FORESIGHT

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Forecasting at Scale:

Lessons from the Target Corporation

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"Knowledge of truth is always more than theoretical and intellectual. It is the product of activity as well as its cause. Scholarly reflection therefore must grow out of real problems, and not be the mere invention of professional scholars."

JOHN DEWEY, UNIVERSITY OF VERMONT

introduction

Forecasting at Scale is a *Foresight* Guidebook exploring the demands on a forecasting system that arise in large, complex organizations. It presents a case study of how one organization—the Target Corporation—committed to fulfilling these demands by providing nearly one billion forecasts per week to a multifunctional group of users and decision makers.

The requirements of the forecasting system were complex and sweeping:

- Create and sustain the infrastructure for hosting the system's software, processing the data, communicating between system components, and generating the forecasts.
- Develop a forecast modeling approach that balances considerations of accuracy, implementation cost, and explainability.
- Provide point forecasts and measures of uncertainty for 1 to 52 weeks ahead at each hierarchical level, down to item by store.
- Account for the impacts of dozens of drivers of product sales, including promotions and market and product characteristics.
- Accommodate the "big data" domain. "To calibrate our statistical models using sales histories of suitable length—4 years, say, for each product, each history containing over 30 predictors (or 'features')—and 52 weeks of forward indicators (promotional plans and the like) to prepare the forecasts implies an input data size around 20 terabytes for the full product line."

The Guidebook's chapters explain and illustrate the processes and models Target created to meet these imposing demands, along with an outside commentary and response.

Chapter 1 describes the interplay of challenges in statistical modeling, software engineering, and business practice, and explains how the team surmounted obstacles in these three fields of knowledge. The chapter details Target's 4-step process of data collection, cluster formation, model estimation, and forecast delivery.

Chapter 2 recounts the management and organizational lessons learned in the process of developing and implementing the demand-forecasting engine. The chapter emphasizes the methodological possibilities for other companies embarking on a large-scale forecasting project, describing a problem encountered and suggesting a solution based on the team's experience in solving it.

Chapter 3 discusses the challenges faced in deploying the forecasting system for users across the company. It was deemed necessary that users be able to obtain an understandable description of how any particular statistical forecast was derived, which sales drivers figured into the calculation of a forecast, and the effect each driver had on the result, thus enabling them to decide if any influences were omitted. With deployment so complex and tedious, the company tried to automate as much as possible, allowing for human participation to appraise model test results.

Chapter Four features a commentary by **Simon Clarke** on the Target Corporation's accomplishments in implementing their forecasting system. Clarke—formerly Group Forecasting Director at Coca-Cola—emphasizes that "It's the Soft Problems that Are Hard to Overcome," such as achieving organizational support and obtaining a clear brief on what is required of the solution. Clarke observes that these are difficult to solve because they involve people with their internalized biases and preferences, and he fears that without fundamental adaptations they could be a brake on the development of the system. Achieving effective collaboration is critical. Then in **Chapter Five** members of the Target team take the opportunity to respond to Clarke's observations.

The Guidebook concludes with bios of the authors and an interview with **Dr. Phillip Yelland**, who led the forecasting project at Target.