

**ISE 580: Performance Analysis with Simulation****Units:** 3**Spring 2024:** Friday 3:30 – 6:50**Location:****Instructor:** Hamid Pourmohammadi**Office:** GER 242-A**Office Hours:** Fridays 2:30-3:30 (by appointment)**Contact Info:** [pourmoha@usc.edu](mailto:pourmoha@usc.edu)**Teaching Assistant:** Citina Liang**Office:** TBD**Office Hours:** Friday 10:00 – 12:00**Contact Info:** [citinal@usc.edu](mailto:citinal@usc.edu)**IT Help:** [consult@usc.edu](mailto:consult@usc.edu)**Hours of Service:** 24, 7**Contact Info:** 213-740-5555**Catalog Course Description**

Introduction to modeling and analysis of stochastic systems, with an emphasis on discrete-event simulation of non-Markovian systems.

**Prerequisite(s):** None.**Recommended Preparation**

Probability and statistics, including hypothesis testing and introductory computer programming.

**Course Introduction:**

In this course we use simulation modeling to analyze the performance of different processes. In simulation modeling we try to explain how a process works by building a replica of it. A simulator such as Arena allows us to collect and compare the output of a simulated model based on different assumptions and inputs over time. This capability is essential in analyzing stochastic (or random) systems where the system's behavior over the time is unpredictable. The ability of running the simulation multiple times without any risk and based on different input set, provides an extremely useful tool for decision makers to see and compare the wide spectrum of possibilities.

**Learning Objectives and Outcomes**

At the end of this course students are able to:

- ✓ Identify the different types of simulation models
- ✓ Build Simulation Models with ARENA
- ✓ Perform goodness of fit tests

- ✓ Apply a general approach to generate random variates
- ✓ Analyze the output of a simulation model
- ✓ Construct Confidence Intervals to compare the performance of two or more system configurations
- ✓ Optimize a system configuration with ARENA

**Required Textbook**

Kelton, Zupick, and Ivey, *Simulation with ARENA*, 7 Ed., McGraw-Hill, 2024

**Course Website:**

The course material will be posted on <http://courses.uscden.net>. IT IS HIGHLY RECOMMENDED TO BRING YOUR LAPTOP TO THE CLASS MEETINGS.

**Technological Proficiency and Hardware/Software Required**

The student version of ARENA is the main computational tool. It is an MS Windows based Software. Students using MacOS should follow the VDI Tutorial pdf file on Blackboard to have access to ARENA. We will also use Excel for the statistical analysis. Here is the link to get a free copy of the software:

Arena Software: <http://www.arenasimulation.com/>

**Description and Assessment of Assignments**

| Assignment                   | % Of Grade |
|------------------------------|------------|
| Homework/Class Participation | 30         |
| Term Project                 | 10         |
| Exam I                       | 20         |
| Exam II                      | 20         |
| Final                        | 20         |
| <b>TOTAL</b>                 | <b>100</b> |

Grading Scale (Course final grades will be determined using the following scale)

|    |        |    |       |    |              |
|----|--------|----|-------|----|--------------|
| A  | 95-100 | B- | 80-82 | D+ | 67-69        |
| A- | 90-94  | C+ | 77-79 | D  | 63-66        |
| B+ | 87-89  | C  | 73-76 | D- | 60-62        |
| B  | 83-86  | C- | 70-72 | F  | 59 and below |

***Exams I and II:***

The midterm will be based on the tentative course schedule and will take 2 hours. Make-up exam is only considered under special situations with advance approval of the instructor. If the modality of the exam is changed, it will be announced in the class and on the website.

### ***Final Exam:***

The final exam will be based on the University schedule and it takes 2 hours. Make-up exam is only considered under special situations with advance approval of the instructor. If the modality of the exam is changed, it will be announced in the class and on the website.

### ***Homework/Class participation:***

There will be two different types of Homework (*usually 20 points*): Individual Homework and Team Homework. Homework sets are assigned based on the topics that are covered in the class. Homework sets will be provided on the website and must be submitted there, as well. Depending on the class's progress, there may be a “case study analysis” assignment. The case needs to be purchased from HBR, the details and instructions for purchasing the case and preparing the report will be covered in the class. As for class participation (*usually 10 points*), in each class session, several examples will be presented and covered in the class. You should actively participate in working on the class example and submit the completed examples as your class participation. **The deadline to submit the class participation activities is 1 hour after the class session on Fridays.**

### ***Term Project***

Teams will be assigned randomly after the midterm. Two major submissions are required, “The Problem Statement” (*2 points*), and the “Final Report and Presentation” (*8 points*). Teams submit the project proposal or problem statement to the instructor first. After approval, teams can start the modeling and implementation of the project using Arena. Teams will present the project in the last session of the class. The project submission guidelines will be provided on the Bb and due dates are provided on the Tentative Course Schedule (see next page).

### **Intellectual property policies:**

This is a clarification that any misuse, inappropriate dissemination, or attempted sale of class recordings and handouts, as well the appropriation of intellectual property is not acceptable. It is student’s responsibilities towards the appropriate use and handling of these recordings under existing SCampus policies regarding class notes (<https://policy.usc.edu/scampus-part-c/>). Students are not permitted to create their own class recordings without the instructor’s permission. Violations of these policies will be met with the appropriate disciplinary sanction.

### **Communication Policies**

- ✓ Students are required to **use their USC email account** for any contact with instructor through email. It is required to include the course number (**ISE 580**) **in the subject** of the email. The instructor will reply to emails within 24 hours. It may take longer over weekends and holidays. The instructor does not respond to emails sent from non-USC accounts or email that do not have the course number on its subject.
- ✓ Simple questions will be answered by email, but for more complex discussions students may need to make an appointment for a meeting.

### Tentative Course Schedule:

|    | Date                    | Topics/Daily Activities  | Chapter          |
|----|-------------------------|--|------------------|
| 1  | 1/12/2024               | Introduction to Simulation Modeling<br>A review of Statistics and Probability Distributions. | Ch. 1,<br>App. B |
| 2  | 1/19/2024               | Queuing Theory and concept   | Class Notes      |
| 3  | 1/26/2024               | Monte Carlo simulation.<br>Examples on Marketing, Manufacturing, and Finance.                | Class Notes      |
| 4  | 2/2/2024                | Fundamental Simulation Concepts  | Ch. 2            |
| 5  | 2/9/2024                | <b>EXAM I</b><br>Simulation with ARENA   | Ch. 3            |
| 6  | 2/16/2024               | Modeling Basic Operations and Inputs with Arena<br>Midterm Review                            | Ch. 4<br>4.1-2   |
| 7  | 2/23/2024               | Modeling Basic Operations and Inputs with Arena  | Ch. 4<br>4.3-6   |
| 8  | 3/1/2024                | Modeling Detailed Operations with Arena<br>(Part I)  | Ch. 5<br>5.1 - 2 |
| 9  | 3/8/2024                | Modeling Detailed Operations with Arena (Part II)  |                  |
|    | 3/10/2024-<br>3/17/2024 | SPRING RECESS  |                  |
| 10 | 3/22/2024               | <b>EXAM II</b><br><b>Project Proposal/Problem Submission</b>                                 | Ch. 5<br>5.3 - 5 |
| 11 | 3/29/2024               | Modeling Detailed Operations with Arena (Part III)   | Ch. 5<br>5.6 – 8 |
| 12 | 4/5/2024                | Statistical Analysis of Output<br>System Optimization  | Ch. 6            |
| 13 | 4/12/2024               | Generating Random Observations; Variance Reduction   | Ch. 12           |
| 14 | 4/19/2024               | Entity Transfer  | Ch. 8 (8.1)      |
| 15 | 4/26/2024               | Term Projects Presentation<br><b>Term Project Report Submission</b>                          |                  |
| 16 | 5/3/2024                | <b>FINAL EXAM</b>  |                  |

## USC'S STATEMENT ON ACADEMIC CONDUCT AND SUPPORT SYSTEM

### Academic Conduct:

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" [policy.usc.edu/scampus-part-b](https://policy.usc.edu/scampus-part-b). Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, [policy.usc.edu/scientific-misconduct](https://policy.usc.edu/scientific-misconduct).

### Support Systems:

*Counseling and Mental Health - (213) 740-9355 – 24/7 on call*  
[studenthealth.usc.edu/counseling](https://studenthealth.usc.edu/counseling)

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

*National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call*  
[suicidepreventionlifeline.org](https://suicidepreventionlifeline.org)

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

*Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press "0" after hours – 24/7 on call*  
[studenthealth.usc.edu/sexual-assault](https://studenthealth.usc.edu/sexual-assault)

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

*Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298*  
[equity.usc.edu](https://equity.usc.edu), [titleix.usc.edu](https://titleix.usc.edu)

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

*Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298*  
[usc-advocate.symplicity.com/care\\_report](https://usc-advocate.symplicity.com/care_report)

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

*The Office of Disability Services and Programs - (213) 740-0776*  
[dsp.usc.edu](https://dsp.usc.edu)

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

*USC Campus Support and Intervention - (213) 821-4710*

[campussupport.usc.edu](http://campussupport.usc.edu)

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

*Diversity at USC - (213) 740-2101*

[diversity.usc.edu](http://diversity.usc.edu)

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

*USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call*

[dps.usc.edu](http://dps.usc.edu), [emergency.usc.edu](http://emergency.usc.edu)

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

*USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call*

[dps.usc.edu](http://dps.usc.edu)

Non-emergency assistance or information.