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IN THIS ISSUE

Survey of Perishable-Asset Revenue Management

The number of industries that face perishable-asset revenue management is very large. The problems in this area combine the traditional areas of yield management, overbooking, and pricing into one macroproblem. The common characteristics of such problems include a perishable good/service, a fixed number of units, and the possibility of segmenting price-sensitive customers. In their *OR Forum* paper, L. R. Weatherford and S. E. Bodily provide a comprehensive taxonomy with 14 different dimensions to classify the problems in this area. They also provide a survey of the relevant literature, and suggest important areas of future research to help bridge the gap between theory and application.

FDA Uses Operations Research

The Food and Drug Administration (FDA) is the federal agency responsible for regulating the pharmaceutical industry. With its limited resources, the FDA intermittently inspects approximately 4,000 firms and collects and analyzes thousands of drug products. In "Improving the Effectiveness of FDA Drug Inspection," R. Klimberg, C. ReVelle and J. Cohon describe the development of several analytical tools to assist FDA management in the planning and evaluation of its drug inspection program. Analytical tools have been developed to produce unbiased performance measurements for the entire industry. A multiple objective integer programming model was developed to determine how to allocate FDA drug inspection resources. As a result, a tradeoff curve is generated that illustrates the relationship between the expected number of violations to be detected and the resources to be used for the entire range of alternatives. Altogether, these decision-making tools have been implemented successfully by the FDA as part of their surveillance of the pharmaceutical industry.

Vietnam Was Not a Class War

There is a strong public interest in the historical accuracy of judgments about the bitterly controversial Vietnam War. One widely held belief that continues to affect national policy debates is that poor and working class American youths suffered far greater casualties in Vietnam than did their middle and upper class counterparts. That perception, however, seems to arise more from anecdotes and personal impressions than from any systematic study. The paper in this issue offers what the authors (Arnold Barnett, Timothy Stanley and Michael Shore) believe is the first scientific analysis that relates Vietnam casualty patterns to economic status. The results suggest that any "class war" rhetoric is highly exaggerated.

Machine Learning for Epidemics

AIDS is one example of an epidemic that demands modeling to account for geographic variation. The literature is meager in this regard, and only a few studies include enough structure for decision modeling. In "Automatic Learning for Dynamic Markov Fields, With Application to Epidemiology," S. Yakowitz, R. Hayes, and J. Gani address this deficiency by posing an epidemic intervention analysis problem in the context of a dynamic Markov field model. Because an analytic solution appears unlikely, the authors devise a machine learning technique that affords an efficient computational methodology. The algorithm is based on simultaneously performing simulation and improvement steps in a controlled manner so that asymptotic global optimality can be assured mathematically. Dynamic Markov field models have been proposed for forest fires, spread of populations, and pollution; the ideas in this paper may be useful in these other contexts.

Analyzing Arms Control Inspection Proposals

The government of the United States is presently negotiating a number of treaties that contain inspection agreements. A clear need exists for quantitative methods to compare the merits of competing inspection proposals. "The Upper Risk of an Inspection Agreement" by William Ruckle discusses a set of parameters which arise from the implicit game determined by the inspection proposal. The value of the implicit game, called the upper risk, provides a one dimension comparison of competing proposals. Inspection arrangements can be classified as sequential and parallel. Examples of both types are presented, some of which apply to current treaty negotiations.

Solution of a 12.75 Million Variable LP

In "Very Large-Scale Optimization," Robert Bixby, John Gregory, Irvin Lustig, Roy Marsten and David Shanno report computational experience for solving a 12,753,313 variable linear program, which results

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from the linear programming relaxation of set partitioning problems. Specifically, they solve an airline crew scheduling model by using a column generation algorithm. The subproblems generated by the procedure are solved by the simplex and interior point methods. A hybrid method is also discussed. This paper illustrates how the interior point and simplex methods can be used to solve very large-scale linear programs. These problems are of interest to the operations research community. The procedure can be used on other large-scale problems, and the authors anticipate further applications to even larger problems.

Behavior of Confidence Intervals

Sampling from a stationary stochastic process such as a steady-state simulation or a real-world system can only produce a finite amount of data for analysis. Thus, an important area of study concerns the small-sample and convergence properties of confidence interval estimators (CIEs) arising from stationary stochastic processes. In "An Investigation of Finite-Sample Behavior of Confidence Interval Estimators," Robert Sargent, Keebom Kang and David Goldsman study these properties for various CIEs commonly used in discrete-event simulation. This paper discusses the causes of small-sample size CIE invalidity, the question of which CIEs require the fewest observations to manifest their validity and symptotic properties, recommendations for practitioners, and issues that need future research.

Tchebysheff Returns to Make a Contribution

The problem of evaluating the expectation of a convex function appears in applications in mechanics, finance, economics, and in the optimization of stochastic programming. If a random variable has several dimensions and its distribution is complicated or not totally known, evaluating the expectation may be intractable. The contribution of the paper by J. H. Dulá and R. V. Murthy is an upper bound on the expectation of a special convex function. The bound results from the solution to a convex program formulated to find a feasible solution to a semi-infinite, linear optimization problem. The only information required about the distribution is the first and second moments of the random variables. The result is an efficient upper bound on the expectation of the recourse function without the restrictive assumptions common to works in this area. The upper bound may be interpreted as a special multivariate Tchebysheff inequality. This is the first Tchebysheff-type result in multiple dimensions where the range of the random variable is not compact.

Identifying Routes Quickly

The paper by Dorit Hochbaum describes an algorithm for solving the maximum flow and minimum cut problems and the vertex disjoint paths problem on random graphs. The problems come up in identifying communication routes that do not overlap. The algorithm is very fast; it does not look up most nodes in the network. It also provides an optimal solution and a proof of its optimality. In addition, the solution is a collection of vertex disjoint paths that is maximum by construction. With some restriction on the graph's density, an optimal solution to the communication problem is also provided. The algorithm lends itself to a sublogarithmic parallel and distributed implementation. The effectiveness of the algorithm is demonstrated via extensive empirical study.

How Do Inventories Affect Performance?

Queueing network models were originally formulated to represent production processes. Things have not quite worked out that way, however. Such models are used extensively in the design and management of information systems, but less so in the manufacturing context. One reason is that a standard network model corresponds to a make-to-order system, where a unit begins its passage through several production stages only in response to a customer's demand. But pure make-to-order systems are rare. Most real systems operate with planned inventories of materials, components and/or finished goods. In "Tandem Queues With Planned Inventories," Yong-Joo Lee and Paul Zipkin show how to extend the basic methodology of queueing networks to include these features. They propose a simple approximation scheme which appears to be quite accurate. With this approach we may begin to understand how inventories really work in systems with limited processing capacities and workload variations.

Mixing Push and Pull Leads to Better Customer Service

There has been an increased interest in pull production systems, such as kanban. Previous studies have shown these systems to outperform push production in terms of WIP and cycle times operating under equivalent demand situations. However, the issue of customer servicee has been avoided. In his paper, Mark Spearman addresses these and other issues. He shows that under certain conditions customer service is nondecreasing in WIP levels and nonincreasing in

the first and second moments of process time. The paper also presents evidence that customer service in the hybrid push/pull system, known as CONWIP, outperforms kanban under general conditions. One result shows that kanban is not as effective with regard to customer service as other systems. This result should generate increased research in hybrid production systems, resulting in more effective manufacturing control.

Managing Unreliable Production Systems

The lot sizing decision is a fundamental management aspect of many production facilities. In spite of this, it has not been studied extensively in the common context of unreliable facilities. In "Production Batching With Machine Breakdowns and Safety Stocks," Harry Goenvevelt, Liliane Pintelon and Abraham Seidmann present a new lot sizing model for an unreliable manufacturing facility operating under a constant demand rate. The random nature of the repair times reduces the effective machine capacity, so safety stocks are introduced to maintain a managerially prescribed service level. The dynamics of the safety stock process are fully characterized. In addition, the sensitivity of the optimal lot size and safety stock levels with respect to failure rate, service level, demand rate setup, and repair times is investigated. These results are incorporated into a broader management decision support framework for economically evaluating resource allocation decisions aimed at improving the productive reliability of the facility.

Meeting Deadlines With Minimum Inventory

This paper is motivated by the enormous interest in just-in-time systems, and the growing awareness that production work should be scheduled so that delivery commitments are met with minimum inventory along the way. Traditional scheduling formulations tend to assume that jobs can be foisted on the customer immediately upon completion. In "Minimizing Job Idleness in Deadline Constrained Environments," Reza Ahmadi and Uttarayan Bagchi present a scheduling formulation in which early and late deliveries of jobs are forbidden. Their formulation is equivalent to a traditional scheduling formulation. The authors use this equivalence to apply known results to the solution of a new problem and to integrate their research into the existing scheduling literature.

Designing Semiconductor Wafers

IBM has developed the capability to put different types of integrated circuits, or chips, on a semiconductor wafer. Customers order chips in sets (a specified number of several different types of chips), and statistical variability and random yield in the wafer fabrication process make it difficult for IBM to deliver these sets in a timely and reliable fashion. In "A Product Design Problem in Semiconductor Manufacturing," F. Avram and L. M. Wein consider the design problem of allocating sites on a wafer to the various types of chips in order to maximize the production rate sets. They employ a stochastic analysis to develop an effective wafer design to measure the improvement in performance of the multiple wafer over the traditional single-type wafer. The analysis reveals that multitype wafers regularize the production flow of nondefective chips and cause these flows to be positively correlated, both of which help to improve performance.

Ordering Policies in a Stochastic Environment

In the semiconductor industry, where the yields are almost always variable, there are many instances where several items are co-produced. If the co-produced items are differentiated on the basis of performance, there often exists a hierarchy of substitutability. That is, a customer will be satisfied with a specified level of performance or better. In such environments, managers must determine how many wafers are to be processed in each period, and when to satisfy unmet demand with higher quality items. The corresponding production planning and inventory allocation problem is analyzed in "Ordering Policies in an Environment of Stochastic Yield and Substitutable Demands." G. Bitran and S. Dasu identify a class of approximation procedures for solving this difficult problem.

Risk Attitude Versus Strength of Preference

In decision theoretic models and in applications to economics, individual behavior that is observed in reality is often explained by referring to the individual's attitude toward risk. It seems obvious that, in such models, the possibility of risk or uncertainty should be incorporated quickly. Nevertheless, there are many examples in the literature where risk is not modeled explicitly, but conclusions are still drawn based on the alleged risk behavior of individuals. In "A Criterion for Comparing Strength of Preference With an Application to Bargaining" Hans Peters provides an alternative explanation of such behavior by referring to an individual's strength of preference. He offers a theoretical contribution to utility theory and a tool for applications where no risk is involved. An application to bargaining theory is included.

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