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Farmers' Strategies in Developing Countries

The paper deals with farmers' strategies in remote areas in Burkina Faso in West Africa, one of the poorest developing countries. On their individual households the farmers produce mainly food for their own consumption. Since high population density causes overexploitation of soils, agriculture is very vulnerable due to deteriorating soil conditions. Production methods are traditional without "modern" methods. Uncertain rainfall also makes the yields uncertain. During the growing season farmers try to adapt their farming strategies to the fluctuating rainfall patterns. This is one of the most important methods to deal with risks of uncertain rainfall. In "Modeling Farmers' Response to Uncertain Rainfall in Burkina Faso: A Stochastic Programming Approach," A. Maatman, C. Schweigman, A. Ruijs, and M. H. van der Vlerk present a stochastic programming model to describe these adaptive sequential strategies. It is shown that operations research techniques can be a powerful tool to analyze grass root problems in developing countries. The paper is the result of a long-term collaboration between researchers in The Netherlands and in Burkina Faso.

Vehicle Routing Under Uncertainty

The vehicle routing problem lies at the heart of distribution management. It involves planning tours that serve multiple customers subject to a number of side constraints. In practice, vehicle routes may not be followed as planned due to the presence of uncertainty. For example, in a collection context, a vehicle may have to return to the depot to unload if its capacity is attained prematurely, which generates extra costs. In "An Integer *L*-Shaped Algorithm for the Capacitated Vehicle Routing Problem with Stochastic Demands," G. Laporte, F. V. Louveaux, and L. Van Hamme address customer demand uncertainty in vehicle routing. They show that by imposing a limited number of hypotheses on the shape of a solution and by appropriately exploiting the structure of the demand distribution, it is possible to optimally solve instances of realistic dimensions. Still, the stochastic vehicle routing problem remains extremely hard to solve in its full generality. One lesson from this research is that significant progress can be achieved if one is willing to incorporate in the model a number of realistic assumptions and take full advantage of data characteristics.

Setting Lot Sizes When Production Can Randomly Get Out of Control

When production is conducted in "lots" involving costly setup, the choice of lot size should take into account that some of the items may ultimately be found to be defective. In many of the familiar production processes, a job shop that must deliver a pre-specified number of custom-made items will optimally set lots that are larger than the needed quantity, to economize on further setups due to rejects. In "Optimal Lot Sizes with Geometric Production Yield and Rigid Demand," S. Anily, A. Beja, and A. Mendel study a class of processes where the optimal lot size is typically smaller than the outstanding demand. In these processes, a machine may randomly get out of control, and henceforth produce defective items until the end of the run, when the output is inspected. Their study investigates how the optimal lot size varies with the outstanding demand, yielding insights that can economize the computational work in the search for the optimal decision. In particular, they show that when the demanded quantity is very large it is optimal to produce in the lot size that maximizes the expected number of good items produced per dollar cost of production.

Locating Facilities and Serving Customer Demands

In many production and service industry settings, a primary problem that arises is where to locate the various warehouses, production plants, or service facilities, each having some specified planned capacity, and how to concomitantly allocate the distribution of their products or services to satisfy customer demands at minimum total cost. By their nature, such problems are known as location-allocation problems. Because of the joint location and distribution decisions, and depending on the distance measures used, the mathematical models for solving such problems turn out to be nonconvex and nondifferentiable, and have defied global or exact solution methods. In "Global Optimization Procedures for the Capacitated Euclidean and ℓ_p Distance Multifacility Location-Allocation Problems," H. D. Sherali, I. Al-Loughani, and S. Subramanian develop a first such global optimization algorithm to solve two challenging versions of this class of problems. They employ a novel Reformulation-Linearization Technique to design strong relaxations that induce an effective search strategy. Promising computational results are presented, including the solution of two previously unsolved problems from the literature.

Gaming Behavior in Double Auctions

Electric power industries around the world have undergone some remarkable changes in the past decade. It is now generally accepted that a deregulated system, under which generators compete with each other to supply power at the lowest cost, can function more efficiently than a rigidly-governed system. Most restructured industries set the trading price for electric power in each period by means of an auction. To increase efficiency and inhibit gaming behavior, many systems are looking to implement demand-side bidding, forming a double auction system. In "Double Auctions Across a Constrained Transmission Line," J. I. Singer revisits the standard double auction models, first with

single actors and then with multiple players, and investigates the effect that possibly-constrained transmission lines have on the behavior of buyers and sellers. This paper shows that different assumptions about the power and influence of the transmission line owner lead to different effects on player strategies, and that truthtelling behavior emerges as the number of participants increases. A numerical study graphically illustrates the convergence.

Decision Modeling Under Uncertainty: Overcoming Implementation Limitations

Optimizing personal and business decisions under uncertainty requires large-scale stochastic models, making implementation computationally unrealistic in many cases. In "A Stochastic Convergence Model for Portfolio Selection," A. V. Puelz presents a technique that provides solutions for these large decision models on almost any computing platform. While the stochastic convergence approach is demonstrated in a portfolio selection context, it has broad applicability in decision making. One natural application is the management of a firm's risk management functions. Most firms are adopting an enterprise-wide risk management approach where all business and financial risks are represented in a single decision framework. The resulting models are of such large magnitude that applying an approach such as stochastic convergence becomes necessary for solution derivation. On a smaller scale, personal asset allocation decisions can be optimized under the proposed stochastic convergence framework without the significant computing requirement necessary with most techniques. This makes the implementation of web-based decision modeling frameworks more practical.

Optimizing Offers to Electricity Markets

In recent years a number of regions around the world have introduced wholesale electricity spot markets, as part of a general restructuring of electricity generation, transmission, and distribution. By separating the generation function from the transmission and distribution functions, electricity markets endeavour to stimulate competition among suppliers to deliver electric power to consumers at a competitive price, while providing sensible signals for investment and new entry. In "Using Supply Functions for Offering Generation into an Electricity Market," E. J. Anderson and A. B. Philpott use the concept of a supply function to develop theoretical models for optimizing the offers that electricity generators make into pool markets. Generators wish to choose their supply-function offers to maximize return under every possible realization of demand for electricity. The authors derive conditions under which this strategy will work, and study the form of Nash equilibria arising when identical agents seek to maximize return simultaneously. This research contributes to a superior understanding of the problems of market power that have been a characteristic of many existing electricity markets.

Optimizing Digitized Images

Digitized images are nowadays routinely used in areas like medical image analysis, remote sensing, and industrial inspection. An image consists of many pixels (picture elements) where at least one observation is given at each pixel. Then the so-called segmentation problem is to analyze the image by finding, for each pixel, a class-label. For a medical image the class-label is tissue type. Usually, the observed image is quite noisy, making segmentation difficult. In "Large-Scale Integer Programs in Image Analysis," G. Dahl, G. Storvik, and A. Fadnes develop a new approach for solving such segmentation problems. They base their work on a stochastic model of the noise in the image (the Markov Random Field model) and formulate the segmentation problem as a discrete optimization problem. Different algorithms for solving these problems are suggested and compared on realistic data. In particular, a Lagrangian algorithm based on combinatorial subproblems is shown to have a very promising performance.

Protecting Confidential Information While Answering Queries to a Database

Information organizations such as health care providers and credit bureaus collect, store, and process large sets of sensitive data on individuals, households, and businesses. The result is that society is faced with an ever increasing conflict between the desire for free access to this information and the individual's right to privacy. In "Confidentiality via Camouflage: The CVC Approach to Disclosure Limitation When Answering Queries to Databases," R. Gopal, R. Garfinkel, and P. Goes develop a tool to help database administrators resolve this conflict. When the confidential data is numerical, the technique is able to supply very good answers to a wide variety of query types, while guaranteeing protection of every piece of confidential data. The technique is particularly useful because it requires minimal additional storage and time. It also has the positive property of giving answers in the form of lower and upper bounds that are guaranteed to be correct. That is, the exact answer lies between the two. Computational experience has shown that the two bounds are usually quite close to each other so that a user of the database can find the answers to be very valuable.

Simultaneous Learning and Inventory Control

In our fast growing and rapidly changing economy, technological advances have dramatically shortened product life cycles so that a wide range of high tech products now exhibit the long lead times and short shelf lives that are characteristics of fashion goods. Researchers and practitioners have widely used the newsvendor inventory model to determine optimal inventory levels in such an environment but usually make the limiting assumptions of a known demand distribution and/or completely observed demand. In "The Censored Newsvendor and the Optimal Acquisition of Information,"

X. Ding, M. L. Puterman, and A. Bisi show that in the presence of an unknown demand distribution and unobservable lost sales it is optimal for the newsvendor in a dynamic environment to set higher stock levels than would be the case if learning was not possible. The reason for this is that the opportunity to use current information in the future penalizes lost sales more than in a single period model. This trade-off is demonstrated analytically and supported by numerical calculations.

Net Present Value and General Inventory Models

Net present value has been widely used in making financial decisions. However, this supposedly more accurate method is rarely used in production and inventory decision making. What would the decision be if we were to use the net present value in the production and inventory models? Does this omission seriously jeopardize the production and inventory decision based on the average cost? In "Production and Inventory Model Using Net Present Value," D. Sun and M. Queyranne answer these questions. The authors provide a power-of-two heuristic to find the near optimal solution to the general production and inventory model based on the net present value with a guaranteed percent error from the optimal, even in the worst situation. The authors also prove that a decision based on the average cost is not significantly worse than the one based on the net present value if the discounted production cost is included in the holding cost. This result gives more confidence in the use of the average cost in production and inventory decision making.

Is Your Internet Connection Slowing You Down? Cost-Effective Design of High-Speed Cable Access Networks

Development of sufficient bandwidth capacity does not meet consumer demands for high-speed Internet access. Phone and cable companies are struggling to deliver high bandwidth access networks within acceptable cost limitations. While predictions have been made that high-speed connections will be dominant in U.S. households by 2003, the majority of the U.S. population are still not covered by these new high bandwidth technologies. The barriers to implementation of these high-speed networks lie in the inability to discover cost effective topological designs. In "Hybrid Fiber Coaxial Network Design," R. A. Patterson and E. Rolland address such network designs for hybrid fiber coaxial cable networks and develop a new solution methodology for solving this problem. Their methodology, the Adaptive Reasoning Technique, is shown to be easily generalizable to other complex combinatorial problems such as the Traveling Salesman Problem. The Adaptive Reasoning Technique is an artificial intelligence methodology that uses memory and learning to build upon the theory of constructive meta-heuristics.

Sequential Decision Making in Maintenance of Repairable Items

Most of the devices used in industry are subject to failures during their mission time which can incur high costs. In order to minimize such failures and the resulting costs, preventive or corrective maintenance actions are taken on a regular basis. In traditional maintenance policies, it is assumed that the structure of the random failure process is known and maintenance policies are developed to be used for an indefinitely long horizon. In the article "An Adaptive Bayesian Replacement Policy with Minimal Repair," S. Dayanik and Ü. Gürler propose a general maintenance policy that allows the sequential use of collected failure data in scheduling the next maintenance time. A failure is classified as "critical," which requires the replacement of the device, or "noncritical," which requires a minimal repair that brings the device back to the condition right before the failure. By using the Bayesian statistical inference methods, the information about the number and the time of repairs are incorporated to modify the failure distribution and the maintenance times.

Once Again, Variability Causes Waiting

A heuristic principle in queueing theory states that waiting time increases as variability increases. This principle is more valuable as a guide to intuition than as a theorem to be comprehensively formulated and proved. Indeed, when stated as loosely as is done here, it is not hard to find counterexamples. And occasionally one comes across an instance of the principle that evades a simple proof. An example is "Ross's Conjecture," which states that Markov modulation of the arrival stream to an $M/M/1$ queue increases the average waiting time. In "On the Tail of the Waiting Time in a Markov-Modulated $M/G/1$ Queue," S. Asmussen and C. O'Cinneide show at least that the asymptotic rate of decay of the tail of the waiting time distribution decreases when modulation is introduced. Thus, in a certain asymptotic sense, the waiting time increases because of modulation.

New Sampling Procedures

New procedures that identify the best of several alternatives when mean performance is inferred by sampling were proposed by Chick and Inoue. The focus is on allocating additional samples (or replications, in a simulation context) to improve the value of information of those samples. In "Corrigendum: New Selection Procedures," S. E. Chick and K. Inoue fix a typographical error that appeared in their article, "New Two-Stage and Sequential Procedures for Selecting the Best Simulated System," which was published in the September-October 2001, 49 (5) issue. The correction permits correct calculation of the expected opportunity cost loss.