotion schedule and up to 5% by slightly modifying some business requirements.

Joint work with Lennart Baardman (ORC PhD student), Maxime Cohen, (ORC PhD student), Swati Gupta (ORC PhD student), Jeremy Kalas (EECS Undergraduate), Zachary Leung (recently graduated ORC PhD student), Danny Segev (Visiting Scholar ORC/MIT Sloan from U. Haifa) as well as Kiran Panchamgam (Oracle RGBU) and Anthony Smith (formerly from Oracle RGBU)

BIO: http://mitsloan.mit.edu/faculty/detail.php?in_spseqno=41137