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Choosing the Right Assortment Can Increase Profits by 50%

Assortment optimization is both extremely important and challenging for retailers. Although there is an abundance of theoretical work on this topic, there is little work that provides empirical information about how assortment planning works in practice and how to estimate parameters for these models. In "Demand Estimation and Assortment Optimization Under Substitution: Methodology and Application," A. G. Kök and M. L. Fisher provide a description of a real assortment planning problem together with real data, an approach for estimating parameters of the model, and a workable algorithm run on the data to demonstrate its effectiveness. They describe the details of their implementation at a large retailer and show that the financial benefits of the recommended solution can be significant.

Internal Pricing Mechanisms for Intermodal Logistics

Hub Group is one of the nation's leading intermodal logistics companies. To maximize profits, they manage their fleet of shipping containers using internal prices that value them based on location and congestion. Their control mechanism is conceptually simple: if the reward for sending a container across a shipping lane exceeds the current internal price for doing so, then the dispatcher instantiates the transaction. In "Price-Directed Control of a Closed Logistics Queueing Network," D. Adelman devises a rigorous methodology for computing these internal prices from Lagrange multipliers of a nonlinear program that captures network flows, queueing effects, and stockouts. He uses these multipliers to construct a tractable value function approximation for the underlying stochastic, dynamic program. Such internal pricing mechanisms have applications in other operational settings, as do the methods used to derive the underlying nonlinear program.

The Impact of Current Prices on Past and Future Demand

In many markets, consumers make purchasing decisions based not only on prices in the period in which they enter the market, but also on past and future prices. In spite of this, most operations research models that have considered the impact of coordinating pricing and manufacturing decisions have assumed that the pricing decision in a particular time period only affects demand in that period. In "Pricing and Manufacturing Decisions When Demand Is a Function of Prices in Multiple Periods," H. Ahn, M. Gümüş, and P. Kaminsky describe a model that incorporates the impact of pricing in multiple periods on the demand in each period. In this model, customers enter the system with a particular reservation price and remain in the system for some number of periods, purchasing if the price falls below their reservation price. They explore various versions of this model and develop approaches for determining what to charge and how much to make in each period.

Solving Stochastic Optimization Problems Realistically and Easily

Stochastic programming provides a natural modeling framework for many real-world decision-making problems under uncertainty, ranging from engineering design to supply chain management problems. However, despite its immense modeling potential, stochastic programming faces two significant challenges. First, stochastic programs, especially multistage problems, are notoriously difficult to solve. Second, stochastic programming modeling requires full distributional knowledge of the uncertain data that are rarely available. In "A Robust Optimization Perspective on Stochastic Programming," X. Chen, M. Sim, and P. Sun propose to solve a class of stochastic programs, namely, chance constrained programming, through tractable approximations of chance constraints using robust optimization approaches. By restricting recourse decisions to linear decision rules, the approach ends up with a second order cone program, which is amenable to large-scale implementations, and thus provides quick and reasonable feasible solutions for a variety of large-scale practical problems, while requiring limited distributional information of the underlying uncertainty.

Coordinating Operational Decisions Within Supply Chains

Within the substantial literature of supply chain management, the benefits of coordination between supply chain partners are well known. However, the coordination of detailed scheduling decisions with known data has not been fully explored, perhaps because of the inherent difficulty in finding optimal solutions to such problems. The simple structure and widespread applicability of assembly systems makes them an ideal environment for studying such coordination. In "Supply Chain Scheduling: Conflict and Cooperation in Assembly Systems," Z.-L. Chen and N. G. Hall

first evaluate the cost of conflict that results when one party in an assembly system imposes its scheduling decisions on the whole system. Since this cost is substantial, they next consider several scenarios with respect to differential decision-making power in the supply chain. They develop mathematical models for the suppliers, the manufacturer, and the overall supply chain. The solution of these models enables the estimation of the benefit of cooperation under each scenario. Finally they show that, in some scenarios but not in others, the various parties can always coordinate their decisions in a way that leads to an overall optimal solution for the supply chain.

New Estimators Provide Meaningful Analysis of the Simulation's Output

In a simulation study of the steady-state operation of a given system, one of the most challenging problems is to perform a meaningful analysis of the simulation's output. Even the seemingly simple task of providing accurate measures of variability for estimators such as the sample mean can be daunting. The trouble is that simulation output processes—for example, a series of consecutive customer waiting times in queue—rarely satisfy the key assumptions of independence, stationarity, and normality as required by the "usual" statistical-estimation methods. In the paper titled "Overlapping Variance Estimators for Simulation" by C. Alexopoulos, N. T. Argon, D. Goldsman, G. Tokol, and J. R. Wilson, the authors derive new estimators for the variance of the sample mean based on standardized times series formed from overlapping batches of observations. The resulting variance estimators are asymptotically unbiased, have dramatically lower variance than many competing estimators, and have computing requirements that compare favorably with their competitors.

The Benefit of Lateral Transshipments

Firms often have multiple plants situated in different geographical regions to cater to different customer bases. Opportunities for judicious virtual lateral transshipments (demand reassignments) could arise when some plants are heavily backlogged while others are starved for demands. In "Capacitated Production Control with Virtual Lateral Transshipments," J. Yang and Z. Qin formulate a stochastic production-inventory control problem and characterize the optimal production and transshipment policies for a firm employing two manufacturing plants between which demands can be exchanged. The policy forms can serve as guidelines for real firms facing similar challenges. Their computational study also confirms that huge benefits can be reaped from adopting the practice of virtual lateral transshipments.

Adaptive Online Marketing

Interactive advertising—including display advertising and online search—is a $10 billion business (JupiterMedia) and represents an increasingly significant portion of the advertising industry. A central question is how best to match advertisements with customers based on accumulated data. An optimal policy trades off the incentive to choose the advertisement that currently looks best with the incentive to choose poorly understood advertisements to gather data for future benefit. This trade-off is central to "A Learning Approach for Interactive Marketing to a Customer Segment" by D. Bertsimas and A. J. Mersereau. The authors propose two adaptive policies for interactive advertising decisions in batches, one based on known multiarmed bandit research and one generated via a relaxation of a dynamic programming formulation. The core problem, essentially a batched version of the multiarmed bandit problem, has applications beyond the interactive advertising domain.

Military Applications: Optimally Assigning Weapons to Targets

In a military engagement, where planes carry expensive weaponry, they need to decide what is the best way to assign it to the enemy targets to maximize damage. A similar problem arises when an enemy's weapons are in our airspace heading towards our critical facilities and we need to decide the best way to neutralize them with limited weaponry at hand so that they cause least damage to our facilities. Problems of this kind are known as the weapon-target assignment problems and remained the Holy Grail of defense operations research for several decades. Exact algorithms could solve only impractical small size problems, and there was no mechanism to determine the goodness of heuristic algorithms. In "Exact and Heuristic Algorithms for the Weapon-Target Assignment Problem," R. K. Ahuja, A. Kumar, K. C. Jha, and J. B. Orlin convincingly solve this nonlinear integer programming problem through linear programming, network flows, and very large-scale neighborhood search algorithms.

Designing a Reliable Optical Network

Telecommunications is a technological area that has had major development during recent years and requires huge investments. The frame of this paper is wide-band optical telecommunication networks. The design of such networks is a complex task and generally subject to a number of complex constraints of different types, such as geographical, technological, and organizational. The problem considered is to build a new physical infrastructure covering business users. A well-spread technique for designing reliable optical networks foresees a set of optical fiber "rings" that cover the city. This technique is based on the request that at least two arc-disjoint paths exist for any possible transmission, connecting the two points. In this case, if there is a failure on one link, the transmission can be routed on the alternative path. To face node failure it is moreover required to consider node-disjoint paths. In "The Capacitated m-Ring-Star Problem," R. Baldacci, M. Dell'Amico,

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and J. Salazar González develop optimization techniques that can be used in the design of reliable optical networks. Computational experiments on a large family of instances, including real-world instances, prove the effectiveness of the proposed algorithms.

How to Win Your Office Pool

You are filling out your pool sheet for the NCAA basketball tournament. Do you pick the top ranked team to win it all, or go with an underdog? The top team is more likely to win but will probably attract many other pool entrants. Underdogs are risky but could leave you as the only person picking the winner. The sports betting pool is an instance of a general competitive setting in which players agree on the desirable choices but face decreasing benefits as more players share the same choice. In "Optimal Strategies for Sports Betting Pools," B. Clair and D. Letscher consider the decision problem: Which picks give the greatest return on investment? They use a model incorporating game outcomes and pool entrant behavior to solve the decision problem completely for football pools and approximately for NCAA tournament style pools. Data from large Internet-based pools are used to establish the model parameters, allowing for explicit solutions. Further numerical study indicates that judicious selection of underdogs offers significant benefits to the pool entrant.

Confidentiality via Camouflage

Modern organizations gather, store, and analyze large quantities of data. Some of this data contains sensitive information regarding individuals and other entities. Several techniques have been developed so that organizations can analyze sensitive data without compromising sensitive information. Confidentiality via camouflage (CVC) was recently proposed for this purpose.

In "Assessment of Disclosure Risk When Using Confidentiality via Camouflage," H. Li, K. Muralidhar, and R. Sarathy analyze the ability of CVC to provide security (prevent disclosure of sensitive information). The analysis indicates that the actual level of security provided by CVC is lower than originally anticipated. The analysis also shows that while it is possible to increase security, it also results in decreasing the usefulness of the data. Prior to implementing CVC we recommend a detailed assessment of disclosure risk and data utility based on the results in this study.

The Random Yield Problem Revisited

Stochastic yield problems have found new attention since product recovery management and connected disassembly problems became a major industry topic. Also recent discussions on inventory discrepancy problems in the context of RFID technology assessment touch specific random yield aspects. This underlines the need for more research in this area where up to now scientific contributions are relatively scarce. In "Note on 'Myopic Heuristics for the Random Yield Problem,'" K. Inderfurth and S. Transchel revisit an article by Bollapragada and Morton, published in 1999 in *Operations Research*, where several myopic heuristics with promising performance are presented for solving inventory control problems with stochastic yield and demand. They show that in case of high service requirements and major yield variability the heuristics proposed by Bollapragada and Morton should be applied very cautiously.