

Simulation Analytics in Business and Management

Title of the course: Simulation Analytics in Business and Management

Analysis Instructor: Weiwei Fan

Course code:

Teaching Language: English

Targeted students: Master

Contact Hours: 36

Self-learning Hours: 72

Prerequisites: Statistics

Number of learners: Less than 55

Academic Year:

Credits: 3

Profile of Teaching Staff

Weiwei Fan

Dr. Weiwei Fan is an Associate Professor in the School of Economics and Management at Tongji University. She earned her Ph.D. from the Hong Kong University of Science and Technology and her B.S. from the University of Science and Technology of China. Dr. Fan specializes in simulation optimization and robust optimization, with a focus on their applications within healthcare management. Her research has been published in prestigious journals such as Management Science and Operations Research.

1. Course Description

This course delves into the dynamic world of simulation, offering students a robust foundation in diverse simulation methodologies such as Monte Carlo Simulation, Discrete-Event Simulation (DES), Agent-Based Simulation (ABS), as well as advanced concepts like Digital Twin and Simulation Analytics. Each module is structured to enhance students' understanding of how simulations can effectively model complex systems and aid in decision-making across various sectors. Through a combination of theoretical knowledge and practical applications, the course aims to equip students with the skills necessary to design, implement, and analyze

simulations.

Students will learn to utilize simulation software, enabling them to create detailed models that simulate real-world processes and predict outcomes in industries ranging from finance to healthcare and urban planning. By the end of this course, students will not only be able to interpret simulation results but also integrate these insights into strategic planning and operational improvements. This course is designed to transform students into proficient problem solvers and decision-makers, well-prepared for challenges in both academic pursuits and professional environments.

2. Course Objectives

- Introduce students to fundamental concepts and practical applications of various simulation methodologies including Monte Carlo Simulation, Discrete-Event Simulation (DES), and Agent-Based Simulation (ABS).
- Provide a deep understanding of how simulations can model complex systems and support decision-making processes through theoretical study and hands-on projects.
- Offer a comprehensive overview of basic to complex simulation applications across different sectors, enhancing students' analytical and problem-solving skills.
- Equip students with a foundational knowledge in advanced topics such as Digital Twin and Simulation Analytics.

By the end of this course, students will be equipped with the skills to:

- Design and implement Monte Carlo simulations, and apply Discrete-Event Simulation in industrial contexts such as manufacturing and supply chain logistics.
- Develop and utilize Agent-Based models for the analysis of systems like social networks, improving their ability to handle complex interactions within various environments.
- Gain proficiency in using simulation software, enabling the creation of detailed models and informed decision-making in professional fields.
- Interpret simulation results accurately and integrate them into broader

decision-making frameworks, particularly in dynamic and uncertain environments, and evaluate the deployment of Digital Twin technologies and Simulation Analytics for real-time operations and strategic planning.

3. Course Requirements and Assessment

Assessment	Ratio	Requirements
Group project	40%	Students are required to complete a group project where they design and implement a simulation model related to one of the course topics. Each group should deliver a project report detailing the simulation design, methodology, results, and conclusions. Additionally, each group will prepare a presentation to showcase the project findings to the class.
Assignments	40%	There will be up to 4 assignments throughout the semester designed to test students' understanding and application of the different simulation methodologies taught in the course.
Class participation	20%	Graded based on a student's engagement in all aspects of the course, including lectures, discussions, and group activities.

4. Course Arrangement

Course Name	Simulation Analytics in Business and Management	Contact Hours	36
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Unit	Credit hours	Contents	Assignments
1	6	Monte Carlo Simulation 1. Introduction to Monte Carlo Methods 2. Implementing Monte Carlo Simulation with Software 3. Application: Financial Risk Analysis	Assignment 1
2	9	Discrete-Event Simulation (DES) 1. Fundamentals of of DES 2. Implement DES with Software 3. Application I: Manufacturing 4. Application II: Supply Chain and Logistics	Assignment 2
3	6	Agent-Based Simulation (ABS) 1. Fundamentals of of ABS 2. Implement ABS with Software 3. Application: Social Network	Assignment 3
4	9	Simulation for Decision Making 1. Introduction to Decision Models 2. Policies for Sequential Decision Making 3. Implementing Policies with Simulation 4. Application: Dynamic Pricing in E-commerce	Assignment 4
5	6	Digital Twin and Simulation Analytics 1. Definition and Concepts 2. Case Study: Urban Traffic Management 3. Case Study: Healthcare Management	Group Project and Presentation

4. Textbook and References

Textbook:

A.M. Law. 2024. Simulation Modeling and Analysis, 6th edition. McGraw Hill.

Supplementary materials:

- [1]. S. M. Ross. 2013. Simulation. Academic Press.
- [2]. W. D. Kelton R. P. Sadowski and N. B. Zupick. 2014. Simulation with Arena. 6th Edition
- [3]. B. Nelson. 2013. Foundations and Methods of Stochastic Simulation: A First Course. Springer.
- [4]. P. Glasserman. 2003. Monte Carlo Methods in Financial Engineering. Springer-Verlag, New York.