**Business Systems Simulation**

**Learning Outcomes**

**Description**

**Simulation** is the imitation of the operation of a real-world process or system over time. The act of simulating something first requires that a model be developed; this model represents the key characteristics, behaviors and functions of the selected physical or abstract system or process. The model represents the system itself, whereas the simulation represents the operation of the system over time. Simulation can be used to show the eventual real effects of alternative conditions and courses of action. Simulation is also used when the real system cannot be engaged, because it may not be accessible, or it may be dangerous or unacceptable to engage, or it is being designed but not yet built, or it may simply not exist.

The aim of this course is to model and analyze the predictions of production or service system behavior  to gain insight into their functioning. Production or service systems are usually characterized by uncertainty; it is hard to predict their behavior precisely. We use two ways to overcome this problem: the analytical and the simulating method. The Analytical Method expresses the system’s function as a mathematical model. The Simulating Method uses a model representative of the system under investigation. The model is helpful when experimenting with the system is impractical, expensive or impossible. By studying the functions of the model we can reach conclusions about the real system itself.

**Requirements**

For the unimpeded understanding of the course, students need to have a basic knowledge of Probability and Statistics and be familiar with Excel.

**Syllabus**

**Introduction to Simulation (Week 1)**

* Introduction and history of simulation
* Basic modeling terms
* Advantages and disadvantages of simulation
* Areas of application
* System and model; types of models
* Discrete event systems simulation.
* Overview of a simulation study

Examples of Simulation (Week 2)

This unit includes a series of examples aiming to enhance the understanding of previously taught terms. The simulation is done by hand or using Excel.

* Example 1: Manufacture system maintenance
* Example 2: Queuing system with one server
* Example 3: Queuing system with two server
* Example 4: Periodic review inventory system with parameters (UOL, T)

**Basic Simulation Terms (Week 3)**

* Basic concepts of a simulation model: entities, attributes, states, resources, queues, accumulators, events, simulation clock, event calendar
* Simulation based on events vs Simulation based on processes

**Introduction to Arena I (Week 4)**

* Introduction to Arena
* Templates of Arena
* Building a simple simulation model with Arena
* Modules: Arrive, Server, Depart, Simulate
* Animation
* Connection between modules

**Introduction to Arena II (Week 5)**

* Continuing the simple model
* Animation
* Running, reports
* Options
* Replications

**Modeling basic operations and inputs (Week 6)**

* Introducing complicated, more realistic models
* Electronic assembly and test system

A closer look at Arena I (Week 7)

* Resource schedules
* Resource failures

A closer look at Arena II (Week 8)

* Saving statistical data; the Statistics module
* The output analyzer

A closer look at Arena III (Week 9)

* Enhancing the animation
* The input analyzer

**Intermediate level modeling (Week 10-12)**

* A small manufacturing system
* New Arena concepts: sequences, variables, expressions, sets
* Building the small manufacturing system model
* Running
* Reports
* Data modules
* Logic modules

**Full course review and exam preparation (Week 13)**

**Α) Suggested Reading**

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| --- | --- | --- | --- | --- |
|  | **Publisher** | **Title** | **Author** | **Date** |
| **1** | McGraw-Hill, | *Simulation with Arena*, 5th edition | Kelton W. D., Sadowski P. R., Sadowski A. D | 2015 |
| **2** | Πανεπιστήμιο Αιγαίου, Χίος (e-class) | *Σημειώσεις στη Προσομοίωση Επιχειρησιακών Συστημάτων* | Μιχαήλ Βιδάλης | 2007 |

**Β) Supplementary Reading**

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| --- | --- | --- | --- | --- |
|  | **Publisher** | **Title** | **Author** | **Date** |
| **1** | Academic Press | Simulation Modelling and Analysis with ARENA | Taufur Altiok Benjamin Melamed | 2007 |
| **2** | Computer Science DeptNC State University | Computer Simulation Techniques: The definitive introduction! | Harry Perros | 2009 |
| **3** | Springer  | Excel Data Analysis Modeling and Simulation | Hector Guerrero | 2010 |

**Teaching and Learning Methods**

* Lectures
* Practice Sessions
* Obligatory projects (3)
* Case studies presentations

**Course Assessment**

* Projects: 100%
* Case Study: 0%
* Written Exams: 0%

**Language**

Greek

**Objective Aims**

**Knowledge**

By the end of the course, students should understand and be able to describe:

* The definition of simulation;
* The advantages and disadvantages of simulation;
* The historical evolution of simulation;
* Simulation languages, Simulators;
* What a system, a model, and their modules are;
* The concepts: entities, attributes, states, resources, queues, accumulators, events, simulation clock, event calendar.

**Skills**

By the end of the course, students will be able to:

* Determine the inputs and outputs of a model;
* Create an event calendar by hand or using Excel
* Use Arena in order to create and run simulation models
* Use the Statistic Tool and Output Analyzer
* Use the Input Analyzer

## **Abilities**

This course should help students:

* Develop simulation models that help the decision process;
* Enhance their abstraction abilities;
* Present a case study in a complete and comprehensive way;
* Learn to use Arena and enhance their Excel skills.