



ISE 580 Performance Analysis with Simulation
Spring 2022- W 3:30 p.m.
3 Units
Location: ZHS 352

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Course Description

Simulation is a widely used statistical method for decision making. It consists of building a probability model representing a system. The model contains relationships that describe how to compute the outputs given the values of the inputs. Some of these inputs are controllable by the decision maker and others are probabilistic in nature. The system outputs depend on the decisions made by the analyst, who may experiment with the model to find the best set of decisions. Those that lead to optimal results. The inputs are modeled by random variables whose distribution may be estimated by the data available. Simulation models are tools to predict how a system operates given some choices. It can be very powerful to designing a new system or to improve an existing one.

Monte Carlo simulation models are useful to represent a system at a fixed time instant while system simulation models represent systems that evolve in time (with changes occurring at separated time instants). Both can be used to improve operations and to identify what decisions lead to optimal results.

In this course we review the fundamentals of simulation models and use state-of-the-art tools to implement these models on a variety of applications.

Prerequisite(s): None.

Recommended Preparation Expected to have knowledge of Engineering Statistics at the level of ISE 225 and working knowledge of a programming language.

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
- 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

Course Notes

The course material is available on Blackboard.

Technological Proficiency and Hardware/Software Required

The student version of ARENA, is the main computational tool. It is a MS Windows based Software. Students using MacOS should follow the VDI Tutorial pdf file on Blackboard to have access to ARENA. The R language and the RStudio IDE will be used for more general statistical analysis.

Required Textbook

- Kelton, Sadowski, *Simulation with ARENA*, 6ed., McGraw-Hill, 2014

Supplementary Materials (References)

- Lantz B., *Machine Learning with R*, Packt Pub., 2015
ISBN 978-1-78439-390-8

Description and Assessment of Assignments

- **Midterm** in-class based on the schedule and 2 hours length.
- **Final Examination** a comprehensive exam scheduled by USC.
- **Homework** are assigned every other week. Homework is based on the material of the previous and current week. It may be graded by an in-class quiz.

Grading Policy

Assignment	Points	% of Grade
Homework	100 each	30
Midterm	100	30
Final	100	40
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

Assignment Submission Policy

Assignments should be typewritten and clean. They should be submitted as pdf files by the due date. Email submissions and late submissions are not allowed. No make-up exams are considered.

Timeline and Rules for submission

Assignments are to be returned the week after submission. Solutions will be released soon after the homework submission date.

ISE 580 Course Schedule: A Weekly Breakdown

	Date	Topics/Daily Activities	Homework	References
1	Jan 11	Introduction to Simulation. Types of Simulation Models. The Flaw of Averages. Introduction to R , RStudio, and rmarkdown. Introductory example with R	HW1 R Exercises	1overview 2Rbase ppt,r 3intro calendars.r 4RStudio.ppt
2	Jan 18	Monte Carlo simulation. Random variables Triangular, Gamma, Weibull, Lognormal. Examples on Marketing, Manufacturing, and Finance.	HW1 due HW2 Simulation with R	intro3.ppt montecarlo.ppt overbooking.r inventory2.r
3	Jan 25	Simulation with ARENA. Category Overview Report. Statistics on Queues, Resources, Time in System. Case Study: Serial and parallel Service.	HW3 ARENA Modeling	K 3.5 arena1.ppt
4	Feb 1	Simulation with ARENA. Exercises 5.2, 4.31, 4.10, 4.4	HW3 due	arena2.ppt
5	Feb 8	Simulation with ARENA. Resource Schedules Exercise 4.18 Fast Food Restaurant. Exercise 4.15.	HW4 ARENA Modeling	schedules.ppt
6	Feb 15	Comparing Two Systems. ARENA Output Analyzer. Two-Sample t test, Paired t test. Exer. 4.18	HW4 due	comparison.ppt K 6.4 p288
7	Feb 22	MIDTERM EXAM		
8	Mar 1	Input Probability Distributions. Fitting data with the ARENA Input Analyzer. Goodness of Fit test. Empirical cdf. Examples.	HW5 Input Analyzer	ia.ppt mixture.r K 4.6
9	Mar 8	Applications on Discrete Event Simulation Queues (Capacity and Entity Priority). Example: Car Wash Service.	HW5 due	queues.ppt
10	Mar 15	Spring Break		
11	Mar 22	Applications on Discrete Event Simulation Sets (Counters). Emergency Room. Sets (Resources). Exercises.	HW6 ARENA Modeling	set.ppt hospital.doe assembly.doe
12	Mar 29	Statistical Concepts on Simulation Models Conf. Interval, half-width and precision. Exercises 5.17, 5.13, 6.6. Sharing Resources.	HW6 due	models12.ppt inventory.ppt
13	Apr 5	Systems Optimization. ARENA OptQuest Toolbox. Exercises 4.22, 6.16		opt.ppt inventory1.doe K 6.6
14	Apr 12	Generating Random Observations The Inverse Transform Method. Mixtures and the Composition Method.	HW7 ARENA OptQuest	random.ppt newproduct2.doe K 12.2
15	Apr 19	Modeling Detailed Operations Model 5-2. Simulating a Call Center	HW7 due	callcenter.pdf K 5
16	Apr 26	REVIEW		
	May 9	Final Exam		