The Analytics of Promotions: Pricing and Vehicle Planning

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

Promotions are a key instrument for driving sales and profits. Important examples include promotions for grocery retailers 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 what vehicle to use to promote each product. This presentation will reflect our ongoing collaboration over the past few years with Oracle RGBU.

An important consumer behavior we will incorporate and which 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. Unfortunately, the underlying optimization formulation even for a single product is NP-hard and highly nonlinear. We will first propose a linear approximation and show how to solve the problem efficiently as a linear programming (LP) problem. We will discuss analytical bounds on the accuracy of this LP approximation relative to exact problem solution. We will also consider a graphical representation of the problem which will allow us to employ a Dynamic Programming (DP) solution approach as an alternative. We will discuss the tradeoffs between the two approaches (LP vs DP).

Apart from the pricing aspect, we will consider how to decide which vehicle to use each time in order to promote which product. We will introduce greedy and integer optimization ideas in order to solve the vehicle selection problem in a tractable way. These methods are computationally efficient and hence easy to use in practice. We will also discuss some performance guarantees for these methods.

Together with our industry collaborators from Oracle Retail, we show that our models run fast in practice using actual data from grocery retailers and that the accuracy is high. We determine that they can improve profits by 3% just by optimizing the promotion schedule and up to 5% by slightly modifying some business requirements.

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BIO

Georgia Perakis is the William F. Pounds Professor at the Sloan School of Management at MIT since 1998. She received an M.S. degree and a PhD in Applied Mathematics from Brown University and a BA from the University of Athens in Greece.

Perakis' research studies the role of operations in many areas such as pricing, supply chain management, energy and transportation applications among others. She has widely published in journals such as Operations Research, Management Science, POM, Mathematics of Operations Research and Mathematical Programming among others. She has received the CAREER award from the National Science Foundation and subsequently, the PECASE award from the office of the President on Science and Technology awarded to the 50 top scientists and engineers in the nation. In 2007 she received an honorable mention in the TSL Best Paper Award, she also received the second prize in 2011, the first prize in 2012 and in 2014 in the Best Paper competition of the Informs Service Science Section for some of her papers. In 2015, she received the Best Application of Theory Award from NEDSI (Northeast Decision Sciences Institute) Conference. She also received the Graduate Student Council Teaching Award as well as the Jamieson Prize for excellence in teaching and the Samuel M. Seegal prize for “inspiring students to pursue and achieve excellence”. Perakis was the recipient of the Sloan Career Development Chair and subsequently of the J. Spencer Standish Career Development Chair. In 2009, Perakis received the William F. Pounds chair that she currently holds. Her pricing work was a Finalist at the Practice Award of the Revenue Management and Pricing Section of INFORMS in 2015. Perakis has passion supervising her students and builds lifelong
relationships with them. So far she has graduated seventeen PhD and thirty Masters students.

Perakis has served as the co-director from the MIT Sloan School side for the Leaders for Global Operations (former LFM) program. She is currently the group head of the Operations Management Group at MIT Sloan. She serves as an Associate Editor for the journals Management Science, Operations Research and Naval Logistics Research and a senior editor for POM. Perakis has served as a member of the INFORMS Council. She has also served as the chair of the Pricing and Revenue Management Section of INFORMS and in 2009-2010 as the VP for Meetings of the MSOM Society of INFORMS. She has co-organized the MSOM 2009 conference and served in the organizing committee of the 2010 MSOM conference. She has also been the co-chair and co-organizer of the Annual Conference of the INFORMS Section on Pricing and Revenue Management for several years and the chair of the cluster on the same topics for the annual INFORMS and ISMP conferences for several years.