Course: IEEM531100- System Simulation

Semester: Spring 2013 MWF 2:20-5:20 AM Engineering Building I, 827R

Number of credit hours: 3

Instructor: Professor Kuo-Hao Chang (changk@mx.nthu.edu.tw)
Office: Engineering Building I, 713R, Tel: (03)5742337
Office Hour: W 3:00-5:00 pm or by appointment

Description: Introduction to Monte Carlo simulation methods and their application to decision problems. Student will learn to identify constraints on problems, collect data for modeling and develop computer programs to simulate and analyze practical situations. Results interpretation is particularly emphasized.

Prerequisites: Engineering Statistics, Introduction to Operations Research.

• Computing, particularly basic file management under Windows 2007, Excel and word processing.
• Statistics, particularly the relationship between probability distribution functions and cumulative distribution functions; confidence-interval procedures based on the normal and *t* distributions; sample mean and variance.

Textbook: Simulation with Arena, by Kelton, Sadowski, and Sturrock, 4th Ed- McGraw Hill
Course Supplement: the Powerpoint lecture notes will be posted on the course website.

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

Course Website:
http://moodle.nthu.edu.tw/

Softwares:
1. Arena: CD included with the textbook (*It has to be Arena 10.0*!)
2. SIMTOOLS and FORMLIST: available at http://home.uchicago.edu/~rmyerson/addins.htm
   • Different versions of Excel require different versions of SIMTOOLS/FORMLIST.
   • *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 softwares are installed on the PCs in the IEM computer lab 827R

Important Policies:

1. Grading Elements, Weighting and Scale:

Grade Element	Weighting	Grade Scale
Midterm exam	20%	A: 90-100
Final exam	25%	B: 80-89

3 Projects	15%	C: 70-79
5 Labs	10%	D: 60-69
Homework Term project	10% 25 %	F: 0-59

- Notice that the sum of the total points is 105.

2. Student attendance is mandatory unless excused by the instructor. Roll will not be taken, however lab assignments will typically be given in class. No show students will be given a 0 (zero) to the assignments. Students are responsible for all the material covered in class and all the announcements made (e.g. date of mid-term tests and deadlines of homework and project). If you know you will be absent for a homework or test, make arrangements with the instructor beforehand.

3. **Electronic Submission:** All the electronic assignments are required to be sent to the following email address: chang.ie531100@gmail.com

• Please title your email "Name_AssignmentName", e.g., "王小明_Homework3", "王小明_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 at least 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 problems, 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 45% of the course*

grade is determined by the midterm and final 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 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.

6. Make-up tests: According to the department policy, no make-up tests are allowed. A student who misses a test without prior permission of the instructor must be assigned a 0 (zero). The secretary of the IMSE Department will have a telephone number where the instructor can be reached.

7. Examinations: The two examinations are open book and notes. The midterm exam is temporarily scheduled in the last week of February and the exact date will be announced 2 weeks before the exam.

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 acquire the ability to use modern and classical industrial engineering methodologies pertaining to simulation modeling (Outcome 1).
2. The course enables the students to acquire the ability to apply knowledge of math, statistics, and industrial engineering (Outcome 2).
3. The course enables the students to acquire the ability to design and conduct experiments, analyze and interpret data, develop implementation strategies, shape recommendations so that results will be achieved, and communicate findings effectively (Outcome 3).
4. The course enables the students to acquire the ability to work individually and on teams to identify,

formulate, and solve problems using simulation and statistical analysis tools (Outcome 4).
5. The course enables the students to acquire the ability to design integrated systems (Outcome 5)

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 week)
- System simulation and queuing 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 (2 week)
- Arena topics: Chapter 8 & 9 (2 weeks)
- Verification and validation & Managing simulation projects (1 week)