

Course: IENG 455 – Simulation by Digital Methods

Semester: Spring 2020; **TR 3:30 – 4:45; ESB-E G78B**

Number of credit hours: 3

Description: Introduction to Monte Carlo simulation methods and their application to decision problems. Students identify constraints of problems, collect data for modeling and develop computer programs to simulate and analyze practical situations. Interpretation of results emphasized.

Prerequisite: IENG 213, 331

Textbook: Simulation with Arena, by Kelton, Sadowski, and Sturrock, 5th Ed- McGraw Hill
Course Supplement: the PowerPoint lecture notes will be posted on eCampus.

Additional References: Discrete-Event System Simulation, by Banks, Carson, Nelson and Nicol
Simulation Modeling and Analysis, by Law and Kelton - McGraw Hill

Softwares: Arena: It has to be compatible with the version of ARENA in the computer lab;
Available in the textbook CD or at the following link:
http://higherred.mheducation.com/sites/0073401315/student_view0/arena_software_download.html

SIMTOOLS and FORMLIST: available at:
<https://home.uchicago.edu/~rmyerson/addins.htm>

SIMTOOLS User Manual is available at the course website under the folder <Software>, which includes the installation guidance and introduction of SIMTOOLS and FORMLIST. Both software are installed on the PCs in the IMSE computer labs (ESB 305 & 355), ESB 225, 231, 239, and MRB 249.

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Assignment submission email:

ieng455wvu2019@gmail.com

- ◆ The gmail account is for the purpose of collecting assignments only.
- ◆ **Please use the instructor's email address for any other matters.**

Course Goals:

1. To provide students with the basic concepts of simulation.
2. To provide students with hands-on experience in the application of a widely used, general-purpose simulation software.
3. To provide students with basic knowledge on the analysis of simulation output.

Student Learning Objectives:

Upon completing the course, the student will be able to:

- a) Recognize problems that can be modeled and solved using simulation techniques.
- b) Become familiar with the main elements and principles needed to build and implement valid and credible simulation models.
- c) Identify the input data needed for the model, perform proper statistical analysis, and select the input probability distributions.
- d) Generate random numbers and random variates.
- e) Perform basic statistical analysis on the output of the simulation models.
- f) Develop good simulation models using SIMTOOLS and ARENA.
- g) Perform a complete simulation study (problem definition and formulation, model building, data acquisition, model translation, model verification, model validation, model implementation, and analysis of the results.)

Course Contribution to Professional Component:

Engineering Science - 50%, Engineering Design - 50%

Course Relationship to Program Educational Outcomes:

The course relates strongly to the following program educational outcomes.

1. The course enables the students to identify, formulate and solve complex engineering problems by applying principles of engineering, science, and mathematics (Outcome 1).
2. The course enables the students to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions (Outcome 6).

Course Topics (Note: This schedule is tentative and flexible)

- Review of probability theory and statistics relevant to simulation (1 week)
- Introduction to spreadsheet simulation and SIMTOOLS basics (1 week)
- Input modeling (1 week)
- Output analysis (1.5 week)
- System simulation and queueing basics (1 week)
- Arena topics: Chapter 2 & 3 (2 weeks)
- Arena topics: Chapter 4 & 5 (2 weeks)
- Output analysis for terminating systems: Chapter 6 (1 week)
- Output analysis for steady state system: Chapter 7 (1.5 week)
- Arena topics: Chapter 8 & 9 (2 weeks)
- Verification and validation & Managing simulation projects (1 week)

Grading:

<u>Range</u>	<u>Grade</u>
97 – 100	A+
93 – 96	A

90 – 92	A-
87 – 89	B+
83 – 86	B
80 – 82	B-
77 – 79	C+
73 – 76	C
70 – 72	C-
67 – 69	D+
63 – 66	D
60 – 62	D-
0 – 59	F

1. Grading Elements and Weighting:

Grade Element	Weighting
1 st Exam (Thursday, January 30 th) – 20%	60%
2 nd Exam (Thursday, February 27 th) – 20%	
3 rd Exam (Thursday, Apr. 2 nd) – 20%	
Non-Comprehensive Final Exam (8:00 – 10:00 am on Wednesday, May 6) – 20%	
3 Projects	27%
5 Labs	5%
Homework	8%

Exam Policy – There are no excuses for missed exams and no makeups. Of the four (4) exams in the class (including the final) the lowest exam score will be dropped:

Notice that 60% of your final grade will depend on the exams.

2. On-time Attendance: Attending and participating in class adds to your knowledge as IEs beyond what can be evaluated on projects and exams.

- ◆ The attendances in the first week does not count.
- ◆ The WVU Catalog contains the full [Attendance Policy](#). In this class there is a significant amount of material to cover and it has been shown that there is a strong correlation to student absences and poor performance in the class. Attendance will be taken each class *before the lecture begins at 3:30 pm*. **No late arrivals will be accepted.** Unexcused absences beyond the first three will result in a 1% reduction in your overall grade for each absence beyond these three unexcused absences.

3. Electronic Submission: All the electronic assignments are required to be sent to the **Gmail** Account – IENG455WVU2019@gmail.com

- ◆ Please title the Subject Heading of your email “LastName_AssignmentName”.
e.g., “Doe_Homework3”, “Doe_Project2”
- ◆ If technical difficulties are encountered with the gmail account, please use the instructor’s email address. **Please remember to CC yourself on all the emails submitting electronic assignments and make sure that the email has been successfully delivered to your own mail**

box. Please keep your own copy of the submission until you have received the grade for that assignment.

Other Policies:

1. Homework grading policy:
 - Homework turned in when due: grading starts at 100%
 - Homework turned in 1 day late: grading starts at 90%
 - Homework turned in 2 days late: grading starts at 80%...
 - Homework turned in 3 days late: grading starts at 70%...
 - Homework turned in later - 0 on the homework

2. **Projects:** the grading policy for projects are as follows
 - Project turned in when due - grading starts at 100%
 - Project turned in 1 day late - grading starts at 90%
 - Project turned in 2 days late - grading starts at 80%
 - Project turned in 3 days late - grading starts at 70%
 - Project turned in later - 0 on the project

3. **Labs:** Some lecture time will be used as lab sessions. **The lab report must be turned in before the end of the lab session.**

4. **Working together:** You are encouraged to discuss the design projects, but all programming and analysis is to be done in **a team of one, two or three**. Numerical results will differ depending on how you code your simulation, so comparing them is no guarantee, anyway. *Notice that 75% of the course grade is determined by the in-class examinations, and it is not possible to be successful on the examination without understanding what was done on the design projects.*

5. **Regrades:** Regrades of projects, or labs are obtained by submitting a written explanation of the reason for the regrade via the instructor's mailbox within 48 hours of when the work was returned in class. Regrades will only be discussed **after** submitting the work in this manner.

Communication:

The WVU MIX email system will be used for all communication. The students are responsible for checking their MIX email regularly for information regarding assignments, lecture information, and any other important course related information. Students may be asked to print out information from the attachment in their email and bring it to class. Not all material will be sent in electronic form. Some material only in the form of hard copies will be distributed in class.

Academic Integrity Statement

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, instructors will

enforce rigorous standards of academic integrity in all aspects and assignments of their courses. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the West Virginia University [Academic Standards Policy](http://catalog.wvu.edu/undergraduate/coursecreditstermsclassification)(<http://catalog.wvu.edu/undergraduate/coursecreditstermsclassification>). Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see your instructor before the assignment is due to discuss the matter.

Academic Standards Policy, including Academic Dishonesty

The WVU Catalog contains the full [Academic Standards Policy](#).

- [Resources for Faculty and Students for Reporting and Appealing Violations of Academic Standards](#)

Adverse Weather Statement

In the event of inclement or threatening weather, everyone should use his or her best judgment regarding travel to and from campus. Safety should be the main concern. If you cannot get to class because of adverse weather conditions, you should contact your instructor as soon as possible. Similarly, if your instructor(s) are unable to reach the class location, they will notify you of any cancellation or change as soon as possible, using agreed upon methods to prevent students from embarking on any unnecessary travel. If you cannot get to class because of weather conditions, instructors will make allowances relative to required attendance policies, as well as any scheduled tests, quizzes, or other assessments. [adopted 9-8-2014]

Attendance Policy

The WVU Catalog contains the full [Attendance Policy](#).

Campus Safety Statement

The WVU Police are committed to creating and maintaining a safe learning environment for all students, faculty, and staff. Part of this mission includes educating the campus community on how to respond to potential campus threats, such as the threat of an active shooter on campus or other suspicious behaviors. Fortunately, WVU Police offer training - both online and in-person - on how to handle a variety of campus safety scenarios. All students are encouraged to visit the [WVU Police](https://police.wvu.edu/)(<https://police.wvu.edu/>) webpage, in particular the content under the [Active Shooter](https://police.wvu.edu/training)(<https://police.wvu.edu/training>) training program. Students are also encouraged to report any suspicious behaviors on campus using the [Report a Threat](https://police.wvu.edu/emergency-management/threat-assessment) (<https://police.wvu.edu/emergency-management/threat-assessment>) portion of the webpage. Additional materials on campus safety prepared by WVU Police, including special safety tips and training, will also be provided on our eCampus page. [adopted 10-2-17]

Inclusivity Statement

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in your classes, please advise your instructors and make appropriate arrangements with the [Office of Accessibility Services](https://accessibilityservices.wvu.edu/). (<https://accessibilityservices.wvu.edu/>)

More information is available at the [Division of Diversity, Equity, and Inclusion](https://diversity.wvu.edu/) (<https://diversity.wvu.edu/>) as well. [adopted 2-11-2013]

Incomplete Policy

The WVU Catalog contains the full [Incomplete Policy](#).

Sale of Course Material Statement

All course materials, including lectures, class notes, quizzes, exams, handouts, presentations, and other course materials provided to students for their courses are protected intellectual property. As such, the unauthorized purchase or sale of these materials may result in disciplinary sanctions under the [Student Conduct Code](https://studentconduct.wvu.edu/policies-and-procedures). (<https://studentconduct.wvu.edu/policies-and-procedures>)

Sexual Misconduct Statement

West Virginia University does not tolerate sexual misconduct, including harassment, stalking, sexual assault, sexual exploitation, or relationship violence [[BOG Rule 1.6](#)]. It is important for you to know that there are resources available if you or someone you know needs assistance. You may speak to a member of university administration, faculty, or staff; keep in mind that they have an obligation to report the incident to the [Title IX Coordinator](https://titleix.wvu.edu/staff). (<https://titleix.wvu.edu/staff>)

If you want to speak to someone who is permitted to keep your disclosure confidential, please seek assistance from the [Carruth Center](#), 304-293-9355 or 304-293-4431 (24-hour hotline), and locally within the community at the [Rape and Domestic Violence Information Center](#) (RDVIC), 304- 292-5100 or 304-292-4431 (24-hour hotline).

For students at WVU-Beckley, contact the [Women's Resource Center](#) at 304-255-1585 (toll free at 1-888-825-7836) or [REACH](#) at 304-340-3676. For students at WVU-Keyser, contact the WVU-Keyser [Psychological Services Office](#) at 304-788-6976, and locally in Keyser, the [Family Crisis Center](#), 304-788-6061 or 1-800-698-1240 (24-hour hotline). For more information, please consult [WVU's Title IX Office](https://titleix.wvu.edu/confidential-resources) (<https://titleix.wvu.edu/confidential-resources>).

Student Evaluation of Instruction Statement

Effective teaching is a primary mission of West Virginia University. Student evaluation of instruction provides the university and the instructor with feedback about your experiences in the course for review and course improvement. Your participation in the evaluation of course instruction is both strongly encouraged and highly valued. Results are strictly confidential, anonymous, and not available to the instructor until after final grades are released by Admissions and Records. Information about how you can complete this evaluation will be provided by your instructor. [adopted 4-14-2008]

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