

**NYU Stern School of Business**  
**Department of Information, Operations & Management Sciences**  
IOMS Colloquium Series

**TOPIC:** From Predictive to Prescriptive Analytics

**SPEAKER:** Dimitris Bertsimas (MIT)

**DATE:** Wednesday, March 27, 2015

**TIME:** 12:30 PM – 1:45PM (Lunch served at 12:15 pm)

**PLACE:** KMC 3-110

**ABSTRACT**

Operations Research and Management Science (OR/MS) as a field typically starts with models (optimization or stochastic) and aims to obtain decisions. Data by enlarge is rarely present. Machine learning (ML) as a field typically starts with data and aims to make predictions. Decisions are really addressed.

In this work, we combine ideas from ML and OR/MS in developing a framework, along with specific methods, for using data to prescribe optimal decisions in OR/MS problems. In a departure from other work on data-driven optimization and reflecting our practical experience with the data available in applications of OR/MS, we consider data consisting, not only of observations of quantities with direct effect on costs/revenues, such as demand or returns, but predominantly of observations of associated auxiliary quantities. The main problem of interest is a conditional stochastic optimization problem, given imperfect observations, where the joint probability distributions that specify the problem are unknown.

We demonstrate that our proposed solution methods, which are inspired by ML methods such as local regression (LOESS), classification and regression trees (CART), and random forests (RF), are generally applicable to a wide range of decision problems. We prove that they are computationally tractable and asymptotically optimal under mild conditions even when data is not independent and identically distributed (iid) and even for censored observations.

As an analogue to the coefficient of determination  $R^2$ , we develop a metric  $\rho$  termed the coefficient of prescriptiveness to measure the prescriptive content of data and the efficacy of a policy from an operations perspective.

To demonstrate the power of our approach in a real-world setting we study an inventory management problem faced by the distribution arm of an international media conglomerate, which ships an average of 1 billion units per year. We leverage both internal data and public online data harvested from IMDb, Rotten Tomatoes, and Google to prescribe operational decisions that outperform baseline measures. Specifically, the data we collect, leveraged by our methods, accounts for an 88% improvement as measured by our coefficient of prescriptiveness. Joint work with Nathan Kallus, MIT.