

IS 464 – Standard Course Outline

COLLEGE OF BUSINESS ADMINISTRATION:

INFORMATION SYSTEMS DEPARTMENT

I. General Information

- Course number: IS 464
- Title: Network Modeling and Simulation
- Units: 3
- Prerequisites: IS 310: Business Statistics I and an average knowledge of Spreadsheet Environment.
- Course Coordinator: Khosrow Moshirvaziri
- SCO Prepared by: Khosrow Moshirvaziri, Faculty of CBA
- Date prepared/Revised: September 2012/October 2012

II. Catalog Description

Fundamentals of simulation methodologies, discrete and continuous, for performance and feasibility study of business models. Basic probability distributions, random number generation, model formulation, evaluating results, validations, waiting-line simulation, and computer network performance measurement via simulation and use of computer software simulation packages.

III. Curriculum Justification

Analysts and managers find quantitative tools, such as spreadsheets, Monte Carlo, discrete event and continuous simulation environment, intuitive and user-friendly platforms for organizing information and performing “what if” analyses for making vital business decisions. This is a relatively a new area of applications, other than those of traditional engineering applications. These apparatus have therefore become indispensable tools of modern business and operational analysis. This course provides a comprehensive understanding of the wide range of analytical tools that can be used for modeling, analyzing, and ultimately designing best practices and processes in modeling and simulation. Particular emphasis is placed on discrete event simulation as it represents one of the most flexible and powerful technology available today.

Upon completion, the student will meet the following three specific CBA learning goals:

- Learning Goal #1 – Critical Thinking (& Problem Solving Skills)
- Learning Goal #2 – Ethics (Use and Interpretation of Data)
- Learning Goal #6 – Quantitative and Technical Skills

IV. Course Objectives and General Learning Goals

- Introduce what-if analysis through spreadsheet modeling, optimization and simulation, as it applies to the study and analysis of technological and quantitative systems for decision making. The introduction of simulation and spreadsheet models provide a framework to think about a wide range of issues that arise in the context of Homeland Security issues. Probabilistic simulation methods are a powerful tool for the study, analysis and design of such systems.
- To expose students to a wide range of applications for these methods and models, and to integrate this material with their introduction to national security management.
- To strengthen the student's analytic thinking and background in anticipation of the rest of the BA in Engineering Systems curriculum.

V. Student Learning Outcomes

- Quantitative and Technical skills.** Students will possess quantitative and technological skills enabling them to analyze, interpret business data, and to perform what-if analysis to improve operational performance.
- Critical Thinking.** Students will be able to demonstrate conceptual learning, critical thinking, and problem-solving.
- Technology Selection.** Students will be able to select proper technical approach and make use of appropriate technology for presenting an efficient solution.
- Additional Tasks.** Students will be proficient in the following tasks:
 - Translate a verbal or graphical description of a decision problem into a valid decision model, by identifying variables, resources, and limitations.
 - Organizing data and describing patterns and relations between variables verbally, numerically, graphically, and symbolically.
 - Express a given decision model in a structured form for use with ExtendSim Simulation software and/or Risk Solver Platform.
 - Determining whether enough data or information is given in resolving a problem situation.
 - Making reasonable approximations of numerical results.
 - Posing questions and making hypothesis about a given situation or a set of data or information.
 - Recognize situations where quantitative analysis may provide useful in-sights and apply appropriate numerical and statistical techniques to reach conclusions.
 - Evaluating and critiquing mathematical and statistical statements, arguments, and reasoning.
 - Questioning assumptions, detecting fallacies, and evaluating risks associated with a decision.

- Assessing, comparing and selecting among multiple strategies for solving real-world problems and recognizing sources of error.

VI. Outline of Subject Matter

VII. Outline of Subject Matter

- Topics on the practical skills necessary to design, implement, and analyze discrete-event simulation systems; and spreadsheet modeling.
- Coverage of basic theory underlying what-if analysis and discrete-event simulation methodologies, in order to enable a critical understanding of simulation output in operational environments and build the foundations necessary to quickly adapt to future advances in simulation technology.

Week #	Tentative topics	Remark
1	Quick view of important concepts: Expected value, Variance, Interpolation, Systems States, and Network Parameters.	
2	Implementing Simulation models and its building block objects, running existing model.	
3	Building Simulation models and first hands-on exercise on using software: Network Simulation software (ExtendSim 8.02)	
4	Queuing Theory: Practical knowledge Introduction to ExtendSim Simulation Language	
5	Modeling steps and procedures Model Design, Blocks, Items, Properties, and values	
6	Modeling Design; Network Queueing Systems and disciplines	
7	Modeling Design; Routing, Branching, and selection blocks.	
8	Overview of Simulation in the context of: Modeling and Design of Processes (Exam 1)	
9	Routing Techniques; Process Times; Batching Processing, Batch/Unbatching, Resources, and Shift	
10	Modeling Design and Optimization Spreadsheet Modeling techniques	
11	Modeling techniques: Databases Interface	
12	Advanced Modeling and its Applications in such areas as: National Security, Air/Seaports, and Network Security.	
13	Assigned Projects –Workshop Session 1	
14	Assigned Projects – Workshop Session 2	
15	Final Project Presentations and Review (Exam 2)	

VIII. Methods of Instruction

The course will be offered through formal lectures and series of hands-on demonstrations. Plenty of opportunity will be provided for classroom discussion, group work, and student presentations. Students are expected to actively engage in participating in their modeling and logical thinking skills through exercises and discussions.

Teaching Method

- Lectures and hands-on demonstrations
- Assignments
- Term Project (individual or team work)

IX. Extend and Nature of Technology Use

Students' familiarity and moderate skills in spreadsheet manipulation (Microsoft Excel) will be assumed. Other modeling software packages and any additional Add-ins utilized will be covered. In addition to MS Excel, other software packages such as ExtendSim LT Version 8 or higher; Simulation and Modeling tools and Risk Solver Platform (RSP) or equivalent may be used.

X. Textbooks and Manuals

The following books are most popular modern textbooks used for teaching modeling, simulation, and spreadsheet approaches. The instructor may select materials from a combination of the list below along with practical cases and application areas dealing with issues of interests in Technology, Telecommunications, Security and Recovery, and Logistics and Supply Chain.

1. Diamond, B., [ExtendSim User Guide Release 8](#), ISBN: 978-0-9825040-0-0, Published by Imagine That, Inc., 2011.
2. Banks, J., Carson, J.S., Nelson, B.L., and Nicol, D.M., [Discrete-Event System Simulation, fifth edition, Pearson publishing](#), 2010.
3. Krahl, D. and Clark, R., [ExtendSim for System Simulation](#) (e-book by ExtendSim) 2011
4. Strickland, J.S., [Discrete Event Simulation Using ExtendSim 8](#), lulu.com publisher, 2011.
5. Ross, S. M., [Simulation, 5th Edition](#), ISBN: 978-0-12-415825-2, Elsevier Science & Technology publishing, 2013.
6. Laguna, M. and Marklund, J., Business [Process Modeling Simulation and Design](#) ISBN-10: 0131099795, Person publishing, 2005.

XI. Instructional Policies Requirements

Grading and Plagiarism, withdrawal, absences, and others: University policy will apply. Grading will be based on performance on exams, assignments, projects, and class participation.

- Test 1 (20%)
- Test 2 (20%)
- Computer Assignments: (Assign: 6 or more bi-weekly) (6% each)
- Group Projects (20%)
- Active Participation (4%)

XII. Bibliography

1. Banks, J, editor. Handbook of Simulation: Principles, Methodology, Advances, Applications, and Practice. New York: John Wiley & Sons, Inc; 1998.
2. Simulation - Based Engineering Science: Final Report, May 2006. Available at http://www.nsf.gov/pubs/reports/sbes_final_report.pdf .
3. Fishwick, PA. Simulation Model Design and Execution: Building Digital Worlds. Upper Saddle River, NJ: Prentice Hall, 1995.
4. Law, AM, Kelton, WD. Simulation, Modeling, and Analysis, 4th ed. New York: McGraw - Hill, Inc; 2006.
5. Link Simulation & Training. Available at <http://www.link.com/history.html>
6. Carley, K. Social Behavior Modeling. In Defense Modeling, Simulation, and Analysis: Meeting the Challenge. Washington, DC: National Academies Press; 2006.
7. Meadows, D.H. (Sustainability Institute), Thinking in Systems – A Primer, 2008. <http://www.sustainabilityinstitute.org/>
8. Sterman, J.D., Business Dynamics: Systems Thinking and Modeling for a Complex World, Irwin/McGraw-Hill, 2000.
9. Seila, A. F., V. Ceric, and P. Tadikamalla. Applied Simulation Modeling. Belmont, California: Brooks-Cole, 2003.
10. Winston, W. L. Simulation Modeling Using @risk. Belmont, California: Duxbury, 1996
11. Nelson, B. L., Stochastic Modeling – Analysis & Simulation, McGraw-Hill, NY 1995.
12. Baker, Kenneth R., Modeling with Spreadsheets, second edition, John Wiley, 2011.
13. Powell, S.G. and Baker, K.R., Management Science: The Art of Modeling with Spreadsheets

XIII. Additional Resources

Internet sites:

Software: ExtendSim LT – included with the text by David Krahl and Robin Clark

<http://www.extendsim.com/>

The DecisionToolsSuite from Palisade Academic Software

<http://www.palisade.com/risk/>

Risk Solver Platform (RSP) <http://www.solver.com/xlspremsolvsim.htm>

<http://www.solver.com/>