

Operations Research Seminar Series in 2010

Seminars are listed in reverse chronological order, most recent first.

8 December - John Hooker (Tepper School of Business, Carnegie Mellon) **Multivalued Decision Diagrams in Optimization**

Multivalued decision diagrams (MDDs) have recently shown promise as a new approach to discrete optimization. They combine propagation ideas from constraint programming with relaxation ideas from mathematical programming. After an introduction to MDDs and their historical use for circuit analysis and product configuration, I will illustrate how MDDs can be used for propagation, relaxation, a feasibility heuristic, and a guide to branching. Computational experiments to date show that MDDs yield substantial speedups for solving vertex colouring and employee scheduling problems, provide an effective feasibility heuristic for set covering problems, and permit in-depth postoptimality analysis. I will conclude by describing nonserial MDDs and their connection with nonserial dynamic programming, tree width, induced width, and related concepts.

1 December - Alex Scott (Oxford) **A New Bound for the Cops and Robbers Problem**

The game of Cops and Robbers is played on a finite, connected graph. A number of cops and one robber are placed on the vertices of the graph, and moves are made along the edges of the graph. At each turn, the cops each move along an edge, and then the robber moves. The goal of the cops is to capture the robber, while the robber wishes to avoid the cops indefinitely.

Meyniel conjectured 25 years ago that, for graphs on n vertices, at most $O(n^{1/2})$ cops are needed for the cops to win. The best previous upper bound was due to Chiniforooshan, who showed that $O(n/\log n)$ cops suffice. We give a substantial improvement on this.

This is joint work with Benny Sudakov (UCLA).

24 November - Peter Key (Microsoft Research Cambridge) **Forza Auctions: A Study of an Artificial Economy**

Forza Motorsport is a racing video game for the Xbox. Players can win virtual money and cars by racing, and also modify cars. They can also use the virtual currency to buy and sell cars through an auction house. From real data, comprising millions of such auctions, we present findings on user behaviour, the structure of the interconnection or social graph, and the wealth of traders. Many of the relevant

distributions are heavy tailed, and can be approximated by power-law or log-normal distributions. We derive novel constructive probabilistic models to suggesting how such distributions may arise, and give preliminary results on validating the models.

27 October - Gideon Weiss (Haifa)

First Come First Served: Infinite Matching with Applications to Queues with Multi-type Customers and Multi-type Servers

We consider a system where jobs of several types are served by servers of several types, and a bipartite graph between server types and job types describes feasible assignments. This is a common situation in manufacturing, call centres with skill based routing, matching of parent-child in adoption or matching in kidney transplants etc. We consider the case of first come first served policy: jobs are assigned to the first available feasible server in order of their arrivals. We survey some results for four different situations:

- For a loss system we find conditions for reversibility and insensitivity.
- For a manufacturing type system, in which there is enough capacity to serve all jobs, we discuss a product form solution.
- For an overloaded system with reneging, we emphasize a global first come first served property under fluid scaling.

These queuing models are intimately connected to the following discrete time Markovian model, which is both simpler and more general:

- There is an infinite sequence of customers with i.i.d. types, and infinite sequence of servers of i.i.d. types and the two are matched according to the bipartite customer server graph, using first come first matched.

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We obtain a product form stationary distribution for this system, which we use to calculate matching rates.

This talk surveys joint work with Ivo Adan, Rene Caldentey, Cor Hurkens and Ed Kaplan, as well as work by Jeremy Visschers, Rishy Talreja and Ward Whitt.

20 October - Nitin Bakshi (London Business School)

Securing the Containerized Supply Chain

To mitigate the threat that terrorists smuggle weapons of mass destruction into the United States through maritime containers, the U.S. Bureau of Customs and Border Protection (CBP) inspects containers either upon entry to domestic ports, or at the international port of origin itself. In this talk I will focus mainly on inspection policies followed at the US-domestic ports, followed by a brief discussion of another research project that deals with container inspections at international ports. Inspection-driven congestion is costly, and CBP provides incentives to firms to improve security upstream in the supply chain, thereby reducing the inspection burden at U.S. ports. We perform an economic analysis of this incentive program,

called Customs-Trade Partnership Against Terrorism (C-TPAT), modeling in a game-theoretic framework the strategic interaction between CBP, trading firms, and terrorists. Our equilibrium results highlight the possibility that a properly run program can efficiently shift some of CBP's security burden to private industry. These results also suggest that CBP may have the opportunity to use strategic delay as an incentive for firms to join. Analysis of comparative statics shows that, with increasing capacity, membership in C-TPAT systematically declines.