NC STATE UNIVERSITY

ISE/OR 562 Simulation Modeling
ISE 441 Introduction to Simulation

Spring 2026 Course Syllabus

Instructor Information

Name	Office Phone	Email	Office	Office Hours
Professor: Dr. Shashaani	919-515-6400	sshasha2@nscu.edu	FHW 4175	Tuesdays 10:00-11:00am
TA 1: Nicole Felice	NA	ndfelice@ncsu.edu	FHW 4331/4333	Wednesdays 1:30-2:30pm
TA 2: Daniel Peeler	NA	drpeeler@ncsu.edu	FWH 2131	Wednesdays 11:00-12:00pm

Preferred Method of Communication & Response Time

- **Asking questions about the course:** If you have a question about the course or its content, you should post your question on the Student Help Forum in Moodle. You can expect to receive a response within two business days from myself or the TAs (i.e. not over the weekend). Other students can also answer questions if they know the answer to. These questions may not be about validating an answer but rather about content, clarifications, or technical issues related to the course.
- **Preferred method of communication:** If you need to contact me directly for personal reasons, my preferred method of communication is email. You can expect to receive a response within two business days (i.e. not over the weekend). If I email you directly, please strive to respond within two business days. It is recommended that you check your NC State email at least once a day to stay on top of course communications.
- **Email and Forum Post Guidelines:** Always include a descriptive, specific, but concise subject.

- For emails, include your course number and section in your email, and provide adequate context for your question in order to ensure full understanding of your email. Be sure to use your NC State email account, and sign in with your name and Student ID number.

Course Information

Course Website: NC State WolfWare

Meeting Time and Location: Tuesday and Thursdays 8:3–9:45 AM FWH 4134

Course Credit Hours: 3

Catalog Description

This course concentrates on design, construction, and use of discrete-event simulation object-based models employing Python and Simio (www.simio.com) software, with application to manufacturing, service, and healthcare. The focus is on methods for modeling and analyzing complex problems using simulation objects. Analysis includes data-based modeling, process design, input modeling, output analysis, and the use of 3D animation with other graphical displays. Object-oriented modeling is used to extend models and enhance re-usability.

Structure

This course is **synchronous**, delivered through real-time, face-to-face class sessions. Additional materials and activities are delivered through **Moodle**. Learning Activities include weekly individual homework assignments and three group projects. Attendance in the course is mandatory and students are expected to arrive before the start of class and stay until the end. Assignments and projects are all due Sunday midnight of the weeks they are assigned. See the course schedule for the due dates.

Prerequisites/Corequisites

This course overlaps with ISE 441. For undergraduates taking the course, ISE 362: Stochastic Models in Industrial Engineering is a prerequisite.

Learning Outcomes

Upon completion of the course students will be able to

1. develop complex simulation models of real or conceptual systems subject to risk,

2. design an effective simulation experiment to be run on the model,
3. analyze, interpret and communicate the simulation results,
4. and manage simulation projects.

The main foundational topics in this course are

A. spreadsheet and discrete-event simulation
B. selecting probability distributions with and without data
C. measures of risk and error
D. experiment design
E. assessing sensitivity and model risk
F. time-varying arrivals and outputs
G. big data and simulation
H. random number and random variate generation
I. simulation optimization
J. steady-state simulation
K. reporting simulation results

The assessment will be on your understanding of these concepts. We will repeatedly come back to these when building simulation models in Python or Simio. Therefore, you will also be expected to learn to work within these platforms.

Course Materials

Required textbook

- [Free] 6th Edition. Simio and Simulation: Modeling, Analysis, Applications - Jeff Smith & David Sturrock
  - Web Link: https://textbook.simio.com/SASMAA7/
- [Free] 6th Edition. Simulation Modeling with SIMIO: A Workbook - Jeff Joines and Michael Kuhl
  - Web Link: https://textbook.simio.com/Workbook6/
- Short readings may be provided on Moodle. Some lectures will require completing the reading before coming to class.
- If you are a novice to probability and statistics topics (or it has been a long time)
  - Video lectures by Professor Larry Leemis http://www.math.wm.edu/~leemis/videos/probability.
  - Khan Academy Introduction to Probability and Statistics: https://www.khanacademy.org/math/statistics-probability -- review especially 3-5 and 10-12.
  - Terminology https://www.youtube.com/watch?v=-JXDd52XsQE
  - Kinds of 'Variables' https://www.youtube.com/watch?v=ZxV-kf0yBss
  - Boxplots https://www.youtube.com/watch?v=9AKLd5FHzfI
  - Standard Deviation and Degrees of Freedom https://www.youtube.com/watch?v=nlm9gfso4mw

- Confidence Interval for Mean https://www.youtube.com/watch?v=dl0CXDsTYjk and https://www.youtube.com/watch?v=nKQ2KcCCnb0
- Hypothesis Test for the Mean https://www.youtube.com/watch?v=6F6frEyMxuk and https://www.youtube.com/watch?v=sVkzPl1M7Ms

Optional materials

- Recommended: J. Banks, J.S. Carson, B.L. Nelson, D.M. Nicol, *Discrete-Event System Simulation,* 5th Ed. Prentice Hall, 2010. (Same level to this class, referred to as **DESS**)
- Recommended: P. Sanchez, *Fundamentals of Simulation Modeling* (referred to as **FSM**) https://github.com/PaulSanchez/SimpleKit-Python/blob/master/SimulationBasics.pdf
- Recommended: D. T. Sturrock, Tips for Successful Practice of Simulation. In *Proceedings of the 2011 Winter Simulation Conference*, pp. 1415-1422. IEEE, 2011.
- Recommended (download for free through NCSU libraries): B. L. Nelson. *Foundations and Methods of Stochastic Simulation: A First Course* (referred to as **FMSS**), Springer-Verlag (2013). (Slightly higher level than this class, very readable)

Technology Requirements

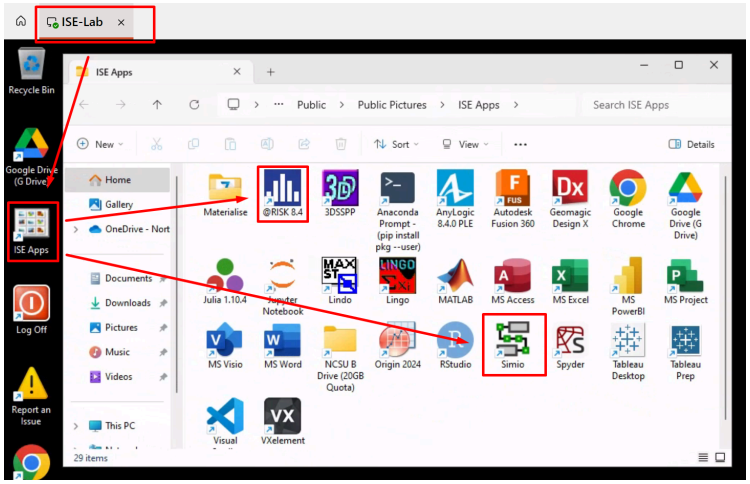
NC State University Libraries offers Technology Lending, where many devices are available to borrow for a 7-day period. Computer labs are available in various locations around campus for student use.

Computer

A laptop computer is required for students taking this course. NC State's Office of Information Technology provides recommendations for your computer at NC State.

The Software is only compatible with Windows operating systems but if you have a Mac you can follow these instructions to install a Windows virtual environment and install the software on it. Alternatively, you can access both @Risk and Simio via the "ISE Remote Lab"

- Instructions - **go.ncsu.edu/ise-remote-lab**
- Note: idle sessions are set to suspend after 1 hour. Software is Pre-installed.
- Sample screenshot below



- For Simio software only, you can still install the software in your Macbook following this manual (by setting up a virtual Windows OS): https://cdn.simio.com/SimioLicenses/MacInstructions.pdf
  - For the virtual machine, use https://www.virtualbox.org/wiki/Downloads
  - For a Windows OS, use https://azureforeducation.microsoft.com/devtools
  - Useful link: https://answers.microsoft.com/en-us/windows/forum/all/how-to-install-windows-10-on-a-mac-using-oracle/c42a39c5-bd47-448a-acdf-3ef496be8f63
- You may use the EOS computer labs in 2355 FWH or the Hunt Libraries https://it.engr.ncsu.edu/computing-labs/ with softwares already installed on them.
- There are also several computers available in 2125 FWH when not in session.

- For additional help regarding software, license issues, and installation, contact ISE Direction of IT, Justin Lancaster, or stop by his office at FWH 4165.

Software and digitally-hosted course components

- Simio Software for discrete-event simulation: To request a Student License, visit https://forms.simio.com/f/student-license and fill out the form to receive a Simio Student License. Your Student License Claim Code is 00729-M6Zs7cVdzj. To be approved automatically, make sure to use the claim code and your university email address. If the code is omitted or incorrect, your request will require manual intervention, which may take up to five (5) business days. Note, we cannot provide technical support to students. Instead, please talk to your instructor; if they are unable to help resolve your problem, they can send your concern to Simio for support.
  - You can find important information about licenses, Simio version compatibility, installation, and troubleshooting at https://www.simio.com/academics/academic-licensing-support.php.

- We also use Excel with macros so make sure you enable your macros as well.
- We use Python notebooks for a couple of lectures. You can use Jupyter notebooks through Anaconda or Google Colab or Visual Studios.
- We will use TopHat for attendance and possible in-class pop quizzes. For technical support for TopHap in case of any issues, you may chat with their support team right away at the bottom of this page: https://support.tophat.com/student-support
    - Make sure to enable location services on your laptop https://support.tophat.com/article/Student-Secure-Attendance#SecureAttendance. Sometimes this will be the first thing in class and if you are late, you will miss it.
- We will use Gradescope for assignments and projects submission and grading.

Grading and Feedback

Grading criteria, details, and timing of feedback

% of grade	Component	Details and timing of feedback
10 %	Attendance and Participation	• In every session, mark attendance with TopHat. No absences are to be waived except with prior notice and providing appropriate documentation. • Ask questions and participate in the discussion and teaching tasks in class. • *During the lecture, do NOT use your laptop or phone. When asked to do an exercise in class, have your laptop with the software ready. Engage with your fellow classmates when asked to work with a partner in class.* • Pop-up TopHat quizzes or exercises will be considered as your participation points—most likely the quiz will be on the last lecture or new lecture requiring that you have done the reading before coming to class.
30 %	Weekly Assignments	• *Individual* short assignments that go along with the weekly modules. Submission is through Gradescope. There will be a late penalty if submission is late up to three days. • Can work with your classmates but must submit your own work. • It is against the course policy and considered cheating if you directly submit AI generated solutions.
60 %	Projects	• You have three projects, each worth 20% of the total grade. Each project has three deliverables due in three consecutive weeks.

		• This is the most critical and challenging part of your assessment. You are expected to perform a complete simulation study based on real-world cases from start to finish (conceptualizing, modeling, experimenting, reporting). • Projects are in groups of 3 so in the first 2 weeks you need to form a group. Working in a group is a valuable training for an industrial engineer. Peer evaluations at the end of each project may be collected to ensure balanced contributions. Teams are expected to meet weekly to discuss the project and decide how to do the modeling and make conclusions based on simulation results.

*modifications to the timing of grades/feedback, if required, will be announced via email.

Grading scale

This course uses this grading scale:

Low	Letter	High
97 ≤	A+	≤ 100
93 ≤	A	< 97
90 ≤	A-	< 93
87 ≤	B+	< 90
83 ≤	B	< 87
80 ≤	B-	< 83
77 ≤	C+	< 80
73 ≤	C	< 77
70 ≤	C-	< 73
67 ≤	D+	< 70
63 ≤	D	< 67
60 ≤	D-	< 63
0 ≤	F	< 60

NC STATE UNIVERSITY

Course Schedule

Please note: the course schedule is subject to change.

Week	Dates	Tuesday	Thursday	Project (Group)	Homework (Indiv)
1	Jan 13, 15	Introduction Reading: FSM 1, 2, 3, SASMAA 1	Spreadsheet Simulation Reading: SASMAA 3.2		
2	Jan 20, 22	Probability and Statistics Reading: two videos	Queuing Theory Reading:	Project released	HW 1
3	Jan 27, 29	Discrete Event Simulation Reading:	Simio Modeling Reading:	P1 D1	HW 2
4	Feb 3, 5	Output Analysis Reading:	Time-Varying Inputs and Outputs Reading:	P1 D2	HW 3
5	Feb 10, 12	Modeling Customized Statistics, Local v. Global Variables, Output Stats Reading:	Modeling Customized Logic, Default and Add-on Processes Reading:	P1 D3	
6	Feb 19	Wellness Day	Simio - Tables & Sequences Reading: SASMAA 5.2-5.5		HW 4
7	Feb 24, 26	Simio - Workers and Resources Reading:	Input Modeling and Sensitivity Analysis Reading:		HW 5

8	Mar 3, 5	Big Data, Dependent Data Reading:	Financials in Simio Reading:	P2 D1	HW 6
9	Mar 10, 12	Transport in Simio Reading:	Comparison of Systems Reading:	P2 D2	HW 7
10	Mar 24, 26	Inventory and Material Handling Reading:	Customized Statistics ctd Reading:	P2 D3	
11	Mar 31, Apr 2	Random Number Generation, Common Random Numbers Reading:	Servers - Input/output Buffer; Balking and Reneging Reading:		HW 8
12	Apr 7, 9	Optimization and Constraints Reading:	Multi-objective Optimization Reading:	P3 D1	HW 9
13	Apr 14, 16	Verification and Validation Reading:	Steady-State Simulation, Review Reading:	P3 D2	HW 10
14	Apr 21, 23	No Class - Work on Final Project			
15	Apr 28	Final Project Submission		P3 D2	

Course Policies

Late submissions

All submissions are due Sunday midnights on Gradscope. Deadlines are non-negotiable. Late submissions are worth progressively 20% less credit per day. (For example, if you are late by one day, the full credit you receive is 80%, and if you got 90% in the original form, you will only receive 72% by converting to the new scale) If you need an extension, contact the instructor ASAP. The bottom line is we can't and won't accept a late submission AFTER solutions are posted. No late submissions for the project deliverables are accepted.

Assignments done individually

All assignments are to be done individually while discussions with classmates are allowed. They are step-by-step instructions that should take at most 3 hours to complete.

Regrade requests

Students must submit a regrade request on Gradescope within 3 days from when the grades are posted. Regrades will only be discussed after the report is accepted.

Attendance

- Attendance in all sessions is required and will be tracked via TopHat.
- If you miss a class due to health issues, your absence will be excused if you provide a doctor's note to me the same day or the day before.
- Your absence can negatively impact your performances for weeks. For all absences, please notify me prior to missing any class. If you are absent that day in class, then you will miss out on what we did.
- You should consider that, from the very first day of class, your decisions about class attendance and participation will have the most impact on whether or not you do well in the class. Especially in technical topics, you must give the class your full effort from the beginning. Students sometimes encounter personal circumstances, some of which are beyond their control, which affect their ability to do as well in the course as they could have otherwise done. You are encouraged to email me regarding personal circumstances that affect aspects of the course (i.e. the need to miss a class due to unforeseen circumstances), and I will respond to these emails with advice and actions. Students who believe that their personal circumstances are such that University academic policies may be of assistance to them should pursue these options with their academic advisor or other appropriate University services.

Related NC State Policy: REG 02.20.03 – Attendance Regulations

Projects

In the “real world,” problems are typically not as well-formed, complete, or tidy as they are in typical homework problems. You often face missing or ambiguous information, tricky situations, and multiple solutions based on problem interpretation. You may expect the same from the projects. As these situations are encountered, you should make and document reasonable assumptions. Each project consists of

- Data Analysis - fitting distributions, finding details about the system, analysing the outputs
- Modeling (simulation logic with software) - may include approximations with queuing
- Report - following a report template provided on Moodle.

Groups will have three weeks to complete each of the three projects. Each project will be submitted in three deliverables. So you will submit a total of nine deliverables on Gradescope. Make sure you include all your group members.

Artificial Intelligence Policy

Artificial Intelligence may be an important tool in your life, but does not replace the engineering thought process that this class emphasizes. It is an academic integrity violation to use AI without proper authorization and attribution. Students should be prepared to defend their work orally upon request. If you cannot explain and defend your analysis, you will not receive credit.

Communication Guidelines

Use NC State Accounts for Academic Work

Students should continue to use their **NC State email account** for all course assignments, thesis work, data analysis and any other educational, research-related activities or work involving sensitive university data.

Using NC State Google accounts for academic and research work helps ensure:

- Data is kept secure.
- Compliance with university and federal requirements.
- Clear boundaries around intellectual property.
- Longevity and continuity of data.

Respecting our learning community

The NC State Code of Student Conduct outlines expectations for behavior in the classroom (whether virtual or physical) and the consequences for students who violate these expectations. Any behavior that impacts other students' ability to learn and succeed will be addressed, but expressing diverse viewpoints and interpretations of course content is welcome.

Community guidelines for this course include:

- Use a respectful tone in all forms of communication (email, written, oral, visual).
- Maintain professionalism (avoid slang, poor grammar, etc.) in your written communication.
- Respect regional dialects and culturally embedded ways of oral communication.
- Stay home or in your dorm room if you are exhibiting symptoms of a contagious illness (fever, chills, etc.).
- Enter our virtual and/or physical classroom community respectfully by refraining from lewd or indecent speech or behavior, helping to maintain a safe physical environment, not using your cell phone for voice or text communication except when explicitly given leave to do so, and not attending class under the influence of any substance.
- Treat each community member with respect by not recording others without their consent or engaging in any form of hazing, harassment, intimidation, or abuse.
- Respect cultural differences that may influence communication styles and needs.

University Policies

Academic integrity and honesty

Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct 11.35.01 sections 8 and 9. Therefore, students are required to uphold the Pack Pledge: "I have neither given nor received unauthorized aid on this test or assignment." Violations of academic integrity will be handled in accordance with the Student Discipline Procedures.

Please refer to the Academic Integrity web page for a detailed explanation of the University's policies on academic integrity and some of the common understandings related to those policies.

Student privacy

Originality Checking Software

☐ Software is being used in this course to detect the originality of student submissions.

Class privacy statement:

☐ This course requires online exchanges among students and the instructor, but NOT with persons outside the course. Students may be required to disclose personally identifiable information to other students in the course, via electronic tools like email or web postings, where relevant to the course. Examples include online discussions of class topics and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.

Other Policies

Students are responsible for reviewing the NC State University PRR's which pertain to their course rights and responsibilities:

- Equal Opportunity and Non-Discrimination Policy Statement and additional references
- Code of Student Conduct
- Grades and Grade Point Average
- Credit-Only Courses
- Audits

Student Resources

Academic and Student Affairs maintains a website with links for student support on campus, including academic support, community support, health and wellness, financial hardship or insecurity, and more. Find Help on Campus.

Disability resources

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the Disability Resource Office (DRO). For more information on NC State's policy on working with students with disabilities, please see the Policies, Rules and

Regulations page maintained by the DRO and REG 02.20.01 Academic Accommodations for Students with Disabilities.

Safe at NC State

At NC State, we take the health and safety of students, faculty and staff seriously. The Office of Equal Opportunity supports the university community by providing services and resources to support and guide individuals in obtaining the help they need. See the Safe at NC State webpage for resources.

Supporting Fellow Students in Distress

As members of the NC State Wolfpack community, we each share a personal responsibility to express concern for one another and to ensure that this classroom and the campus as a whole remain a healthy and safe environment for learning. Occasionally, you may come across a fellow classmate whose personal behavior concerns or worries you, either for the classmate's well-being or yours. If you feel this way, I would encourage you to report this behavior to the NC State CARES website. Although you can report anonymously, it is preferred that you share your contact information so they can follow up with you personally.

As a student, you may experience personal challenges that affect your learning, such as stress, anxiety, relationship issues, or difficulties with motivation and concentration. The Counseling Center offers confidential services, including same-day emergency support, for full-time NC State students. Please visit https://counseling.dasa.ncsu.edu/ to learn more and get connected.

Course Evaluations

ClassEval is the end-of-semester survey for students to evaluate the instruction of all university classes. The current survey is administered online and includes 12 closed-ended questions and 3 open-ended questions. Deans, department heads, and instructors may add a limited number of their own questions to these 15 common-core questions.

Each semester students' responses are compiled into a ClassEval report for every instructor and class. Instructors use the evaluations to improve instruction and include them in their promotion and tenure dossiers, while department heads use them in annual reviews. The reports are included in instructors' personnel files and are considered confidential.

Online class evaluations will be available for students to complete during the last two weeks of the semester for full-semester courses and the last week of shorter sessions. Students will receive an email directing them to a website to complete class evaluations. These become unavailable at 8 am on the first day of finals.

- Contact ClassEval Help Desk: classeval@ncsu.edu
- ClassEval website
- More information about ClassEval

Syllabus Modification Statement

Our syllabus represents a flexible agreement. It outlines the topics we will cover and the order in which we will cover them. Dates for assignments represent the earliest possible time they would be due. The pace of the class depends on student mastery and interests. Thus minor changes in the syllabus can occur if we need to slow down or speed up the pace of instruction.