IME 6300
Advanced Simulation Modeling & Analysis
Fall 2010
Class 7:00 pm - 9:50 pm W CEAS-Parkview C0229/D-206

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Office Hrs: R 4:00 – 6:00 p.m. & by Appointment

Text: Required:

1. **Simulation Using ProModel**: Harrell, Ghosh, Bowden; McGraw Hill 2003.
2. Web-based course material for Modeling & Simulation: URL– http://webct.wmich.edu, Gupta, T. 2010 (Access to the course materials requires WMU username & a valid password).
3. Supplementary course materials (& handouts), Gupta, T.

References: 1.ProModel Student Version, User's Guide, and Reference Guide.

2. **Discrete-Event Simulation**, Fourth Edition, Banks J., Carson J., & Nicol, D., Prentice Hall, 2005.
3. Probability and Statistics for Engineers, Miller and Freund.
4. Simulation Modeling & Analysis; Law & Kelton; 2nd Edition, 2000.
5. Introduction to Simulation Using SIMAN, Pegden et. el. 2nd Edition

Recommended Reading: Series of articles on Simulation (e.g. a five article series beginning with the June 1998) issue of Industrial Engineering Magazine.

Catalog Description: Advanced topics in modeling of complex systems using both discrete and continuous simulation. Emphasis on the simulation of manufacturing systems.
Prerequisites: IME 3300 or Equivalent

Action Objectives:

(1) To learn basic concepts, process of simulation, and computer animation.
(2) To familiarize students with simulation language ProModel. In addition we will also investigate & capability analysis of at least two other simulation modeling tools (FlexSim & ProcessModel).
(3) To emphasize on modeling and problem solving issues.
(4) To introduce students with problems related to manufacturing systems and service operations.
(5) To become proficient in working with real world simulation project independently.

COURSE OUTLINE

Module# (Wk#s)	Topic	# of Sessions	Text Readings
I(1&2)	Introduction to Modeling Simulation, Types & Forms of Simulation Systems and System Domain System Components Random number generation for Monte Carlo Simulation	**2**	Ch. 1 & 2 Web Slides 1-15 **Assignment #1 & 2** Web slides 16-30
II(3&4)	Concepts in Discrete-Event Simulation (DES) DES Logic Diagram Basic Definitions Model Development Methodology		Ch. 3 & 4 Web Slides 45-63 **Assignment #3**
	Review of Statistical Concepts and Data Acquisition Fitting Distributions and Sampling from Distributions Random Variate Generation Deterministic vs. Stochastic Modeling	**2**	Ch. 5 Web Slides 31-45 **Assignment #4**
III(5)	Analysis of Simulation Data Input Modeling Verification & Validation	**1**	Ch. 6 & 7 Web Slides 46-60 **Assigment # 5**
	Analyzing Output Results Identifying Measures of Performance Mathematical Model vs. Simulation Model		Ch. 8 & 9 Web Slides 61-80
IV(6)	**First Exam (Oct. 13 – Ch. 1-7 & Slides)** Logic Statement Flexible Machining System Example	**1**	 Web slides 81-89 ProModel Guide & Handout **Assignment 6**
V(7&8)	Designing a Simulation Study – Alternate Scenario Comparing Systems Conveyor & Material Handling Logic Modeling Manufacturing Systems	**2**	 Ch. 10 Ch. 12 **Assignment 7**
VI(9&10)	Modeling Service Systems Production Systems Applications Additional Modeling Concepts	**2**	Ch. 13 Ch. 14 **Assignment 8**
VII(11)	Optimization in Simulation /w SimRunner	**1**	Ch. 11
VIII(12)	Semester Project Presentations & Review		**1**
IX(13)	Course Review		

Second/Final Exam – Wednesday, December 15 2010; 7:15p – 9:15 p.m.

Grading:

First Exam (Oct. 13, 2010)	20%
HomeWork	30%
Final/Second Exam (??)	15%
Semester Project	25%
Quizzes & Class Work Assignments	10%

Exams: One midterm and a comprehensive final closed books and notes.

Homeworks: Homeworks are due at the beginning of the hour. Late homeworks will not be accepted **w/o 10% off per day late**. No homework will be accepted if submitted **three or more day past the deadline**.

Attendance Policy:
Attendance is mandatory. The student will receive a score of zero for any assessment item not submitted because of absence. Extreme circumstances on medical grounds with a doctor's note may be considered, however, arrangements must be made prior to the due date.

Quizzes & ClassWork Assignments
In some sessions there may be a 20-30 minutes quiz on the previously covered subject matters. During the quiz, classwork assignments and exams instructions will be given ahead of time about the usage of your notes and or computer. Quizzes & classwork assignments could be theoretical or applied. No classwork or quiz make-up is permitted.

Requirements for Homework Assignments

1. All homework assignments are due at the beginning of class on the date of submission. You are expected to submit your completed assignment in the class room.

2. Computer programs must be well documented. The program should be submitted with necessary output. The output format will be discussed in class for each assignment.

3. Each computer assignment must include a program flow chart or network diagram.

4. A section titled "Analysis of Output & Important Conclusions" should be included with each completed assignment.

Make-up Exams: "Make-up" exams are NOT EXPTECTED. **One may request ONLY for medical ground (written note from the doctor required) based case.**

Grading Scale:

>= 90	**A,**	**85<x<=89**	**BA,**	**80<x<=84**	**B**
75<x<=79	**CB,**	**70<x<=74**	**C,**	**65<x<=69**	**DC**
<=65	**D**				

Academic Honesty Policy:

The Faculty Senate's Professional Concerns Committee recommends all instructors include the following paragraph in each syllabus they prepare. "You are responsible for making yourself aware of and understanding the policies and procedures in the Undergraduate and Graduate Catalogs that pertain to Academic Honesty. These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse. [The policies can be found at http://catalog.wmich.edu under Academic Policies, Student Rights and Responsibilities.] If there is reason to believe you have been involved in academic dishonesty, you will be referred to the Office of Student Conduct. You will be given the opportunity to review the charge(s). If you believe you are not responsible, you will have the opportunity for a hearing. You should consult with your instructor if you are uncertain about an issue of academic honesty prior to the submission of an assignment or test."

In addition, instructors are encouraged to direct students to http://osc.wmich.edu and www.wmich.edu/registrar to access the Code of Honor and general academic policies on such issues as diversity, religious observance, student disabilities, etc.

Semester-Project:

Participants in class will team up with another participant. Each team is expected to identify a real-world manufacturing/industrial/ service system related problem to be simulated. A one-pager description of the scope is expected by **September 22, 2010. The grade is based on the complexity of the problem, the elegance of the simulation model, and the quality of the presentation.** Each team should submit a final report along with a disk-copy of the simulation model. The report should include:

- One page description of the problem
- Flow charts, graphs and other form of representation of the current & proposed process with exogenous and endogenous processes
- A complete list of the components of the model
- A list of decision variables, and independent variables
- Description of the experimental design procedure
- Findings, conclusions and recommendations.

Each team is free to choose any problem, but they are expected to adhere to this guideline:

The simulation problem should include:

1. A minimum of ten locations with at least ten processing stations
2. A minimum of five random processing times
3. A minimum of five resources & three attributes
4. A minimum of three locations and resources downtimes
5. Shift assignments (if applicable) to locations and resources
6. Use of logic statements, and also use of verbs e.g., JOIN, MATCH, ACCUM, LOAD
7. Path network for the material handlers, resources and entity movements
8. Counters that show the number of processed part in each station, throughput, and a summary of major statistics.
9. ***Incorporating SUBMODEL & MERGE MODEL functions will earn extra credit.***

A written report will be required in a standard report format. The report must follow Ten step process covered in the class for planning the scope of the project and also for preparing the final project report that needs to be submitted in one hard copy plus its soft version on a disk or a CD. The report should include

1. Define the problem
2. Include a clear Statement of Objective/s of the simulation modeling project
3. State the procedure used to collect data relevant to the problem
4. Describe the simulation model
5. Explain the simulation outputs
6. Discuss the team's interpretation of the output; and
7. List the team's recommendations as to how the problem can be resolved.

Each team will have 20 minutes to present their model and to answer questions. You are expected to prepare power-point slides for your presentation. Every member of the group should be involved in the presentation, as well.

List of Practice Homework Problems

The following is the list of 50 problems from the Banks textbooks (prob #s indicated for Edition 4 & 5 in two separate columns below) that you are responsible for a week after the material has been covered in class.

Chap. #	**Probs on Page #s Ed. 4 /Ed. 5**	**Problem #s (Ed. 4)**	**Problem #s (Ed. 5)**
1	**22** / 22	1a, 1e, 1h, 3, and 5	1a, **1d**, **1g**, 3, and 5
2	57 / 57	6, 8, 12, 17, 21, and 28	6, 8, 12, 17, **22**, and **29**
3	93 / 93	1 and 4	1 and 4
4	132 / 156	1. 4, 5, 6, 44, **52,** and **55**	1. 4, 5, 6, 43, **51**, and **54**
5	193 / 219	All odd numbered problems	All odd numbered problems
6	**243** /268	5, 6,7,8,9, 10,13, and 17	5, 6,7,8,9, 10,13, and 17
7	**269** / 295	3, 4, and 8	3, 4, and 8
8	300 / 327	17, 18, and 19	17, 18, and 19
9	346 / 379	1, 2, 8, 10, 20, and 23	1, 2, 8, 10, 20, and 23
10	380 / 415	1, 3, 5, and 7	1, 3, 5, and 7
11	424 / 455	1, 2, and 6	1, 2, and 6
12	**477** / 502	6, 11, 16, and 19	6, 11, 16, and 19
13	524 / 531	2, and 7	2, and 7