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ENME 725

Course Syllabus

Course Description

Provide an introduction to optimization under uncertainty. Recourse problems, chance-constrained programming, robust optimization, reliability programming, value of information, two-stage problems with recourse, decomposition methods, nonlinear and linear programming theory, probability theory.

Suggested Course Textbooks

1. J. R. Birge and F. Louveaux, *Introduction to Stochastic Programming,* Springer-Verlag, New York 1997, ISBN 0-387-98217-5.
2. A. J. Conejo, M. Carrion, J. M. Morales *Decision Making under Uncertainty in Electricity Markets,* , Springer, New York 2010, ISBN: 978-1-4419-7420-4.

Other Reference Books

1. S. Vajda, *Probabilisitic Programming*, Academic Press, New York, 1972.
2. W.L. Winston, J.B. Goldberg, *Operations Research: Applications and Algorithm*s (Vol. 3), Belmont, CA, Thomson/Brooks/Cole, 2004.
3. A. Ben-Tal, L. El Ghaoui, A. Nemirovski. *Robust Optimization* (Vol. 28). Princeton University Press, 2009.

Also, various related articles to be distributed.

Course Objective

1. Provide understanding for studying problems that involve optimization under uncertainty.
2. Learn about various stochastic programming formulations (chance constrained programs, two stage methods with recourse, robust optimization) relevant to engineering and economic settings.
3. Present theory for solutions to such problems.
4. Present algorithms to solve these problems.

Instructor

Dr. Steven A. Gabriel
www.stevenagabriel.umd.edu

Grading

Grading is based on comprehension and mastery of the material and the overall course score is computed as follows:

- **Homeworks, 1 for Module 1-Recourse Problems (weeks 1-7), 1 for Module 2 -- Chance-Constrained Problems (weeks 8-10): 25%**
- **In-class exam on Modules 1 & 2: 40%**
- **Project on topic Module 3- Robust Optimization report: 25%, Project presentation/Code Verification: 10%**)

- Two extensive homeworks which will be a mixture of developing GAMS models as well as more theoretical assigments. Total homeworks will count 25% of the course grade-- no collaboration with others. Any collaboration will be an immediate grade of zero.
- One in-class exam which will count 40% of the course grade-- no collaboration with others.
- One class project implementing some of the stochastic optimization modeling. The project report will be worth 25% and will be due the last day of class. A project presentation (to be scheduled after the report is received)) will be worth 10% of the course grade and all team members can be asked about any aspect of the project (and related topics). The code will be checked in-real time on a laptop provided by the project team. You are allowed to collaborate only with your team members on these case studies-- no other collaboration is allowed. The teams will consist of 2-3 students and must be pre-approved by Dr. Gabriel ahead of time. These mini case studies will involve both the modeling as well as data aspects of stochastic optimization and will entail a short report as the deliverable and all modeling done in GAMS. Part of the deliverable is to make sure that it runs on Dr. Gabriel's computer.

Course Policies

Students are encouraged to attend all lectures to maximize their understanding of the course material.

Students will complete the homeworks and then exam by themselves although teams of one to three students will be allowed for the Case Study portion of the course.

The course is subject to the Code of Academic Integrity available on the web. The Code prohibits students from cheating on exams, plagiarizing papers, submitting the same paper for credit in two courses without authorization, buying papers, submitting fraudulent documents, and forging signatures.

The University has a legal obligation to provide appropriate accommodations for students with disabilities. Please inform Dr. Gabriel of any accommodations needed relative to disabilities. Also, University of Maryland policy states that students should not be penalized due to observances of their religious beliefs. Please inform Dr. Gabriel of such instances well in advance so that appropriate steps can be taken.

Short Bio on Dr. Gabriel

Academic Experience: Besides teaching at University of Maryland, Dr. Gabriel has held appointments in the Mathematical Sciences Department at The Johns Hopkins University, and in the Engineering Management and Systems Engineering Department at The George Washington University. In addition, he has served as a postdoctoral researcher in the Mathematics and Computer Science Division at Argonne National Laboratory. Besides being a faculty member in the Department of Mechanical Engineering at UMD, he is also part of the faculty in Applied Mathematics, Statistics, and Scientific Computing. Also, he has also been: Director of the Master of Engineering and Public Policy Program (http://www.mepp.umd.edu) and Group Coordinator for the Civil Systems Program (http://www.civilsystems.umd.edu) within the Department of Civil & Environmental Engineering where he was a faculty member 2000-2015.

Industry Experience: Dr. Gabriel has over 25 years of industry and academic experience involving mathematical modeling of engineering-economic systems with applications in energy, transportation, service performance, and operations management. His specialties include optimization/equilibrium modeling.

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Department of Civil & Environmental Engineering and
Applied Mathematics and Scientific Computation Interdisciplinary Program
at the University of Maryland, College Park