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IN THIS ISSUE

Best-practice Management of Small Business Development Centers

Best-practice management guidelines were found from observed data of Small Business Development Centers (SBDC) in the Houston area. The guidelines match up the best productive capability with values, as required to be market responsive. Using Data Envelopment Analysis (DEA), a linear-programming method for estimating production frontiers, unique efficiency prices were verified for some inefficient centers. Adjustments were identified in funding allocations for several centers to achieve their most productive scale size. In "DEA/Assurance Region SBDC Efficiency and Unique Projections," the authors report on how the modeling results were regarded by the SBDC management as matching closely their expectations of what centers were leading role models as well as providing improvement advice for inefficient centers.

Screening for HIV in Developing Countries

Pooled (or group) testing is a cost-effective alternative for screening donated blood products (sera) for HIV in developing countries. Pooled testing has a possible shortcoming—the dilution effect: if the pool size is too large, then any HIV positive sera may be sufficiently diluted so as to become undetectable by the test. The discrepancy between existing field studies and the recommendations of the World Health Organization is an indication that the dilution effect is not well understood by the blood-banking community. In "Pooled Testing for HIV Screening: Capturing the Dilution Effect," Lawrence M. Wein and Stefanos Zenios develop a model that captures the effect of pooling together different samples, validate the model using data from a variety of field studies, and embed the model into a stochastic control framework. Their analysis shows that the efficacy of group testing depends upon the use of a classification rule (i.e., discard the samples in the pool, transfuse them, or test them further) that is dependent on pool size, a characteristic that is lacking in currently implemented pooled testing procedures.

Synchronization of Traffic Signals

A fundamental problem in setting traffic signals is their mutual synchronization so that arriving traffic will not have to wait for long for a green light. This is a special case of a class of scheduling problems involving synchronization of node variables. In "A Flow Algorithm for Network Synchronization," Refael Hassin shows that these problems are closely related to network flow optimization. This relationship is used for developing algorithms that can be applied to large instances, such as those originating from synchronization of traffic signals.

Using Warehouse Capacity

In the "Single Resource Multi-Item Inventory Systems," Guillermo Gallego, Maurice Queyranne, and David Simchi-Levi consider two economic models used to determine warehouse capacity and product order quantities. The authors developed lower bounds on the cost over all feasible policies. They used these bounds to analyze the "worst case" performance of heuristics as proposed in the literature. In addition, a key property of optimally staggered orders was identified and used to develop a new heuristic that significantly outperforms other heuristic attempts to solve this notoriously difficult problem.

Dimensioning of Gas Transmission Networks

The paper treats an important problem encountered in the natural gas industry. When deciding an expansion of its network, a gas transmission company needs to select the new capacities taking into account the direct investment costs and the future operations costs entailed by these investments. The model and the solution method proposed by Daniel De Wolf and Yves Smeers in "Optimal Dimensioning of Pipe Networks with Application to Gas Transmission Networks" provide a tool for handling these two aspects simultaneously. The model is formulated as a two-stage optimization problem: the first stage deals with investments, the second with the simulation of gas transmission operations. The solution method is based on nondifferentiable programming and constitutes a novel application of this field to an important practical problem. A case study using the model on a realistic example is presented, namely the optimal expansion of the Belgium gas transmission network.

Multiattribute Utility Functions on Subsets

One of the main results of the field of multiattribute utility theory is the well-known multiplicative/additive decomposition theorem. This result is important since it provides the necessary foundations for the development and application of a number of mathematical models to evaluate, compare, and choose among prospects characterized by multidimensional uncertain outcomes. Many such practical applications have been developed successfully in the past. Very often in practice, restrictions exist on the prospects being evaluated so that the outcome set is only a subset of the full outcome set. For such realistic decision problems, the decomposition theorem does not apply, and researchers have usually dealt with the difficulty in an ad-hoc fashion. In "Decomposition of Utility Functions on Subsets of Product Sets," François Sainfort and Jean Deichtmann prove a new decomposition theorem for multiattribute utility functions on subsets. This new theorem covers a larger class of decision problems.

Efficient Scheduling

Efficient production scheduling is essential. Unfortunately most scheduling models are very difficult to solve, and only approximate solutions can be proposed. However, there are a few cases where the particular technology allows for viable models. For instance, this is the case of loom scheduling, where the possibility of preempting and splitting jobs lends itself to network flow models and fast algorithms. In "Scheduling Jobs on Several Machines with the Job Splitting Property," Paolo Serafini provides the mathematical formulation for such a model, discussing various particular cases, including loom scheduling.

A Surprising Theorem About Polling Models

A *polling model* is used to represent a system of multiple queues that are attended by a single server that travels from queue to queue. These models have many important applications (computer networks, telephone switching systems, materials handling, etc.), and they tend to be very complicated. A key element is the *switchover times*, which are the times required for the server to travel from one queue to the next. In their paper, "A Decomposition Theorem for Polling Models: The Switchover Times are Effectively Additive," Robert B. Cooper, Shun-Chen Niu, and Mandyam M. Srinivasan prove a somewhat surprising theorem. It says that, in some cases, the mean waiting times *decompose* into a sum of two terms: one term is a simple function of the sum of the mean switchover times, and the other is the mean waiting time in a corresponding model with zero switchover times and modified service-time variances. These insights have already generated interest among researchers seeking to prescribe optimal operating policies and to better understand polling models.

Scheduling Make-to-stock Production Systems

Many manufacturing facilities operate in a make-to-stock mode in order to be responsive to customers, yet are experiencing pressure to reduce their inventories. Improved methods of setting stock levels and priorities between products have the potential to reduce inventory requirements while achieving high service levels in these systems. Modeling the production facility as a multiclass queueing system allows the impact of capacity constraints as well as production and demand uncertainty to be assessed. In "Scheduling a Make-to-stock Queue: Index Policies and Hedging Points," Michael H. Veatch and Lawrence M. Wein go beyond the static or "lowest inventory position" priority schemes proposed earlier. They develop more robust priority schemes that are sensitive to differences between products. Approximate policies are found that are easily computed from production capacity, demand, and cost data, even for a large number of products. Their methods include the application of Whittle's "restless bandit" index to provide a priority scheme and contribute to the heavy traffic scheduling literature.

Scheduling Flow-shop

When jobs arrive simultaneously at a multi-stage production facility arranged in series for processing, decisions have to be made regarding how jobs are sequenced. The aim is to finish the jobs as soon as possible. In "A Note on Heuristics of Flow-shop Scheduling," Tsung-Chyan Lai proposes a simple rule for sequencing the jobs. The jobs are partitioned into two groups by sequentially looking at the processing times of each job at each stage. One group precedes the other, with the jobs in a group being sequenced arbitrarily. This simple rule is a heuristic with no guarantee of producing an optimal solution. If one wants to sacrifice solution time for a better solution, this simple rule is a basis for further refinements.

A Service Discipline for Time-shared Computer Systems

A common problem in time-shared computer and communications systems is to provide different levels of service to different classes of customers. This can be achieved by a suitable priority structure. Time-shared computer systems have routinely used the round-robin service discipline for its customers. The discriminatory processor-sharing discipline is the idealization of the round-robin discipline. In "Queue-length Distribution for the Discriminatory Processor-sharing Queue," Kiran M. Rege and Bhaskar Sengupta analyze the discriminatory processor-sharing discipline, a multiclass variant of the traditional processor-sharing discipline. Using this technique, they provide a solution to the problem of finding the moments of the queue-length distribution and also prove a heavy traffic limit theorem.