课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	**课程名称 Course Title**	数据智能与决策分析 Data Intelligence and Decision Analytics
2.	**授课院系 Originating Department**	信息系统与管理工程系 Department of Information Systems & Management Engineering
3.	**课程编号 Course Code**	MIS305
4.	**课程学分 Credit Value**	3
5.	**课程类别 Course Type**	专业核心课 Major Core Courses
6.	**授课学期 Semester**	春季 Spring
7.	**授课语言 Teaching Language**	英语 English
8.	**授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师） Instructor(s), Affiliation& Contact （For team teaching, please list all instructors）**	王松昊，信息系统与管理工程系， wangsh2021@sustech.edu.cn Wang Songhao, Department of Information Systems & Management Engineering, wangsh2021@sustech.edu.cn
9.	**实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact**	待公布 To be announced
10.	**选课人数限额(可不填) Maximum Enrolment （Optional）**	

11. 授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other（Please specify）	总学时 Total
学时数 Credit Hours	32		32		64

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	MA212 概率论与数理统计 MA212 Probability and Statistics
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	无 None
14. 其它要求修读本课程的学系 Cross-listing Dept.	无 None

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

This course introduces students to data-driven analysis, modeling and decision making for complex real systems based on discrete-event simulation. We mainly focus on problems that have no closed-form solutions but with abundant data resources. The course provides a solid mathematical/statistical grounding in simulation and some tools to solve actual problems. It will cover data collection and input data analysis, modeling techniques, random number generators, discrete-event simulation approaches, simulated output data analysis, simulation variance reduction techniques and state-of-the-art simulation software.

本门课程以离散事件仿真技术为基础，教授如何利用现实系统的数据进行分析、建模和决策。我们将主要针对缺乏闭式解但拥有丰富数据资源的决策问题。本门课程将讲解关于仿真的数学、统计学背景，并介绍如何利用仿真解决实际问题。具体介绍的主题包括数据收集和输入数据分析、建模技术、随机数生成、离散事件仿真方法、仿真数据分析、方差缩减以及先进的仿真软件。

16. 预达学习成果 Learning Outcomes

Students will be able to demonstrate knowledge of data collection and analysis, stochastic simulation models and interpret results from simulation analysis and how to apply those results to real-world problems.

Students will be able to build simulation models with simulation software.

Students will be able to use simulation in their research and go into an advanced course on simulation methodology.

学生能够掌握如何对真实系统进行数据收集和分析、建立随机仿真模型的知识，能够进行仿真结果分析，并将其使用到实际问题之中。

学生能够使用仿真软件自主建模。

学生能够将仿真技术应用到对其他领域的研究之中，并为进阶的仿真理论学习打下基础。

17. 课程内容及教学日历 （如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）
Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

理论和实验课（共 64 学时）

理论（32 学时）

第 1-2 周 数据驱动的仿真模型简介（4 学时）

本次课介绍离散事件仿真的基础，包含系统描述与仿真、仿真的类型、步骤、优势和局限等。

第 3-4 周 数据驱动的仿真实例（4 学时）

本次课介绍多种仿真实例，包含排队模型、一阶自回归模型、随机活动网络等。这些模型将作为示例贯穿本门课。

第 5-6 周 基础概率与统计（4 学时）

本次课提供另一种看待仿真的角度：将其结果视为随机过程，并提供设计仿真实验和分析结果的框架。具体内容包含：统计与概率论基础，如常见分布、随机过程基础、排队理论等。

第 7-8 周 输入数据分析（4 学时）

本次课程介绍仿真的输入模型，并讨论真实系统的数据收集和基于这些数据的单变量、多变量输入的推断、估计和检验。

第 9 周 期中考试（2 学时）

第 10-11 周 输出数据分析（4 学时）

本次课介绍仿真输出分析的常用技巧，包含点估计、置信区间、仿真长度、对终止和非终止仿真的重复次数、预热阶段、去除初始偏差等。

第 12 周 随机数产生（2 学时）

本次课介绍如何产生用于驱动随机仿真的随机数，包含逆变换法、拒绝法等

第 13 周 方差缩减（2 学时）

本次课介绍用于方差缩减的方法，包含重要性抽样、 控制变异法、反向变异法、相同随机数等。

第 14 周 仿真优化和数据驱动的决策（2 学时）

本次课介绍如何利用仿真选取最优决策，包含随即逼近法、排序选择法、基于替代模型的算法等。

第 15 周 关于仿真的其他课题（2 学时）

本次课程主要介绍如何利用仿真支持其它领域的研究，如优化、排队、金融工程、生产规划、物流等。

第 16 周 课程项目汇报（2 学时）

实验（32 学时）

第 1 周 AutoMod 介绍（2 学时）

本次课介绍 AutoMod 的安装，以及如何打开、编辑、运行模型。

第 2 周 AutoMod 基本概念（2 学时）

本次课介绍 AutoMod 的一些基本概念，包含文件结构、系统、负载、领地等。

第 3 周 AutoMod 的编程介绍（2 学时）

本次课主要介绍 AutoMod 的编程语言以及随机数产生方式。

第 4-6 周 过程系统介绍（6 学时）

本次课主要讲解如何使用资源、队列、负载参数、其他关键字等创造 AutoMod 中的负载和各种实体。

第 7-9 周 传送带介绍（6 学时）

本次课主要介绍如何利用 AutoMod 创建传送带系统以及如何利用该系统对多种不同负载进行运输和筛选。同时，介绍如何显示和解释传送带系统输出报告。

第 10 周 期中讲评（2 学时）

第 11 周 使用 AutoStat 进行基本统计分析（2 学时）

本次课程介绍如何使用合适的统计采样技巧来更精确估计变量。

第 12 周 不确定的延迟（2 学时）

本次课主要介绍如何使用有序列表来延迟一些负载的行动。这些负载的行动取决于一些其他负载的行为。

第 13-14 周 Path Mover 系统简介（4 学时）

本次课程主要讲解如何画出 Path Mover 系统， 并放置交通工具来模拟自动导引车系统。同时，介绍如何定义控制这些导引车的调度列表。

第 15 周 上机测试（2 学时）

第 16 周 课程项目汇报（2 学时）

Lecture and Lab (64 hours)

Lecture (32 hours)

Week 1~2 Introduction to data-driven stochastic simulation models (4 hours)

This lecture gives a general introduction of discrete-event simulation models including system description, system simulation, types of simulation, steps of simulation, advantages and limitations of simulations.

Week 3-4 Examples of data-driven simulations (4 hours)

This lecture provides several illustrating simulation example that will be used throughout the course, including queueing examples, autoregressive order 1 surrogate model, stochastic activity network, etc.

Week 5-6 Basic Statistics and Probability (4 hours)

This lecture introduces another view of simulations: view simulation results as a stochastic processes to provide a framework for designing simulation experiments and analyzing the results. It covers some basics of statistics and probability theory including standard distributions, stochastic process, queueing models, etc.

Week 7-8 Input data analysis (4 hours)

This lecture gives an overview of input modeling and discusses data collection, inference, estimation and testing of univariate and multivariate input models based on the collected data.

Week 9 midterm (2 hours)

Week 10~11 Output data analysis (4 hours)

This lecture introduces techniques for simulation output data analysis, including the point estimators, confidence intervals, length of simulation, simulation replications for terminating and non-terminating simulations, warm-up period, elimination of initial biases.

Week 12 Random number generation (2 hours)

This lecture introduces approaches to generate random numbers that are used in stochastic simulation, such as the inverse transform approach and the acceptance rejection approach.

Week 13 Variance reduction (2 hours)

This lecture introduces several techniques for variance reduction, including importance sampling, control variates, antithetic sampling, common random number, etc.

Week 14 Simulation optimization and data-driven decision making (2 hours)

This lecture discusses how to make data-driven decisions through simulation. We will introduce several simulation optimization approaches such as Stochastic Approximation Algorithms, Ranking and Selection, surrogate-based optimization.

Week 15 Other topics in simulation (2 hours)

This lecture discusses some advanced topics in simulation, especially how to use simulation to support basic research in domains like optimization, queueing, financial engineering, production planning and logistics.

Week 16 Project presentation (2 hours)

Lab (32 hours)

Week 1 Introduction to AutoMod (2 hours)

This lecture introduces the installation of the AutoMod software and explains how to open, edit, and run a model.

Week 2 AutoMod Concepts (2 hours)

This lecture introduces the AutoMod file structure, systems, loads, territories, and how to archive and submit models.

Week 3 Introduction to AutoMod Syntax (2 hours)

This lecture discusses the AutoMod simulation language and introduces the available distributions for generating random numbers in a model.

Week 4-6 Introduction to process systems (6 hours)

This lecture introduces how to use resources, queues, variables, load attributes and additional keywords to create the loads and entities in AutoMod.

Week 7-9 Introduction to Conveyors (6 hours)

This lecture discusses how to create conveyor systems, transport and sort multiple load types in a conveyor, and display and interpret conveyor section reports.

Week 10 Midterm review (2 hours)

Week 11 Basic Statistical Analysis Using AutoStat (2 hours)

This lecture discusses how to apply proper statistical sampling techniques to a model to accurately estimate performance under random conditions.

Week 12 Indefinite Delays (2 hours)

This lecture discusses how to use order lists to delay loads for an amount of time that depends on the processing of other loads in the simulation.

Week 13-14 Introduction to Path Mover Systems (4 hours)

This lecture explains how to draw a path mover system and place vehicle graphics to model an automated guided vehicle system. It also describes how to define scheduling lists to control the vehicles.

Week 15 lab test (2 hours)

Week 16 project presentation (2 hours)

18. **教材及其它参考资料 Textbook and Supplementary Readings**

Foundations and Methods of Stochastic Simulation: A First Course, by Barry L. Nelson

Stochastic Simulation: Algorithms and Analysis, by Søren Asmussen and Peter W. Glynn

Getting Started with AutoMod, by Jerry Banks

课程评估 ASSESSMENT

19.	评估形式 **Type of**	评估时间 **Time**	占考试总成绩百分比 **% of final**	违纪处罚 **Penalty**	备注 **Notes**

Assessment		score		
出勤 Attendance				
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		10		
期中考试 Mid-Term Test		20		
期末考试 Final Exam		40		
期末报告 Final Presentation		30		
其它（可根据需要改写以上评估方式） Others (The above may be modified as necessary)				

20. 记分方式 **GRADING SYSTEM**

☑ A. 十三级等级制 **Letter Grading**
☐ B. 二级记分制（通过/不通过） **Pass/Fail Grading**

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority