

# IE 8990: Stochastic Optimization

Hugh Medal

Syllabus

## COURSE INFORMATION

### Instructor

Hugh Medal  
Assistant Professor, Department of Industrial Engineering  
260K McCain Engineering Building  
Phone: 662-325-3923  
Email: [hugh.medal@msstate.edu](mailto:hugh.medal@msstate.edu)

### Office Hours

Our office hours are the following:

- Tuesday: 11-12pm (Medal)
- Thursday: 11-12pm, (Medal)
- Monday/Wednesday/Friday: by appointment

For Dr. Medal's office hours you are welcome to drop in. However, if you wish to reduce/eliminate waiting time, you may wish to schedule an appointment via <https://hughmedal.youcanbook.me/>.

### Course materials

*Required textbooks*<sup>1</sup> Introduction to Stochastic Programming, John R. Birge and François Louveaux, Springer Series in Operations Research, New York: Springer, 2011

*Other materials* We will also be reading various journal articles throughout the semester.

### Prerequisites

A student should have training in linear programming (e.g., IE 4733: Linear Programming I), probability (e.g., IE 4613: Engineering Statistics I); and statistical inference (e.g., IE 4613: Engineering Statistics I).

### Course Description

An introduction to stochastic optimization, focusing on stochastic programming. Covers applications of stochastic modeling and formulation, important properties of stochastic programs, and solution methods such as decomposition, Monte Carlo methods, and approximation methods.

---

<sup>1</sup>Other free textbooks are also available: Lectures on Stochastic Programming, Alexander Shapiro, Darinka Dentcheva, and Andrzej Ruszcynski. (Available on first author's website); Stochastic Programming, Peter Kall and Stein Wallace. 2nd. ed. (available at: <http://www.business.uzh.ch/professorships/qba/members/kall/ka-wal-94.pdf>); and Handbooks in Operations Research and Management Science, 10: Stochastic Programming, Andrzej Ruszcynski and Alexander Shapiro (eds.) (available as PDFs through the MSU website).

## Course Website and Communication

I will use the course website (found via [mycourses.msstate.edu](http://mycourses.msstate.edu)) to post assignments, grades, etc. Students will submit their homework to this website. Students should make sure that they receive announcements from the course website (it should automatically go to your MSU email address). Students are also responsible to check their msstate.edu email account.

## LEARNING OBJECTIVES

At the end of the course students should:

- Be able to select the most appropriate type of SP model for a problem
- Be able to formulate a SP using a non-scenario-based formulation (symbolic formulation)
- Be able to model a two-stage SP using scenarios (extensive form)
- Be able to model a multi-stage SP using scenarios
- Be able to model a stochastic program with chance constraints
- Be able to explain the theoretical properties of a stochastic program
- Be able to demonstrate the value of a stochastic programming model and know when its use is appropriate
- Be able to solve special cases of stochastic programs
- Be able to solve a stochastic linear (or convex) program using the L-shaped method
- Be able to solve a stochastic linear (or convex) program using other methods
- Be able to choose an appropriate solution method for a model
- Be able to compute bounds on the optimal objective value of a stochastic program
- Be able to explain how to solve a chance-constrained problem

## IMPORTANT DATES

- August 22, Last day to drop a course without a grade (5th class day) 5:00 p.m.
- September 5, Labor Day Holiday
- January 19, Last day to register or add a course (6th class day)
- August 23, Last day to request undergraduate academic forgiveness via myState 5:00 p.m
- September 26, First progress grades reporting deadline
- October 13–14, Fall Break – No Classes Scheduled (Dates Subject to Change)
- October 21, Second progress grade reporting deadline (end of week 10)
- November 11, Last day to withdraw from University (ten days of classes remaining); Progress grade reporting closes
- November 23–25, Thanksgiving holiday – no classes scheduled
- November 30, Classes end
- December 1–2, Reading Days (No mandatory class assignments, requirements, meetings)

- December 3, Make-up days (if needed)
- **December 9, Final exam from 12–3pm**
- December 10, Make-up days (if needed)
- December 12, Final Grades Due 12:00 noon

## COURSE ASSESSMENTS

Student learning will be assessed using the following methods: problem sets, a competitive project, and an open-ended project.

### Problem Sets

Take-home assignments will be given about every other week. I expect to give between 6–7 assignments. 5 of your best assignments will contribute to your average. Assignments can be done in groups of at most two. They should be typed and submitted online via the course website. Late assignments will not be accepted. You are responsible for ensuring that you successfully upload the files in the correct format (.doc, .docx, or .pdf). I recommend that you use a mathematical typesetting software such as  $\text{\LaTeX}$  or  $\text{\LyX}$ .

### Competitive Project

Students will compete on solving a problem given by the instructor. Students will be evaluated based on the quality of their solution and the rigor employed in their solution method. Students must work individually.

### Final Project

Students will complete a project over the course of the semester. This project will consist of applying stochastic programming techniques to a problem. Hopefully many of you can choose a problem from your dissertation research and apply stochastic programming. The goal is that your project in this course will be the start of a journal article or conference paper. Students may work individually or in groups of 2 to 3. The grade will be based on a series of progress reports as well as the final report.

If you work in a group, you should clearly state what each of you did in a separate document. I would like you have equal participation. The quality of work should increase with the size of your group.

### Grade Distribution

Assignments	– 40 points (8 points each)
Competitive Project	– 20 points
Final Project	– 40 points

### Grading Scale

The following scale represents the minimum percentages needed for you to be guaranteed each letter grade.

A	90.0%
B	80.0%
C	70.0%
D	60.0%

However, I also use gray areas to determine grades. The gray areas are as follows:

A	89.0-89.9%
B	78.0-80.9%
C	67.0-70.9%
D	55.0-60.9%

If you in a gray area, your grade may be bumped up based on the following criteria: How many gray points did you earn? Did your grade increase over the course of the semester? Gray points can be earned from various activities through the semester such as the syllabus and knowledge quizzes at the beginning of the semester and reading memos.

## Grading Policies

### Late Problem Sets

If you cannot complete a problem set for a University-excused reason (see <http://www.policies.msstate.edu/policypdfs/1209.pdf>), you will be allowed to promptly submit it as soon as you are able. However, you must have your excuse validated by the Student Affairs office (<http://www.saffairs.msstate.edu/>).

### Grade Appeals

Grades will be posted on the course web site and updated periodically. It is your responsibility to verify that your grades have been correctly entered. You have *one week* after an assignment or a test is returned to discuss changes in your grade. Note that grade changes may result in an increase or a decrease in your grade.

## GUIDELINES

### Academic Honesty

We will comply with the MSU Honor Code (<http://www.honorcode.msstate.edu/pdf/honor-code.pdf>), which requires me to report cases of academic dishonesty (page 8). Examples of academic dishonesty in this class include by are not limited to the following:

- Using unauthorized materials/resources on a quiz/test
- Communicating with people outside the class during a quiz or test
- Communicating or copying work on a quiz/test
- A conversation about an quiz/test between a student who has taken the exam and a student who has not yet taken it
- Copying homework from another student

### Students Needing Extra Accommodation

If there are any issues that may affect your learning, please let me know. I would like to make accommodations in any way I can, in collaboration with Student Support Services (<http://www.sss.msstate.edu/disabilities/>). In addition, you may wish to consult with Student Support Services yourself to understand how you can receive help. Students who need academic accommodations based on a disability should visit the Office of Student Support Services, 01 Montgomery Hall, call 662-325-3335, or visit the website at [www.sss.msstate.edu](http://www.sss.msstate.edu).

## Title IX

MSU is committed to complying with Title IX, a federal law that prohibits discrimination, including violence and harassment, based on sex. This means that MSU's educational programs and activities must be free from sex discrimination, sexual harassment, and other forms of sexual misconduct. If you or someone you know has experienced sex discrimination, sexual violence and/or harassment by any member of the University community, you are encouraged to report the conduct to MSU's Director of Title IX/EEO Programs at 325-8124 or by e-mail to [titleix@msstate.edu](mailto:titleix@msstate.edu). Additional resources are available at <http://www.msstate.edu/web/security/title9-12.pdf>, or at <http://students.msstate.edu/sexualmisconduct/> <<http://students.msstate.edu/sexualmisconduct/>>.

## INFORMATION FOR DISTANCE EDUCATION STUDENTS

- For office hours, distance students may communicate with me via phone. However, students have found a video chat (e.g., Skype) to be more useful.
- Distance students are expected to keep up-to-date with watching video lectures. A link to the video lectures will be provided on the course website.
- Students can visit [www.bcoeonline.msstate.edu](http://www.bcoeonline.msstate.edu) to report technical difficulties or to access classroom videos. There is a link for each on the bottom right side of the page.