

Stochastic Optimization

ME 391Q (15870) Spring Semester 1997

Classroom: ETC 5.132

Meeting Time: 9:30-11am Tuesdays and Thursdays

Prerequisites: Knowledge of linear programming, probability, and statistics.

Instructor: David Morton

Office: ETC 5.122

Office Hours: 2-3:30pm Tuesdays and Thursdays

Telephone: 471-4104

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Texts: P. Kall and S.W. Wallace, *Stochastic Programming*,
John Wiley & Sons, Chichester, 1994.

D. Morton, ME 391Q Stochastic Optimization (Operations Research) Class
Notes, 1997.

Software: A. Brooke, D. Kendrick and A. Meeraus, *GAMS: A User's Guide, Release 2.25*,
The Scientific Press, South San Francisco, 1992.

Grading Policy

Problem Sets (due about every two weeks) 70%

Project (due at noon on Wednesday, May 7) 30%

Students are encouraged to work together in determining how to do the problem sets, but problem sets must be written-up individually.

Course Outline

- **Modeling and Applications**
 - Extending the linear programming model
 - Feasibility: fat, penalty, and chance-constrained models
 - Optimality: expected-value, probability threshold, Markowitz, and expected utility
 - Stochastic programming with recourse
 - Some applications
 - Capacity expansion planning (power systems and telecommunications),
 - Financial planning, Vehicle allocation, Hydroelectric scheduling
 - Capacitated facility location, Network interdiction / design
 - Simple recourse models
 - Robust optimization
 - Bounds on the value of information and the value of the stochastic solution
 - Incomplete information
- **“Exact” Optimization Methods**
 - Simplex method
 - Interior point methods
 - Decomposition
 - Dantzig-Wolfe
 - Benders / L-shaped Method / Cutting plane algorithms
 - Enhancements: multicut, proximal term, bunching, preliminary cuts
 - Extensions to multistage setting
 - Lagrangian-based methods (progressive hedging)
- **Approximation and Bounding Techniques**
 - Jensen and Edmundson-Madansky bounds
 - Bounds for network recourse problems
 - Stochastic PERT, max-flow, telecommunications, vehicle allocation
 - Sequential approximation methods
 - Partitioning schemes
- **Monte Carlo Sampling-Based Algorithms**
 - Stochastic quasi-gradient
 - Sampling-based L-shaped algorithms
 - Stochastic decomposition
 - Variance reduction techniques: control variates and importance sampling
 - Sampling-based lower bounds
 - Hybrid methods: approximation / sampling
 - Stopping rules

References

- J.R. Birge and F. Louveaux, *Stochastic Programming*,
<http://www-personal.umich.edu/~jrbirge/843/843syl/843syl.html>
- M. Dempster (ed.), *Stochastic Programming*, Academic Press, London, 1980.
- Y. Ermoliev and R.J.-B. Wets (eds.), *Numerical Techniques for Stochastic Optimization*, Springer Verlag, Berlin, 1988.
- K. Frauendorfer, *Stochastic Two-Stage Programming*, Springer Verlag, Berlin, 1992.
- Haneveld, W.K.K., *Duality in Stochastic Linear and Dynamic Programming*, Springer Verlag, Berlin, 1986.
- G. Infanger, *Planning Under Uncertainty: Solving Large-Scale Stochastic Linear Programs*, The Scientific Press Series, Boyd & Fraser, 1993.
- A. Prékopa, *Stochastic Programming*, Kluwer Academic Publishers, Dordrecht, 1995.
- S. Vajda, *Probabilistic Programming*, Academic Press, London, 1972.

Additional Administrative Notes

The University of Texas at Austin provides upon request appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4241 TDD or the College of Engineering Director of Students with Disabilities at 471-4382.

An engineering student must have the dean's approval to add or drop a course after the fourth class day of the semester or after the second class day of a summer term. Adds and drops are not approved after the fourth class day except for good cause. "Good cause" is interpreted to be documented evidence of an extenuating nonacademic circumstance (such as health or personal problems) that did not exist on or before the fourth class day.

A Course-Instructor Survey from UT's Measurement and Evaluation Center will be administered near the end of the semester.