EMIS 8384: Spring 2018

Stochastic Programming

Mondays and Wednesdays: 2:00-3:20 pm Caruth Hall 383

Instructor(s)	:	Prof. Harsha Gangammanavar
email	:	harsha@smu.edu
Office hours	:	Caruth Hall 331 Mondays and Wednesdays 11:00 am - 1:00 pm

Description: *Stochastic programming (SP) is a systematic framework for modeling and finding optimal decisions for optimization problems that involve uncertain data. This course will introduce the main themes and methodologies in SP in both two-stage and multistage settings. The main topics include: SP models, optimality and bounds in SP, and computational solution methods including sampling methods. A course project will involve implementation in C/C++.*
Pre-requisites: *EMIS 8370: Stochastic Models (or equivalent) and EMIS 8371: Linear Programming (or equivalent).*

Course Material:

- **Reference book:** Alexander Shapiro, Darinka Dentcheva and Andrzej Ruszczyski, *Lectures on Stochastic Programming: Modeling and Theory*, MOS-SIAM Series on Optimization, second edition, 2014, ISBN: 978-1-611973-42-6. (Available online for registered SMU students.)
- **Reference book:** John R. Birge and François Louveaux, *Introduction to Stochastic Programming*, Springer New York, tenth edition, 2011, ISBN: 978-1-4614-0236-7 (Online: 978-1-4614-0237-4). (Available online for registered SMU students.)
- **Reference book:** Patrick Billingsley, *Probability and Measure*, Wiley Series in Probability and Statistics, anniversary edition, 2012, ISBN: 978-1-118-12237-2.
- Journal articles and lecture notes to be posted on Canvas course page.

Course Requirement and Grading:

- **Assignments:** There will be six problem sets which will be spread across (evenly) throughout the duration of the semester. Each of these assignments will be of one of two types (a) textbook-type problem sets, and (b) presentation of archived journal articles. You may consult/collaborate with one other student on these problem sets, however, you are completely responsible for your final submission. If you have collaborated on your assignment, then you are required to declare the name of your collaborator, and the nature of collaboration during submission.

  You will turn in your assignment electronically on Canvas, or present during our meeting hours. When submitting online, the assignments should be submitted in a **single MS Word or PDF file** (cell phone camera pictures of handwritten notes will not be accepted). **Late homework will not be accepted for grading**, unless prior permission has been granted. Please make sure you complete the homework early to avoid any unforeseen situations (internet/electronic troubles etc.).

- **Examinations:** There will be a single take home examination at the end of semester. The textbook and class notes can be used as reference to complete the examination. This will be an individual examination, and collaborations with anyone (classmates or otherwise) is strictly prohibited.

  Scheduling conflicts: Legitimate conflicts that prevent you from taking your exam on scheduled dates and special requests should be notified within the first two weeks of the course. Any requests after that time will be handled on case-by-case basis.

- **Project**: The course project can be done by a group of one or two students. Students are encouraged to work on an implementation-based project which will require programming skills in C, C++, or java.
- **Grade distribution:**
  1. Problem sets/assignments: 40%
  2. Project: 30%
  3. Final Exam: 30%

Tentative Syllabus:

Part I: Stochastic programming models (3 weeks)

(a) Two-stage stochastic programs with fixed recourse
(b) Probabilistic/chance constrained programs
(c) Stochastic integer programs
(d) Multistage stochastic programs
(e) Risk-averse and robust formulations.

Assessment: One problem set and a presentation on application

Part II: Optimality, duality and bounds in stochastic programs (3 weeks)

(a) Expected value of perfect information
(b) Value of stochastic information
(c) Jensen's inequality; Edmunson-Madansky inequality
(d) Optimality conditions (basic and multistage)
(e) Duality (basic and multistage).

Assessment: One problem set

Part III: Computational solution methods (4 weeks)

(a) L-shaped method (single and multicut)
(b) Regularized decomposition
(c) Trust-region methods
(d) Nested methods for multistage stochastic programs
(e) Progressive hedging.

Assessment: One problem set and a presentation on recent developments in solution approaches

Part IV: Monte-Carlo sampling methods (2 weeks)

(a) Sample average approximation
(b) Stochastic decomposition
(c) Variance reduction
(d) Statistical optimality.

Assessment: One problem set

University policies:

- **Disability Accommodations:** Students needing academic accommodations for a disability must first register with Disability Accommodations & Success Strategies (DASS). Students can call 214-768-1470 or visit here to begin the process. Once registered, students should then schedule an appointment with the professor as early in the semester as possible, present a DASS Accommodation Letter, and make appropriate arrangements. Please note that accommodations are not retroactive and require advance notice to implement.
- **Religious Observance:** Religiously observant students wishing to be absent on holidays that require missing class should notify their professors in writing at the beginning of the semester, and should discuss with them, in advance, acceptable ways of making up any work missed because of the absence. (See University Policy No. 1.9.)
- **Excused Absences for University Extracurricular Activities:** Students participating in an officially sanctioned, scheduled University extracurricular activity should be given the opportunity to make up class assignments or other graded assignments missed as a result of their participation. It is the responsibility of the student to make arrangements with the instructor prior to any missed scheduled examination or other missed assignment for making up the work. (University Undergraduate Catalogue)
- **University Honor Code:** Students are reminded that the SMU Honor Code applies to this course. Honor Code violations will be dealt with in a manner determined by the instructor.
- **"Campus Carry" law:** In accordance with Texas Senate Bill 11, also known as the "campus carry" law, following consultation with entire University community SMU determined to remain a weapons-free campus. Specifically, SMU prohibits possession of weapons (either openly or in a concealed manner) on campus. For more information, please see: link.