Math 482-001

Mathematical Methods of Operations Research
Spring 2026

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▬▬▬ Course Information

Course Time:	M, W, F: 8:00 − 8:50 am	Office Hours:	M, W, Th, F: 10:00 − 11:30 am
Course Location:	Nick 165	Office Location:	Benson 87

▬▬▬ Textbooks

Main reference is course notes provided by the instructor.

▬▬▬ Course Format

As Paul Halmos noted, "The only way to learn mathematics is to do mathematics." Hence, we will spend the majority of our class time working through exercises that complement the daily lecture.

▬▬▬ Learning Outcomes

Upon successful completion of the course, students will be able to

- Formulate mathematical models for real-world decision problems arising in operations research, engineering, economics, and the sciences, clearly identifying assumptions, variables, objectives, and constraints.
- Translate applied problems into linear programming formulations, including objective functions and constraint systems, and interpret model components in the context of the original application.
- Convert linear programs into standard form and correctly construct and interpret the dual problem, including economic and geometric meanings of dual variables.
- Analyze feasible regions geometrically, using concepts such as convex sets, polyhedra, extreme points, and faces to reason about existence and structure of optimal solutions.
- Apply the Simplex Method from both geometric and algebraic perspectives, including pivot rules, tableau/dictionary representations, and algorithmic implementation.
- Diagnose and explain infeasibility, unboundedness, and degeneracy, including cycling behavior and the role of anti-cycling rules.
- Use complementary slackness and primal–dual relationships to certify optimality and to extract meaningful sensitivity and shadow-price information.
- Construct and interpret optimality certificates, demonstrating correctness of solutions independently of a specific algorithm.
- Employ matrix and linear algebra techniques (e.g., basis matrices, dictionaries, rank considerations) to analyze and manipulate linear and quadratic optimization models.
- Formulate and analyze convex quadratic programming models arising from optimization and equilibrium problems, including identification of convexity, interpretation of quadratic objectives, and connections to linear programming and variational formulations.
- Develop nonlinear mathematical models that extend beyond quadratic structure, and analyze these models using first-order optimality conditions, local approximations, and qualitative solution behavior, with emphasis on methods suitable when closed-form solutions are unavailable.
- Compare linear, quadratic, and general nonlinear modeling approaches, evaluating their appropriateness, limitations, and computational implications in the context of large-scale or performance-driven applications studied in the final weeks of the course.

▬▬▬▬ Grading Policy

Your final grade is broken up as follows.

Category	Percentage
Worksheets	15%
Homeworks	15%
Exams (15% each)	45%
Final Project	25%

Your final letter grade is based on the following scale.

Grade	Percentage Interval	Grade	Percentage Interval
A	$[93, 100]$	C+	$[77, 80)$
A-	$[90, 93)$	C	$[70, 77)$
B+	$[87, 90)$	D	$[60, 70)$
B	$[83, 87)$	F	$[0, 60)$
B-	$[80, 83)$		

▬▬▬▬ Assignment Descriptions

Worksheets

Worksheets are given on Workshop days, which are designed to provide class time for students to work on bigger problems. Some of these problems may have a programming component. Students may be deducted points for being absent for the given class period.

Homeworks

To help develop a mastery of the material, students will be given weekly homework assignments to cover the material in greater depth. The students are expected to write out their answers with an appropriate amount of work shown. Students may recieve additional time to complete the assignment for excused abscences; however, the student must communicate with the instructor prior to the assignment deadline.

Exams

We will have 3 exams throughout the semester. These exams are intended to test your understanding of the concepts covered up to that point, with a heavy emphasis on the main definitions, theorems, and problem solving methods. These exams will be administered in class. Students may be given a makeup exam time for excused abscences; however, the student must communicate with the instructor prior to the assignment deadline.

Each student is allowed two opportunities to make up points on an exam; one correction per exam, up to 3 points for each correction. When performing exam corrections, the student must redo one or more problems (all parts) and then present their corrections to the instructor during office hours or another agreed upon time. During this time period, the instructor will ask follow up questions and may have the student attempt other similar problems at the board.

Final Project

During the last week of class, students will explore additional topics related to the course that we did not have time to cover, e.g., more on non-linear programming, queues, or simulation. During finals week, we will meet so that students can present their research to the class.

▬▬▬▬ Attendance Policy

Class attendance is highly encouraged and partially monitored through worksheets. In the case of an excused absence, e.g., illness, athletic contests, job interviews, and academic conferences, students will be given a reasonable amount of time to makeup an exam or assignment. However, students are responsible for notifying the instructor prior to the absence. In the event of a longterm absence, the student should contact Student Affairs about the possibility of a withdrawal for the semester.

▬▬▬▬ Academic Integrity

Academic integrity is a basic guiding principle for all academic activity at the University, and all members of the community are expected to adhere to this principle. Specifically, academic integrity is the pursuit of

scholarly activity in an open, honest, and responsible manner. It includes a commitment not to engage in or tolerate acts of falsification, misrepresentation, or deception. Such acts violate the fundamental ethical principles of the University community and undermine the efforts of others.

Violations of academic integrity are not tolerated at Penn State Behrend. Violators will receive academic sanctions and may receive disciplinary sanctions, including the awarding of an XF grade. In cases such as these, an XF grade is recorded on the transcript and states that failure of the course was due to an act of academic dishonesty. All acts of academic dishonesty are recorded so those repeat offenders can be sanctioned accordingly.

For more information:

> https://behrend.psu.edu/academics/academic-services/academic-integrity-students

■■■■■ Disabilities and Learning Differences

Penn State is firmly committed to providing full access to its programs and services for all individuals. The University encourages academically qualified students with disabilities to take advantage of the educational programs and accommodations offered at Penn State Behrend.

For more information:

> http://behrend.psu.edu/student-life/educational-equity-and-diversity/
> student-resources/students-with-disabilities-and-learning-differences

■■■■■ Educational Equity Concerns

Penn State takes great pride in fostering a diverse and inclusive environment for students, faculty, and staff. Acts of intolerance, discrimination, harassment, and/or incivility due to age, ancestry, color, disability, gender, national origin, race, religious belief, sexual orientation, or veteran status are not tolerated and can be reported through Educational Equity at the Report Bias site:

> https://equity.psu.edu/reportbias

■■■■■ Counseling and Psychological Services

Students with academic concerns related to this course should contact the instructor in person or via email. Students may also occasionally have personal issues that arise in the course of pursuing higher education that may interfere with their academic performance. If you find yourself facing problems affecting your coursework, you are encouraged to talk with an instructor and to seek confidential assistance at the Penn State Behrend Personal Counseling Services at (814) 898-6504.

For more information:

> https://behrend.psu.edu/student-life/student-services/personal-counseling

■■■■■ Copyright of Class Materials

You may not share any information from this course (including notes and assignments) with others who are not currently registered for the course, nor post such information electronically without the permission of the instructor–this includes online note-taking/note-sharing services (See Penn State Administrative Policy AD-40). Also prohibited in the policy is the posting of audio, video, or photographs posted to social media sites or other publicly accessible resources. Unless you have my permission, you risk disciplinary sanctions.

■■■■■ Title IX

Penn State is committed to fostering an environment free from sexual or gender-based harassment or misconduct. The Office of Sexual Misconduct Prevention and Response ensures compliance with Title IX, a federal law that prohibits discrimination based on the sex or gender of employees and students. Behaviors including sexual harassment, sexual misconduct, dating violence, domestic violence, and stalking, as well as retaliation for reporting any of these acts violate Title IX and are not tolerated. The University is also committed to providing support to those who may have been impacted by incidents of sexual or gender-based harassment or misconduct and may provide various resources and support services to individuals who have experienced one of these incidents. For more information:

https://universityethics.psu.edu/our-expertise/title-ix

or

https://universityethics.psu.edu/our-expertise/title-ix/t9-resources/campus-resources/behrend

Center for Learning Excellence

The Center for Learning Excellence offers tutoring services that can help you find gaps in your understanding of concepts, show you how to get the most out of your textbook, give you advice about how to prepare for a test, and study for the course. Free peer tutoring appointments (in person and online) can be made via Tutor Trac

<div align="center">https://tutorapp.bd.psu.edu</div>

For more information about study abroad, scholarships/fellowships, GRE, writing personal statements and study skills, visit

<div align="center">https://behrend.psu.edu/lrc</div>

email BDtutor@psu.edu or call 814-898-6140 from 8:00 a.m. to 5:00 p.m. Monday through Friday.

Career Services

Penn State Behrend Career Services prepares Penn State students to enter the workforce or graduate school through a variety of services. Career professionals will assist with resume and cover letter reviews, internship and job searches, interview prep and mock interviews, career fair prep, development of career competencies, and graduate school prep. You can stop by the Career Services office in Reed 125 during drop-in hours Monday-Friday, 12:00-4:00 p.m. You may also schedule an appointment through Starfish or call 814-898-6164. For more information, visit

<div align="center">https://behrend.psu.edu/careerservices</div>

Important Dates

Classes Begin . . . . January 12
Regular Drop Deadline . . . . 11:59 pm January 17
Regular Add Deadline . . . . 11:59 pm January 18
Martin Luther King Day . . . . January 19
Exam 1 . . . . February 9
Final Exam Conflict Filing Period . . . . February 16 – March 18
Exam 2 . . . . March 6
Spring Break . . . . March 8 – March 14
Late Add/Drop Deadline . . . . April 10
Exam 3 . . . . April 24
Class Ends . . . . May 1
Final Exams . . . . May 4 – 8

Disclaimer:

I reserve the right to diverge from this syllabus in the best interest of my students' learning and achievement. Any changes will be announced in advance.