

# ESI4313: Operations Research 2

**Class Periods:** M,W,F | Period 6 (12:50 PM - 1:40 PM)

**Academic Term:** Fall 2023

**Location:** FLG0285

## 1 Instructor

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*Office hours and location:* Tuesdays 1:30–3:20pm at Weil 401D (additional office hours may be available by appointment)

## 2 Course Description

Credit number: 3

Catalog Description: Introduction to stochastic models and methodologies for analyzing and providing solutions to decision-making problems with uncertainties.

## 3 Prerequisites/Co-Requisites

Pre-requisites: ESI 4327C and STA 4321 with minimum grades of C.

To succeed in this class, a working knowledge of calculus, linear algebra, matrix, and probability is needed. Some experience with basic programming techniques in Matlab or equivalent is a plus.

## 4 Course Objectives

At the end of the class, students are anticipated to (1) understand the concepts about randomness/uncertainty, probability models, Markov chains, and queueing systems; (2) be familiar with basic rules of probability and stochastic models; (3) be able to derive analytical solutions to small-scale problems; (4) be able to use probability and stochastic models in modeling uncertainty; and (5) be able to address problems that involve randomness/uncertainty.

## 5 Relationship of Course to Program Outcomes

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	
3. An ability to communicate effectively with a range of audiences	
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5. An 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	
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	

\*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

## 6 Textbooks and Software

**Required textbook:** “Introduction to Probability Models,” Author: Sheldon Ross, Academic Press: 11th edition, ISBN: 978-0124079489

**Recommended textbook:** “Introduction to Probability,” Author: Dimitri Bertsekas and John Tsitsiklis, Athena Scientific; 2nd edition, ISBN: 978-1886529236

## 7 Materials and Supply Fees

None

## 8 Course Outline

Below is a list of topics for the class. Items may be added to or reduced from the list according to the pace of the class. Though unlikely, but the exam dates may be subject to change due to the pace of the class.

Week	Topic	Book Chapters
1	Course introduction, Review of Probability Theory, Random Variables	1, 2
2	Review of Probability Theory, Random variables, Conditional Probability	1, 2, 3
3	Conditional Probability	3
4	Poisson Process	5
5	Review, Midterm exam 1	NA
6	Poisson Process	5
7	Poisson Process, Markov Chains	5, 4
8	Markov Chains	4
9	Review, Midterm exam 2	NA
10	Spring break	NA
11	Markov Chains, Continuous-time Markov Chains	6
12	Continuous-time Markov Chains	6
13	Continuous-time Markov Chains, Queueing Theory	6, 8
14	Queueing Theory	8
15	Queueing Theory & Dynamic programming	8
16	Review	NA

## 9 Important Dates

Two midterm exams:

- Detailed time and location TBA.

Final exam

- Final Exam: 12/14/2023 @ 7:30 AM - 9:30 AM (May be subject to change)

Extra-credit project dates:

- Deadline to inform the instructor of topic choices: September 18, 2023.
- Project deliverables submission deadline: 11:59 pm on April 24, 2023.

## 10 Attendance Policy

Attendance is strongly recommended. It will be to your benefit to attend all lectures. Students will be responsible for all material covered in class. Please remember to turn off your cell phone as soon as you enter the classroom. Those who behave inappropriately will be asked to leave.

## 11 Student Teams

Student teams are to be formed in the first week of the class. The team size is expected to be 6 or 7. Please first form the team based on your own preference. Then the instructor will make adjustments if necessary. The same student teams are expected to participate in both in-class team-based activities and, if the team is willing to, extra-credit projects. Team size will *not* be factored into grading.

## 12 Practice Problems

Multiple sets of practice problems will be announced during the course. Those problems will not be collected, but they are very helpful to prepare for the exams. Selective problems out of these practice problems will be graded upon during in-class student presentations explained in Section 13.1.

## 13 Evaluation of Grades

Class grades will be based on:

- a. two mid terms (the one with the higher score will count 30%, and the other, 25%, towards the final grade),
- b. final exam (30%),
- c. class participation (15%).

### 13.1 In-Class Participation

The 15% points of in-class participation is determined from the following components:

- 9/15. There will be two opportunities for the each student team to make short in-class presentations on their solutions to practice problems. While the problems will be assigned to each team before the day of the presentation, the presenter will be randomly chosen from the student team “on the fly”. These presentations will be followed by questions from the student audience, TA, and the instructor. Grading rubrics of each problem will be announced before each presentation in accordance with the level of difficulty of the problems. The higher score out of the two opportunities will be the final score for this component.
- 6/15. Additional in-class activities requiring student participation will be announced during the course. Students will be evaluated based on their performance in those activities.

### 13.2 Exams Are Either In-Class or Online

The exams will be in-class or online (specific formats to be announced). Below are the description for both formats. Once decided, all students will take the same format of exams.

#### **In-class exam:**

- The mid-term exams will be closed-book but each student is allowed to bring in one sheet of 8.5×11.0 inches paper of handwritten notes and a calculator. The exact date of the midterm will be communicated later.
- The final exam will be closed-book but each student is allowed to bring in one sheet of 8.5×11.0 inches paper of handwritten notes and a calculator. The final exam is cumulative and will cover materials in both the lectures and the practice problems.
- No collaboration is allowed in any form during the exam. E.g., lending/borrowing a calculator, sharing notes, etc., are not allowed.

#### **Online exam:**

- The mid-term exams will be open-book, but each student has to use only paper-based notes. A calculator is allowed. The exact date of the midterm will be communicated later.
- The final exam will be open-book, but each student has to use only paper-based notes. A calculator is allowed. The final exam is cumulative and will cover materials in both the lectures and the practice problems.
- No collaboration is allowed in any form during the exam. No cellphone or pads are allowed. The only screen allowed is the one proctored by Honorlock.

### 13.3 Extra-Credit Projects

**Maximally 5 extra credit:** Extra-credit take-home projects will be announced. The topics of the projects include building simulators, solving problems in stochastic models, and review advanced results in operations research. Each problem can be chosen by only one team of students. The first team who formally indicates interest (via an email through elearning/Canvas) will be given the problem. This extra-credit project is for the students who are interested in gaining further insights into the stochastic models. Intense self-learning will be expected from the participants. The instructor or the TA(s) will only provide general guidance in the project. Neither the instructor nor the TA(s) will help with actual proofs, data structure, simulator/algorithm design, coding, platform environment setup, and debugging. Each participating team is required to present their solutions in class and submit their powerpoint slides. When applicable, the team should also submit their programming codes. Grading rubrics will be announced together with those extra-credit problems during the first two weeks of the class. Student teams who have agreed to participate but fail in completing the project will be penalized 0.5 point from their total score. However, if the project team makes sufficient efforts, completes the project, but the solution is wrong, extra credit will be awarded in accordance with the rubrics to be announced, but at least 0.5 point is guaranteed.

### 13.4 Exam Grading Appeals

The instructor and the TA will make every effort to ensure that grading is as objective and fair possible. Students are allowed to submit an appeal in writing within one week of your exam being returned. The written appeal should be done on a sheet of paper that is stapled to your original graded paper. The packet should be submitted before/after the class or during office hours. The written appeal should indicate the reason why you believe re-grade is appropriate. At the receipt of such an appeal, the instructor and the TA will regrade the entire exam to ensure that all parts are properly graded. It is possible that the second grade will be either higher or lower than the first grade.

No re-grade will take place on the spot nor will be considered face-to-face. The instructor and TA keep the prerogative of deciding of a complete re-grade of the paper when you request the re-grade of any of its parts. This rule is to prevent frivolous complaints. Finally, be aware that samples of quizzes and tests are photocopied and kept to verify if any alteration was made between the return of a paper and the request for a re-grade. In the case of such event, you will receive a failing grade for the totality of your paper and the case will be handed to the Dean of Students Office for prosecution.

Please be aware that if the grader misunderstood your answer during the first grading, it is probably that it was not clear. Explaining what you meant afterwards will not earn you any point as it should have been clear the first time around.

## 14 Grading Policy

The grading scale for the class is as below:

Grade	Range	Grade Points
A	[93, 100]	4.00
A-	[90, 93)	3.67
B+	[87, 90)	3.33
B	[83, 87)	3.00
B-	[80, 83)	2.67
C+	[77, 80)	2.33
C	[73, 77)	2.00
C-	[70, 73)	1.67
D+	[65, 70)	1.33
D	[60, 65)	1.00
D-	[55, 60)	0.67

Curving might occur in any assignment/exam if the average result is too low. More information on UF grading policy may be found at: <https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/>.

Grades are not subject to negotiation and will be solely based on your performance in this course; that is, no outside factors will be considered. Those outside factors include the plan to graduate within certain timeline and the current grade being near to the next higher or lower grade.

A grade of C is required to pass this class. A C– is NOT considered passing.

## 15 Make-up Exam Policy

We anticipate the students be present without exception in the exams; please make all other plans in avoidance of conflicts with the exam dates. Absence in exams can be excused in medical emergencies, if accompanied by a doctor's note. A note indicating that you were seen at a health/medical care provider on the day of the exam is not sufficient documentation of a medically excused absence from an exam. The note explicitly must state that the absent student were medically unable to take the exam. If the absent student fails to take the exam on the assigned day and do not have a valid excuse, there will be no makeup exam and a zero (0) grade will be given on the exam. Reasons such as job interviews, employer events, weddings, vacations, etc., are not valid excuses for being absent in any of the exams. Maximally one make-up exam is allowed for each of the midterm and final exams.

## 16 Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

## 17 Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

## 18 In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor. A ?class lecture? is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session. Publication without permission of the instructor is prohibited. To ?publish? means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or

persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

## 19 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/policies/student-honor-code-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.

## 20 Commitment to a Safe and Inclusive 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, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

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

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0904, [student-support-hr@eng.ufl.edu](mailto:student-support-hr@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

## 21 Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

## 22 Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

## 23 Campus Resources

### Health and Wellness

**U Matter, We Care:** Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

**Sexual Discrimination, Harassment, Assault, or Violence:** If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the Office of Title IX Compliance (<https://titleix.ufl.edu/>), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

**Sexual Assault Recovery Services (SARS):** Student Health Care Center, 392-1161.

**University Police Department:** 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

### Academic Resources

**E-learning technical support:** 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu). <http://lss.at.ufl.edu/help.shtml>.

**Career Connections Center.** Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

**Library Support:** <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center:** Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <http://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall:** 846-1138. Help brainstorming, formatting, and writing papers. <http://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus:** <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

**On-Line Students Complaints:** <https://distance.ufl.edu/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.