

Operations Research 1
ESI 3312 (Section 267B)
Class Periods: MWF, Period 8 (3:00 PM - 3:50 PM)
Location: CSE E121
Academic Term: Fall 2025

Instructor:

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Office Hours: Monday 4:00-5:00 PM (by appointment, Weil 401A)

Graders:

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Office Hours: TBD	Office Hours: TBD
Location: TBD	Location: TBD

Course Description

(3 credits) Introduces deterministic optimization modeling, algorithms, and software to aid in the analysis and solution of decision-making problems.

In this introductory course on deterministic Operations Research (OR), we will learn to formulate mathematical models and develop solution methods to support decision-making. The course focuses on finding optimal solutions to real-life problems based on well-defined objectives. While we will examine various problem types, the primary emphasis will be on those that can be modeled as linear programming problems—optimizing a linear function of several variables subject to linear constraints. Applications will span transportation, healthcare, and logistics, among others. The theoretical foundation will cover the Simplex algorithm, duality theorems, sensitivity analysis, network flows, and an introduction to basic integer programming.

Course Pre-Requisites / Co-Requisites

ESI 3327C with minimum grade of C. Knowledge of linear algebra (matrix algebra, linear independence, solution of systems of equations) and basic programming skills (any language).

Course Objectives

At the end of this course, students are expected to be able to: (1) identify situations where optimization can improve the decision-making process, (2) mathematically formulate optimization problems, (3) implement and solve optimization problems using commercial software, and (4) analyze, interpret, and communicate the output of an optimization problem to professionals in other disciplines.

Materials and Supply Fees: No fees.

Relation to Program Outcomes (ABET):

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	High
5. Ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives	Medium

*Coverage of additional outcomes is Low

Textbooks and Software

- **Textbook (not required):** Optimization in Operations Research by Ronald Rardin. Pearson (ISBN#: 0134384555) (1st or 2nd edition).
- **Software:** AMPL. Unrestricted version available in Canvas (Linux, macOS 64, Windows 32 and 64). Linear and nonlinear state-of-the-art solvers (Baron, Knitro, Cplex, Gurobi).

Recommended Materials

- AMPL: A Modeling Language For Mathematical Programming, 2nd ed. 2002. R. Fourer, D.M. Gay, and B.W. Kernighan. Cengage Learning. URL: <http://ampl.com/resources/the-ampl-book/>
- Linear programming and network flows, 4th ed. 2010. M.S. Bazaraa, J.J. Jarvis, and H.D. Sherali. John Wiley & Sons.

Required Computer

- Recommended Computer Specifications: <https://it.ufl.edu/get-help/student-computer-recommendations/>
- HWCoe Computer Requirements: <https://www.eng.ufl.edu/students/advising/fall-semester-checklist/computer-requirements/>

Course Schedule (Subject to Change)

Week 1:	Introduction to the course, impact of OR, selected applications, in-class activity. Introduction to optimization modeling.
Week 2:	Basic definitions and classification of optimization problems. Large-scale formulations, canonical and standard forms.
Week 3:	Common modeling structures: types of constraints, objective functions, and decision variables. Modeling practice (with AMPL).
Week 4:	Graphical solution method. Basic concepts in optimization, global and local optima, improving search paradigm.
Week 5:	Linear algebra concepts (matrix/vector multiplication, inverse, determinant, systems of linear equations). Assumptions of linear programming, slack variable, binding constraint, polyhedron, extreme point, direction of a set, extreme directions, recession cone.
Week 6:	Geometry of linear programming, basis, basic solution, basic and non-basic variables, moving along extreme points.
Week 7:	Simplex method: Basic feasible initial solution, reduced costs, optimality test.
Week 8:	Exam 1 (Monday, October 6) . Simplex method: Direction of movement, minimum ratio test, pivoting.
Week 9:	Simplex method in tabular form. Simplex method: Initialization.
Week 10:	Spring Break
Week 11:	Motivation, dual and primal problems, dual interpretation. Duality theorems, primal-dual relationship.
Week 12:	Sensitivity analysis, changes in right-hand-side, objective function. Change in objective function coefficients and right-hand side, adding/removing a variable, adding/removing a constraint.
Week 13:	Introduction to network optimization, notation, definitions, selected applications, minimum cost flow problem. Shortest path problems.
Week 14:	Exam 2 (Monday, November 17) . Maximum flow, transportation, and assignment problems. Applications. Specialized algorithms (Dijkstra's algorithm, Bellman-Ford algorithm).
Week 15:	Introduction to integer programming. Motivation, modeling structures, applications, modeling practice.
Week 16:	Branch-and-bound.
-----	Final Exam (December 12, 12:30 pm - 2:30 pm)

Important Dates

- October 6 Exam 1 (in class)
- November 17 Exam 2 (in class)
- December 12 Final Exam (12:30 pm - 2:30 pm, regular classroom)

Attendance & Makeup Exams: Student attendance is encouraged, and active participation is expected. If you anticipate not being able to attend any class due to travel restrictions or personal health concerns, contact me at the beginning of the semester or as soon as your situation changes. Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Read the university attendance policies: <https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>. No makeup exams will be given for this class. If you miss Exam 1 or Exam 2 for a reason approved under UF policy, the grade for your next exam will replace the missed exam.

Class Expectation: To ensure a classroom environment conducive to success for everyone, please turn off cell phones before class starts and avoid using your computer during the lecture for matters that are unrelated to the class content. Please arrive at class on time. If you must enter the classroom late or leave early, be considerate and be as quiet as possible.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework (x 5)	100 each	25%
Exam 1	100	25%
Exam 2	100	25%
Final Exam	100	25%
Total		100%

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Grading Policy (Subject to Change)

Percent	Grade	Grade Points
92.0 - 100	A	4.00
90.0 - 91.9	A-	3.67
86.0 - 89.9	B+	3.33
82.0 - 85.9	B	3.00
78.0 - 81.9	B-	2.67
74.0 - 77.9	C+	2.33
71.0 - 73.9	C	2.00
68.0 - 70.9	C-	1.67
65.0 - 67.9	D+	1.33
62.0 - 64.9	D	1.00
60.0 - 61.9	D-	0.67
0 - 59.9	E	0.00

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Academic Policies & Resources

To support consistent and accessible communication of university-wide student resources, instructors must include this link to academic policies and campus resources: <https://go.ufl.edu/syllabuspolices>. Instructor-specific guidelines for courses must accommodate these policies.

Commitment to a Positive Learning Environment

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values.

If you feel like your performance in class is being impacted, please contact your instructor or any of the following:

- Your academic advisor or Undergraduate Coordinator
- HWCoe Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu