

**ISE 580: Performance Analysis with Simulation****Units:** 3**Spring 2023:** Friday 3:00 – 6:50**Location:** THH 116**Instructor:** Hamid Pourmohammadi**Office:** GER 242-A**Office Hours:** Fridays 2:00-3:00 (by appointment)**Contact Info:** pourmoha@usc.edu**Teaching Assistant:** Mohammadmehdi Naghiaei**Office:** TBD**Office Hours:** Friday 10:00 – 12:00**Contact Info:** naghiaei@usc.edu**IT Help:** 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

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
Midterm	30
Final	30
TOTAL	100

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

Midterm Exam:

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 instructor.

Final Exam:

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 instructor.

Homework/Class participation:

There will be two different types of the 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 Blackboard and must be submitted on Bb, as well.

As for the 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 of 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 (Fridays, 8:00 PM)**

Term Project

Teams will be assigned randomly after the midterm. There are two major submissions are required, one “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 and after approval, they can start of the modeling and implementation of the project using Arena. Teams will also present the project on the last session of the class. The project submission guidelines will be provided on the Bb and due dates are provide 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 does 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 meeting.

Tentative Course Schedule:

	Date	Topics/Daily Activities	Chapter
1	8/25/2023	Introduction to Simulation Modeling A review of Statistics and Probability Distributions.	Ch. 1, App. B
2	9/1/2023	Queuing Theory and concept	Class Notes
3	9/8/2023	Fundamental Simulation Concepts	Ch. 2
4	9/15/2023	Monte Carlo simulation. Examples on Marketing, Manufacturing, and Finance.	Class Notes
5	9/22/2023	Simulation with ARENA	Ch. 3
6	9/29/2023	Modeling Basic Operations and Inputs with Arena	Ch. 4 4.1-2
7	10/6/2023	Modeling Basic Operations and Inputs with Arena Midterm Review	Ch. 4 4.3-6
8	10/13/2023	MIDTERM EXAM	
9	10/20/2023	Modeling Detailed Operations with Arena (Part I)	Ch. 5 5.1 - 2
10	10/27/2023	Modeling Detailed Operations with Arena (Part II) <i>Project Proposal/Problem Submission</i>	Ch. 5 5.3 - 5
11	11/3/2023	Modeling Detailed Operations with Arena (Part III)	Ch. 5 5.6 – 8
12	11/10/2023	Statistical Analysis of Output System Optimization	Ch. 6
13	11/17/2023	Generating Random Observations; Variance Reduction Entity Transfer	Ch. 12 Ch. 8 (8.1)
14	11/24/2023	<i>Thanksgiving Holidays-No Class</i>	
15	12/1/2023	Term Projects Presentation <i>Term Project Report Submission</i>	
16	12/8/2023	FINAL EXAM	

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. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
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

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

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, 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

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

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

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

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, 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

Non-emergency assistance or information.