RUTGERS
Rutgers Business School

26:711:555 Stochastic Programming
Fall 2024, Wed. 12—2:50
1WP-502

Office hours: Livingston & online

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COURSE DESCRIPTION

The course focuses on modeling, analysis, and solution methods for optimization problems in the presence of uncertainty. It addresses expected value optimization, chance constraints, stochastic dominance, and risk measures. Two- and multi-stage problems will be discussed in depth, with applications to machine learning, finance, and operations management.

COURSE MATERIALS

The course notes will be posted on Canvas (canvas.rutgers.edu). There is no required textbook, but additional material may be found in the following books:

1. A. Shapiro, D. Dentcheva, A. Ruszczyński: *Lectures on Stochastic Programmi*ng (3rd. Ed.), SIAM, 2019
2. D. Dentcheva, A. Ruszczyński: *Risk-Averse Optimization and Control; Theory and Methods*, Springer, to appear in July 2024.

LEARNING GOALS AND OBJECTIVES

- This course is designed to help students develop skills and knowledge in the following area(s):

1. Modeling of decision problems under uncertainty. Risk modeling.
2. Analysis of stochastic optimization problems.
3. Solution of stochastic optimization problems.
4. Applications of stochastic optimization in operations management, finance, and machine learning.

- Students who complete this course will demonstrate the following:

1. The ability to identify, model, and analyze a stochastic optimization problem.
2. The ability to develop an efficient solution method for a stochastic optimization problem.
3. The ability to effectively implement a solution method and analyze the results obtained

- Students develop these skills and knowledge through the following course activities and assignments:

1. Modeling assignments
2. Optimization assignments
3. Probabilistic analysis and simulation assignments

PREREQUISITES

There are no formal prerequisites, but good preparation in multivariate calculus and the theory of probability is required.

ACADEMIC INTEGRITY

I do NOT *tolerate cheating*. Students are responsible for understanding the RU Academic Integrity Policy (https://slwordpress.rutgers.edu/academicintegrity/wp-content/uploads/sites/41/2014/11/AI_Policy_2013.pdf). I will strongly enforce this Policy and pursue *all* violations. On all examinations and assignments, students must sign the RU Honor Pledge, which states, "On my honor, I have neither received nor given any unauthorized assistance on this examination or assignment." [I will screen all written assignments through *SafeAssign* or *Turnitin*, plagiarism detection services that compare the work against a large database of past work.] Don't let cheating destroy your hard-earned opportunity to learn. See business.rutgers.edu/ai for more details.

ATTENDANCE AND PREPARATION POLICY

- Expect me to attend all class sessions. I expect the same of you. If I am to be absent, my department chair or I will send you notice via email and Blackboard as far in advance as possible. If you are to be absent, report your absence in advance at https://sims.rutgers.edu/ssra/. If your absence is due to religious observance, a Rutgers-approved activity, illness, or family emergency/death and you seek makeup work, also send me an email with full details and supporting documentation [within 3 days of your first absence]. [Explain other aspects of your absence policy in detail; it will save you trouble later.]

- For weather emergencies, consult the campus home page. If the campus is open, classes will be held.

- Expect me to arrive on time for each class session. I expect the same of you.

- Expect me to remain for the entirety of each class session. I expect the same of you.

- Expect me to prepare properly for each class session. I expect the same of you. Complete all background reading and assignments. You cannot learn if you are not prepared. The minimum expectation is that for each 3-hour class session, you have prepared by studying for at least twice as many hours.

- Expect me to participate fully in each class session. I expect the same of you. Stay focused and involved. You cannot learn if you are not paying attention.

CLASSROOM CONDUCT

The use of cell phones is forbidden. Please, refrain from eating and drinking. Do not sleep.

EXAM DATES AND POLICIES

There will be no exams in this course.

GRADING POLICY

Course grades will be determined by the weighted average of the following components: Homework assignments (60%), Final project (40%). A score above 90% will be graded as A, above 80% as B+, above 70% as B, above 60% as C+, and above 50% as C. Scores below 50% are failing grades.

Your final grade is not subject to negotiation. If you feel I have made an error, submit your written argument to me within one week of receiving your final grade. Clarify the precise error I made and provide all due supporting documentation. If I have made an error, I will gladly correct it. But I will adjust grades only if I have made an error. I cannot and will not adjust grades based on consequences, such as hurt pride, lost scholarships, lost tuition reimbursement, lost job opportunities, or dismissals. Do not ask me to do so. It is dishonest to attempt to influence faculty to obtain a grade that you did not earn, and it will not work.

COURSE SCHEDULE

Date	Topic	Items Due
Sep. 4	Modeling uncertainty and risk. Examples	
Sep. 11	Optimization problems with probabilistic (chance) constraints. Convexity theory.	Assignment 1
Sep. 18	Numerical solution of optimization problems with probabilistic constraints.	Assignment 2
Sep. 25	Two-stage stochastic programming problems. Basic properties and optimality conditions.	
Oct 2	Decomposition methods for two-stage problems.	Assignment 3
Oct. 9	Multistage (dynamic) stochastic programming problems.	
Oct. 16	Decomposition methods for multistage problems.	Assignment 4
Oct. 23	Introduction to risk-averse optimization: basic models.	
Oct 30	Optimization of risk measures.	Assignment 5
Nov.6	Stochastic dominance constraints.	
Nov.13	Dynamic risk measures. Time consistency.	Assignment 6
Nov.20	Sample-based optimization.	
Nov 27	Stochastic iterative algorithms.	Assignment 7
Dec. 4	Introduction to risk-averse reinforcement learning.	

SUPPORT SERVICES

If you need accommodation for a *disability*, obtain a Letter of Accommodation from the Office of Disability Services. The Office of Disability Services at Rutgers, The State University of New Jersey, provides student-centered and student-inclusive programming in compliance with the Americans with Disabilities Act of 1990, the Americans with Disabilities Act Amendments of 2008, Section 504 of the Rehabilitation Act of 1973, Section 508 of the Rehabilitation Act of 1998, and the New Jersey Law Against Discrimination. https://ods.rutgers.edu

If you are a military *veteran* or are on active military duty, you can obtain support through the Office of Veteran and Military Programs and Services. http://veterans.rutgers.edu/

If you are in need of *mental health* services, please use our readily available services.
[Select for inclusion in syllabus based on course location]
[Rutgers University-Newark Counseling Center: http://counseling.newark.rutgers.edu/]
[Rutgers Counseling and Psychological Services – New Brunswick: http://rhscaps.rutgers.edu/]

If you are in need of *physical health* services, please use our readily available services.
[Select for inclusion in syllabus based on course location]
[Rutgers Health Services – Newark: http://health.newark.rutgers.edu/]
[Rutgers Health Services – New Brunswick: http://health.rutgers.edu/]

If you are in need of *legal* services, please use our readily available services: http://rusls.rutgers.edu/

If you are in need of additional *academic assistance*, please use our readily available services.
[Select for inclusion in syllabus based on course location; undergraduate only]
[Rutgers University-Newark Learning Center: http://www.ncas.rutgers.edu/rlc
Rutgers University-Newark Writing Center: http://www.ncas.rutgers.edu/writingcenter]
[Rutgers University-New Brunswick Learning Center: https://rlc.rutgers.edu/]