Operations Research

Publication details, including instructions for authors and subscription information:
http://pubsonline.informs.org

In This Issue

To cite this article:
(2016) In This Issue. Operations Research 64(1):ii-iv. https://doi.org/10.1287/opre.2015.1475

OPERATIONS RESEARCH
Vol. 64, No. 1, January–February 2016, pp. ii–iv
ISSN 0030-364X (print) | ISSN 1526-5463 (online)

http://dx.doi.org/10.1287/opre.2015.1475

In This Issue

Linear Regression: From Art to Science

Linear regression models are widely used in Physical and Social Sciences, Engineering and Medicine and are traditionally built through trial and error in order to balance many competing goals such as predictive power, interpretability, significance, robustness to error in data, and sparsity, among others. In "An Algorithmic Approach to Linear Regression," D. Bertsimas and A. King propose an algorithmic approach to build linear regression models based on mixed integer quadratic optimization. While continuous optimization models are widely used in Statistics, discrete optimization models are considered intractable. However, in the period 1991-2015, algorithmic advances in integer optimization combined with hardware improvements have resulted in an astonishing 450 billion factor speedup in solving mixed integer optimization problems. The paper demonstrates that it is possible to automatically design high-quality linear regression models that explicitly address various competing objectives and that the belief that discrete optimization is intractable for statistics needs to be reconsidered.

Pricing in Markets with Non-Convex Costs

Pricing in markets with non-convexities is a challenging interdisciplinary problem which has attracted renewed interest in the context of deregulated electricity markets. In contemporary power pools, generators bid their non-convex costs to a market operator who determines the optimal allocation and price. Under classical marginal-cost pricing, these non-convexities may result in losses for some generators. To address this problem, various pricing schemes have been proposed, but the connection between them has not been thoroughly studied. In "Critical Review of Pricing Schemes in Markets with Non-Convex Costs," G. Liberopoulos and P. Andrianesis review several schemes, also proposing a new variant, in a two-supplier setting. They derive closed-form expressions for the price and profits that each scheme generates and use them to evaluate and compare the schemes. They extend some of their analytical results to more than two suppliers and discuss extant numerical comparisons. They also present known results on the potential for strategic bidding behavior in the context of the considered schemes.

Dynamic Robust Optimization for Large-Scale Power System Operations with Renewable Energy

The reliable, economic, and sustainable operation of electric power systems provides the backbone of the modern society. Today power systems worldwide are experiencing fundamental changes. A transforming force is the rapid adoption of renewable energy. To operate the system with a significant amount of uncertain power supply, the electric industry is in urgent search for a new generation of methodology. Together with a leading power company in the world, the ISO New England, A. Sun and A. Lorca developed a dynamic robust optimization model and a novel algorithmic framework for the Unit Commitment problem in "Multistage Adaptive Robust Optimization for the Unit Commitment Problem." The proposed robust model with affine policy performs extremely well on a large-scale real-world system of 2736 buses under deep wind penetration. This work provides, for the first time, a practical and effective operating methodology that significantly improves the current industry practice.

Designing Feed-In-Tariff policies

Feed-In-Tariff (FIT) policies are widely used around the world as a subsidy mechanism to stimulate the promotion of renewable energy. These programs offer long-term guaranteed purchase agreements to green power producers to sell their electricity into the grid. Policies such as these, however, are not always successful and are sometimes too expensive for the taxpayers. Indeed, the efficiency of this policy critically depends on how the feed-in-tariffs are adjusted over time in order to account for intricate and dynamic market responses. This issue, however, is poorly understood. In "Efficient Feed-In-Tariff Policies for Renewable Energy Technologies," S. Alizamir, F. de Véricourt, and P. Sun follow an analytical approach to address this problem and offers theoretical guidelines on how to design FIT programs. Overall, the analysis reveals how the different characteristics of the market under consideration determine the evolution of FITs over time.

What Can Be Learned by Observing Consumers That are Concerned About Privacy?

Classical revealed preference theory provides insight into what can be inferred from observations of choices made by consumers. How does this theory change if the consumers are concerned about privacy? In "The Empirical Implications of Privacy-Aware Choice," R. Cummings, F. Echenique, and A. Wierman show that if a consumer is concerned about privacy and aware that choices are being observed, it is nearly impossible for an observer to make strong conclusions about consumer preferences without the presence of very strong parametric models for preferences over privacy. The results highlight a possible explanation for why entities like NSA, Google, etc. dislike openly discussing the fact that they are monitoring consumers. One could explain such a desire by political issues or because of public image concerns, but the results in this paper point to another reason: the usefulness of the observations degrade considerably if consumers know they are being observed.

Modeling Choices by Informed Consumers

In "The Exponomial Choice Model: A New Alternative for Assortment and Price Optimization," A. Alptekinoğlu and J. Semple investigate a canonical discrete choice model that is appropriate in situations where consumers exhibit a strong aversion to paying

more than some commonly known pivotal price (e.g., MSRP, invoice price, historical price). This choice model has good structure and permits the choice probabilities to be expressed in closed form. Determining optimal prices for products in an assortment as well as determining revenue-maximizing assortments are both tractable problems. Moreover, fitting the choice model to real data is straightforward given the structure (logconcavity) of the likelihood function. The model performed well during preliminary tests on household panel data for 25 categories of grocery products.

The Positive Side of Inventory Constraints in Salesforce Compensation

Can constraints have a positive side? In "Impact of Inventory on Quota-Bonus Contracts with Rent Sharing," T. Dai and K. Jerath show: Yes, in the case of salesforce compensation, which costs U.S. businesses over $200 billion annually. A popular way to compensate salesforces is to pay a bonus for achieving a sales quota. Prior literature, however, established that under rent sharing with the salesperson, such a quota-bonus contract will not sustain in equilibrium for demand distributions satisfying the increasing-failure-rate property (which includes most well-known distributions) because the firm sets an unattainable quota. Dai and Jerath prove that the presence of inventory constraints can, seemingly paradoxically, be "de-constraining" in the sense that they force the firm to choose a quota equal to the inventory level, which is achievable by the salesperson. This contract has a simple structure—the salesperson is paid a fixed salary and a bonus on clearing inventory stocked, otherwise not.

The Principal Eigenfunction Governs Long-Term Pricing

In markets free of arbitrage, the pricing relationship assigning today's prices to uncertain future payoffs is a linear operator that discounts the future, compensates for risk and takes the expectation conditional on the current information. If all economic uncertainty is generated by a Markov process, the pricing operators indexed by time between the present and the future payoff form a semigroup. In "Positive Eigenfunctions of Markovian Pricing Operators: Hansen-Scheinkman Factorization, Ross Recovery, and Long Term Pricing," L. Qin and V. Linetsky prove uniqueness of a positive eigenfunction of the pricing semigroup when the underlying Markov process is recurrent and give sufficient conditions for its existence. The positive eigenfunction is instrumental in investigating the long term risk-return trade-off and expressing the long term pricing relationship in the economy. As an application, the paper extends the Recovery Theorem of Ross from discrete time, finite state Markov chains to general recurrent Markov processes.

To Markdown or Not to Markdown

While markdown sales of perishable products generate revenue for the otherwise disposed goods, they may stimulate consumers' strategic purchasing behavior and cannibalize sales of the products at full price. In "Joint Inventory and Markdown Management for Perishable Goods with Strategic Consumer Behavior," P. Hu, S. Shum, and M. Yu formulate and analyze a novel model on a firm's dynamic inventory and markdown decisions for perishable goods. They show that the firm should either put all of the leftover inventory on discount or dispose all of it, and the choice depends on the amount of leftover inventory. In particular, the firm should introduce markdown when the amount of leftover inventory is higher than a certain threshold, and dispose all otherwise.

Sequential Multiproduct Price Comzetition in Supply Chain Networks

In supply chain networks of an industry, firms at all echelons often compete on prices as well as the offered product assortment. In "Sequential Multi-Product Price Competition in Supply Chain Networks," A. Federgruen and M. Hu characterize the industry's (subgame perfect) equilibrium choices under a general multi-echelon multi-product sequential oligopoly model. The model assumes a general set of piece-wise linear consumer demand functions for all products (potentially) brought to the consumer market; consumers' preferences over the various supplier/retailer combinations are general and asymmetric. The cost rates incurred by the firms at the most upstream echelon are general as well. They show how all equilibrium performance measures can be computed via a simple recursive scheme. Moreover, they establish how changes in the structure of the supply chain network (such as the elimination of intermediate echelons), or changes in the model parameters (in particular, exogenous cost rates, or intercept values in the demand functions), impact on the system-wide equilibrium. Additional managerial questions that may be assessed by their model include: entry or exit of firms, new direct sales channels, vertical integration and mergers and spinoffs.

Cyclic Pricing Induced by Gain-Seeking Demands

In a market with repeated interactions between consumers and product, demand of the product depends on not only its current price but also its past prices through reference price, a price expectation formed by consumers to judge against the current selling price. In "Dynamic Pricing with Gain-Seeking Reference Price Effects," Z. Hu, X. Chen, and P. Hu study a single product dynamic pricing model in which a monopolist faces gain-seeking demands, i.e., the demand is more sensitive to price reduction (gain) than to price increase (loss) relative to reference price. They illustrate that the gain-seeking behavior leads to complicated price dynamics, and provide conditions to ensure the optimality of a cyclic skimming pricing strategy, a strategy of repeatedly discounting the regular price over time, and in particular its special case-the commonly referred to high-low pricing strategy.

Network Choice Revenue Management

Under a general discrete choice model of demand, S. Kunnumkal and K. Talluri study approximations to the (intractable) network revenue management dynamic program in "A Note on Relaxations of the choice network revenue management dynamic program." They show that the NP-hard affine relaxation, which is a better approximation to the dynamic program, is very close to the deterministic linear program; and the tighter piecewise-linear relaxation is bounded by a factor of two from the linear program.

Inventory Planning under Demand Ambiguity

Demand unpredictability is a major challenge in sales and operations planning. A common paradigm in the operations literature is to assume the decision maker has full information about the demand distribution. This is a strong assumption and often fails to hold in practice. An alternative pure data-driven paradigm endows the decision maker only with demand observations. Reality often lies between these two paradigms. Firms devote significant efforts to characterizing demand before a new product is launched and observe a time series of demands after launch. How should they choose

appropriate stocking quantities over time? In "The Newsvendor under Demand Ambiguity: Combining Data with Moment and Tail Information," S. Saghafian and B. Tomlin consider a repeated newsvendor problem under demand ambiguity. The paper develops a dynamic maximum-entropy based approach that generalizes Bayesian updating. The approach has many desirable properties including robustness to the newsvendor quantile, quick distributional change detection, and a rapidly diminishing "cost of ambiguity".

Routing Optimization under Uncertainty

In solving vehicle routing problems, the presence of uncertainty in the networks is a critical issue to consider explicitly if one hopes to provide solutions of practical value to the end users. In "Routing Optimization under Uncertainty," P. Jaillet, J. Qi, and M. Sim propose a general framework for routing optimization problems where the objective is to obtain optimal solutions that would, as much as possible, adhere to a set of specified requirements. One example is meeting soft time window requirements when travel time is uncertain. They propose a decision criterion to quantify the risk associated with the violation of requirements. The criterion can handle instances when probability distributions are known, and ambiguity, when distributions are partially characterized through descriptive statistics. They develop practically efficient algorithms involving Benders decomposition to find the exact optimal routing solution and provide computational studies to show the attractive performance.

Designing Optimal Road Profiles

Earthwork is a significant cost in any civil infrastructure project. Minimizing these costs is particularly important in the context of transport alignments and leads to challenging problems. For example the design of road profiles, subject to safety and drainage constraints, and the minimization of the resulting construction costs results in a nonsmooth optimization problem. In "Stadium Norm and Douglas-Rachford Splitting: A New Approach to Road Design Optimization," H. Bauschke, V. Koch, and H. Phan present a novel approach to this problem based on the Douglas-Rachford splitting algorithm. Their analysis includes new proximal mappings related to minimizing area. The resulting method has explicit steps and is easily implemented. Fast approximation schemes are also considered. The authors' numerical experiments illustrate significant construction cost savings for the amount of earth work and the final cut-and-fill balance when compared to state-of-the-art projection methods.

Assortment Planning under Dynamic Substitution and Stochastic Demand

Assortment planning is one of the key strategic and operational questions in many industries (e.g., retailing, online services and airlines). The goal is to choose the subset of products (or services) offered to customers to maximize revenue (profit), considering the heterogeneous preferences of customers. In "Near-Optimal Algorithms for Assortment Planning Problem under Dynamic Substitution and Stochastic Demand," V. Goyal, R. Levi, and D. Segev consider an operational variant of the problem, where the inventory level of each product is determined in the presence of capacity constraint on the total amount of inventory. Customers arrive in stochastic manner and exhibit dynamic substitution behavior in that they purchase their most preferred product among those available upon arrival. The authors provide complexity and algorithmic results as well as insightful structural characterizations of near-optimal algorithms for important variants of the problem. Quite interestingly, they show that for these special variants sparse assortments can obtain near-maximal expected revenue.

How to Compute Marginal Values for Nonparametric Production Frontiers?

Data envelopment analysis (DEA) is an established nonparametric methodology for the assessment of efficiency of organisations. In its applications it is often desirable to evaluate various marginal values on the production frontier. Typical examples include marginal rates of substitution and transformation, scale elasticity and a related notion of returns to scale. Because DEA methodology does not produce an explicit production frontier, the assessment of these marginal values may generally be a challenging problem. In the literature, this has been addressed only for a few conventional DEA models. In "Marginal Values and Returns to Scale for Nonparametric Production Frontiers," V. Podinovski, R. Chambers, K. Atici, and I. Deineko develop a unifying general approach for the evaluation of various marginal values in a very large class of technologies. This removes the need to develop individual methods for different types of production frontiers.

A New Preannounced Pricing Policy to Deal with Strategic Pricing Behavior

In "Contingent Preannounced Pricing Policies with Strategic Consumers," J. Correa, R. Montoya, and C. Thraves propose a new pricing scheme to address strategic behavior. The policy offers to consumers a price menu contingent on the available inventory at clearance period. Strategic consumers observe this preannounced menu and decide based on their valuations towards the product. To solve the problem, the authors use a novel approach based on ordinary differential equations. The results show that the proposed contingent policy outperforms previously proposed pricing schemes under certain conditions. The source of the improvement comes from the use of the proposed pricing policy as a barrier to discourage strategic waiting and as a discrimination tool for those customers waiting.