Breakfast.  8:00-8:30 AM

Opening Remarks.  8:30 - 8:40 AM, Mitchell P. Koza, Vice Dean Rutgers Business School Newark & New Brunswick.

Session 1.  8:40 - 10:10 AM. Lee Papayannopoulos, Rutgers University, Chair

A Self-Contained Analysis of the Multi-Armed Bandit. Eric V. Denardo, Yale University.
Pairwise comparison is used to identify an optimal policy for a model with linear utility, for a model with risk-averse exponential utility, and for a model with risk-seeking exponential utility. Algorithms are specified, as is the work required. For the case of linear utility, constraints are handled by column generation.
Talk based on joint work with Uriel G. Rothblum, Eugene A. Feinberg, Haechurl Park and Ludo Van der Heyden.

Optimal Selling under a Hidden Markov Chain. Sheldon M. Ross, University of Southern California.
You have a single item to sell. The state of the environment changes on a daily basis according to a specified discrete time Markov chain. Offers appear one at a time, with the distribution of the offer depending on the current environmental state. Offers are either immediately accepted or rejected without possibility of later recall. A positive fixed cost is incurred each time an offer is received and the objective is to maximize the expected net return both when the environmental states are observed and when they are hidden. In the latter case, a distribution on the initial environmental state is assumed.

We survey the research monograph “Abstract Dynamic Programming” (Athena Scientific, 2013), which aims at a unified and economical development of the core theory and algorithms of total cost sequential decision problems, based on the strong connections of the subject with fixed point theory. The analysis focuses on the abstract mapping that underlies dynamic programming and defines the mathematical character of the associated problem. The discussion centers on two fundamental properties that this mapping may have: monotonicity and (weighted sup-norm) contraction. As shown by research in the 60s and the 70s, the nature of the analytical and algorithmic DP theory is determined primarily by the presence or absence of these two properties, and the rest of the problem’s structure is largely inconsequential. New research is focused on: 1) The ramifications of these properties in the context of algorithms for approximate dynamic programming, 2) The new class of semicontractive models, exemplified by stochastic shortest path problems, where some but not all policies are contractive, and 3) Various applications, including to affine monotonic, multiplicative, and risk-sensitive models involving an exponential cost function.

Break.
Lyapunov Conditions for Differentiability of Markov Chain Expectations.

Peter Glynn, Stanford University.

One of Pete Veinott’s many contributions was a paper co-authored with Cy Derman entitled ”A Solution to a Countable System of Equations Arising in Markovian Decision Processes” (Ann. Math. Statist. 38 (1967), 582-584). This paper concerns existence/uniqueness for a system of linear equations that today would be called Poisson’s equation. In this talk, we will show that two versions of Poisson’s equation arise naturally in the consideration of derivatives of stationary distributions with respect to decision parameters, one being a measure-valued version and the other being a function-valued version. Using Poisson’s equation as a basic tool, we provide easily verifiable conditions for differentiability of continuous state space Markov models, simplifying much of the existing theory that has been developed over the last 20 years.

Talk based on joint work with Chang-han Rhee.

Infinite Horizon Strategies for Replenishment Systems with a General Pool of Suppliers.

Awi Federgruen, Columbia University.

We consider a general infinite horizon inventory control model which combines demand and supply risks and the firm’s ability to mitigate the supply risks by diversifying its procurement orders among a set of N potential suppliers. Supply risks arise because only a random percentage of any given replenishment order is delivered as usable units. The suppliers are characterized by the price they charge and the distribution of their yield factor. The firm incurs, as in standard inventory models, three types of costs: (i) procurement costs; (ii) inventory carrying costs for units carried over from one period to the next and (iii) backlogging costs. We establish the existence of an optimal stationary policy, under both the long-run discounted and average cost criterion, and characterize its structure. Assuming each period’s inventory level distribution can be approximated as a Normal, we develop an efficient solution method identifying additional structural properties. Finally, we identify a simple class of heuristic policies which come close to being optimal.

Talk based on joint work with N.Yang, Olin School, Washington University.

Partially Observable Markov Decision Processes with General State and Action Spaces.

Eugene A. Feinberg, Stony Brook University.

Partially Observable Markov Decision Processes (POMDPs) describe control of stochastic systems whose current states are unknown and information about them is available only via indirect observations. They have a large spectrum of applications to various fields including operations research, electrical engineering, and computer science. In principle, a POMDP can me reduced to a Markov Decision Process (MDP) whose states are belief probabilities, that is, probability distributions on the set of all possible states. Such auxiliary MDPs are called Completely Observable MDPs (COMDPs).

If an optimal policy is found for the COMDP, it is easy to construct an optimal policy for the POMDP. However, the existence of optimal policies for COMDPs (and therefore for POMDPS) and their characterizations via optimality equations have been studied in the literature mainly for problems with finite state sets. Except a few cases, infinite-state problems have been considered only for particular applications. For the expected total costs criteria, we describe natural sufficient conditions for the existence of optimal policies for infinite-state POMDPs and derive optimality equations. The results presented in this talk are based on the recent progress in the analysis of infinite-state MDPs with weakly continuous transition probabilities, which were motivated by applications of MDPs to inventory control, and on new results on
continuity properties of Bayes formula.

Talk based on joint work with P.O. Kasyanov and M.Z. Zgurovsky.

Lunch Break.

Session 3. 1:30 - 4:00 PM. Jaideep Vaidya  Rutgers University, Chair

Competitive Privacy.

H. Vincent Poor  Princeton University.
The proliferation of electronic data has made leakage of private information an important issue. This talk will first describe a fundamental framework for examining the tradeoff between the privacy of data and its measurable benefits. This framework will then be used to investigate the problem of competitive privacy, in which multiple competing parties need to share private data in order to optimize individual utility functions.

Talk based on joint work with Elena-Veronica Belmega, Soummya Kar, Raj Rajagopal, Lalitha Sankar and Ravi Tandon.

Dynamic Rate Multi-Server Queues for Nursing Home Bed Planning.

William A. Massey  Princeton University.
We develop new algorithms to estimate the nursing home bed demand and determine the profit-optimal number beds needed. This is done by analyzing a dynamic rate, multi-server queueing model, with abandonment. Our model uses non-homogeneous Poisson arrivals but the service times need not be exponentially distributed. We give explicit formulas for the transient mean number of beds and the profit function. This enables nursing home managers to do long term planning involving Medicaid reimbursement incentives by using short term models.

Talk based on joint work with Otis Jennings and Jerome Niyirora.

Monte Carlo Methods for Diffusion Processes Avoiding Random Obstacles.

Jose H. Blanchet  Columbia University.
A target travels around a region according to a diffusion process with an instantaneous drift which locally maximizes an objective function and with a noise correction. At the beginning obstacles are placed according to a non-homogeneous Poisson spacial process (all the obstacles are placed at once and independently of the diffusion process). Motivated by applications related to tracking and location of rogue objects, we are interested in efficiently sampling the conditional distribution of the target given that it has evaded the obstacles for long time.

The talk discusses an algorithm that addresses this problem. Our algorithm can be shown to be asymptotically optimal (in the sense of variance minimization and running time) in a large deviations regime as the time horizon increases and the number of obstacles per unit area is suitably large. The procedure touches upon topics related to so-called quasi-stationary distributions (i.e. the distribution of Markov chains constrained to live in a given area for long time), and stochastic approximation algorithms.

Talk based on joint work with Paul Dupuis, Peter Glynn, Aya Wallwater, and John Zheng.

Global Optimization of Smooth Functions using Delaunay Triangulations.

James M. Calvin  Department of Computer Science, New Jersey Institute of Technology.
The problem of approximating the global minimum of a multivariate function is considered. The proposed
algorithm partitions the feasible region using a Delaunay triangulation. Only the objective function values are required by the optimization algorithm. The estimate of the minimum converges to the global minimum for any continuous function, and the convergence rate is analyzed for a class of smooth functions.

**A Stochastic Programming Based Approach to Assemble-to-Order Inventory Systems.**

**Martin I. Reiman, Alcatel-Lucent Bell Labs.**

The assemble-to-order system is a classical model in inventory theory, where multiple components are used to produce multiple products. All components are obtained from an uncapacitated supplier after a deterministic (component dependent) lead time, while demand for the products is random. The optimal control for this system (where the goal is to minimize the long run average inventory + backlog cost) is not known except for very special cases. In this talk I will describe our approach to solving this problem using a particular multi-stage stochastic linear program with complete recourse, which we have shown provides a lower bound on achievable cost in the inventory system. I will also present our translation of the solution of this stochastic program into a control policy for inventory systems with identical lead times. Finally, I will present our result showing that this policy is asymptotically optimal as the lead time grows.

*Talk based on joint work with Mustafa Dogru and Qiong Wang.*

**Break.**

**Session 4. 4:15 - 7:00 PM.**

**Farid Alizadeh**, Rutgers University, Chair

**Markov Population Decision Chains with Constant Risk Posture.**

**Pelin Gulsah Canbolat**, Koc University, Turkey.

One of the products of the “(40±\(\epsilon\))-year collaboration” between Uriel G. Rothblum and Arthur F. Veinott, Jr. is a general theory of Markov population decision chains, which concerns the control of a population of individuals by assigning an action to each individual in the system in each period. Their theory provides a way of formulating and efficiently solving a class of stochastic population-control problems using risk-neutral criteria; it can be instrumental in solving problems like the management of animal populations, forests, and the choice of governmental policies regarding taxation, demographic planning, and social services. In this talk, I envisage enriching the potential impact of their theory by incorporating risk sensitivity within their framework.

**A Puck In The Net Beats Four Men In The Box.**

**Edward H. Kaplan**, Yale School of Management.

The classic Poisson model of hockey provides a simple method for calculating the probability of a team winning a hockey game given the score differential and time remaining to play. We extend this model to include the effect of penalties by expanding the model state space to include manpower differential in addition to score differential and remaining time. Given data from the 2008-2011 National Hockey League seasons (a total of 4,920 games), we derive and report the associated state space model. The data reveal that even after controlling for the home edge afforded by visiting teams being penalized more frequently than home teams, the goal scoring rate for the home team is higher than for visiting teams at all equivalent manpower differential levels. The modeling shows that, for any fixed duration of time left in the game, the probability that a team leading by \(g\) goals playing two men down wins is higher than the probability that a team leading by \(g-1\) goals playing two men up wins, explaining the title of the paper. We demonstrate that this is a property of NHL hockey data as opposed to an artifact of the model. We
also develop a new win probability added metric that could be used to evaluate individual players based on their incremental contribution to the probability of winning.

Talk based on joint work with Kevin Mongeon (Brock University), and John Ryan (Yale University).


Mengdi Wang, Princeton University.
Convex optimization problems involving large-scale data or expected values are challenging, especially when these difficulties are associated with the constraint set. We propose random algorithms for such problems, and focus on special structures that lend themselves to sampling, such as when the constraint is the intersection of many simpler sets, involves a system of inequalities, or involves expected values, and/or the objective function is an expected value, etc. We propose a class of new methods that combine elements of successive projection, stochastic gradient descent and proximal point algorithm. This class of methods also contain as special cases many known algorithms. We use a unified analytic framework to prove their almost sure convergence and the rate of convergence. Our framework allows the random algorithms to be applied with various sampling schemes (e.g., i.i.d., Markov, sequential, etc), which are suitable for applications involving distributed implementation, large data set, computing equilibriums, or statistical learning.

Robust Control Of Stochastic Inventory And Queueing Problems.

E. Lerzan Örmeçi, Koc University, Turkey.
In classical stochastic dynamic programming, the transition probabilities of the underlying Markov Chain as well as other parameters such as rewards and costs are assumed to be known with certainty. We focus on the case where the transition probabilities are uncertain. Robust dynamic programming addresses this problem by defining a min-max game between nature and the controller. Considering examples from inventory and queueing control, we examine the effects of this game on the structure of the optimal control policy when arrival/service times are uncertain. We identify the cases where certain monotonicity results still hold. We show how optimal policy thresholds respond to uncertainty and the value of additional time in this respect.

Talk based on joint work with Zeynep Turgay and Fikri Karaesmen.

On Optimality Properties of the Shiryaev-Roberts Procedure for Detecting Changes in Distributions.

Alexander Tartakovsky, UCONN & University of Southern California.
Change point problems deal with detecting abrupt changes in a process of interest. The gist of the quickest change point detection problem is to design a detection procedure that minimizes the average delay to detection of a change subject to constraints on the risk associated with false alarms. A brief overview of the field with the focus on recent advances will be presented. In particular, certain interesting optimality properties of the Shiryaev-Roberts detection procedure and its modifications will be discussed.

On Sequential Semi-anonymous Nonatomic Games.

Jian Yang, Rutgers University.
We show that equilibria of a sequential semi-anonymously nonatomic game (SSNG) can be adopted by players in corresponding large but finite games to achieve near-equilibrium payoffs. Such equilibria are parsimonious in form and easy to execute, as they are both oblivious of past history and blind to other players’ present states. When an SSNG with a finite horizon possesses an equilibrium in the form of a
random state-to-action rule, we show that large but finite counterparts of the game can use the SSNG equilibrium to reach asymptotically optimal payoffs. The kind of SSNG equilibria we consider are similar to the classic distributional equilibria.

7:00 - 9:00 PM Dinner. Share your memories of Pete Veinott, Michael N. Katehakis, coordinator.

Conference Coordinator: Ms. Luz Kosar kosar@andromeda.rutgers.edu
Registration: By email to the conference coordinator.