

Instructor: Suvrajeet Sen**Office:** OHE 310P**Office Hours:** M,W – 11:30 – 12:30**Contact Info:** s.sen@usc.edu.**Course Description**

Stochastic Optimization is one of the more rapidly growing areas of optimization. Unlike traditional deterministic optimization models, this paradigm allows us to model uncertainty associated with the decision-making process. In essence, they provide formal tools for including random variables within constrained optimization problems. Such models find applications in a variety of situations arising in engineering, science, business, and public policy. The main topics in this course may be classified as follows: Risk Modeling using Stochastic Programming, Two-stage Stochastic Linear Programming using Deterministic as well as Stochastic Algorithms (including Sample-based Bounds), Stochastic Integer Programming Models and Algorithms, and Multi-stage Stochastic Programming (using both deterministic and stochastic algorithms). The exact break down is given in the week-by-week schedule.

Learning Objectives

The purpose of this course is to help the student understand when stochastic optimization may be necessary, and what class of models may be most appropriate in different circumstances. We will cover several important algorithms, including the L-shaped method, stochastic approximation, and stochastic decomposition. We will also introduce some stochastic integer programming algorithms which use decomposition-coordination techniques. Although most of the course will be devoted to two-stage models, students will also be introduced to multi-stage stochastic optimization models and algorithms. Finally, connections with stochastic programming and statistical learning will be explored.

Recommended Preparation: A first graduate course in optimization and the ability to program in a high level language are essential.

Course Notes:

Readings, and power point slides will be provided by the instructor. .

Required Readings and Supplementary Materials

Required readings and supplementary materials will be posted on Blackboard.

Description and Assessment of Assignments

Assignments will include modeling, algorithms, and properties

Grading Breakdown

Students will be graded on two mid-term exams (25% each), a final exam (25%), and homework (25%). Some homework assignments will require the use of software.

Assignment Submission Policy

Homework assignments will be submitted during the class period. The project will require a presentation during a class period.

Course Schedule: Weekly Breakdown

	Topics/Daily Activities	Readings and Lecture Notes	Deliverable/ Due Dates
Week 1 Jan 8, 10	Stochastic Programming Applications	Interfaces Paper by Sen/Higle	
Week 2 Jan 15,17	Applications (Contd) and Alternative Formulations of Risk	CVaR Papers by Rockafellar/Uryasev	Homework 1 Due
Week 3 Jan 22, 24	Alternative Formulations of Risk	Dominance Paper by Dentcheva/Ruszczynski	
Week 4 Jan 29, Feb 1	Two-stage Stochastic LPs: L-shaped method	Chapter from LP book by Bertsimas/Tsitiklis	Homework 2 Due
Week 5 Dates	Sampling Methods for Two-stage Stochastic LPs (SAA and SA)	Mak, Morton, Wood, and Survey chapter by Homem-de-Mello and	Take Home Test I
Week 6 Dates	Robust SA Statistical Aspects of SAA	Survey chapter by Homem-de-Mello, Nemirovski et al	
Week 7 Dates	Stochastic Decomposition (SD)	Chapters 3, 4 of SD book by Higle/Sen + Sen/Liu Paper	Homework 3 Due
Week 8 Dates	Learning Enabled Optimization	Lecture Notes	
Week 9 Dates	Background on Integer Programming	Lecture Notes	Homework 4 Due
Week 10 Dates	Two-stage Stochastic IPs: Branch-and-Cut	Paper by Kucukyavuz and Sen	
Week 11 Dates	Two-stage Stochastic IPs: Branch-Cut-Price	Papers by Sen/Sherali and Lulli/Sen.	Test Home Test 2
Week 12 Dates	Nested Benders' Decomposition	Paper by Donahue and Birge	
Week 13 Dates	Scenario Aggregation Algorithm	MOR Paper by Rockafellar and Wets	Homework 4 Due
Week 14 Dates	Stochastic Dual Decomposition	Paper by Philpott and Guan	
Week 15 Dates	Multi-stage SD	SIAM Paper by Sen and Zhou	Homework 5 Due
FINAL Date			Date: Take Home Final, Due on May 8, and 1:00 pm.

Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. Website and contact information for DSP: http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html, (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) ability@usc.edu.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *SCampus*, the Student Guidebook, (www.usc.edu/scampus or <http://scampus.usc.edu>) contains the University Student Conduct Code (see University Governance, Section 11.00), while the recommended sanctions are located in Appendix A.

Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: <http://www.usc.edu/student-affairs/SJACS/>. Information on intellectual property at USC is available at: <http://usc.edu/academe/acsen/issues/ipr/index.html>.

Emergency Preparedness/Course Continuity in a Crisis

In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies.

Please activate your course in Blackboard with access to the course syllabus. Whether or not you use Blackboard regularly, these preparations will be crucial in an emergency. USC's Blackboard learning management system and support information is available at blackboard.usc.edu.