

智能仿真建模技术 教学大纲

Simulation Modelling Subject Syllabus

一、课程信息 Subject Information

课程编号: Subject ID	3100313006	开课学期: Semester	4
课程分类: Category	专业教育 PA	所属课群: Section	专业基础 MF
课程学分: Credit Points	3.5	总学时/周: Total Hours/Weeks	56
理论学时: LECT. Hours	50	实验学时: EXP. Hours	6
PBL 学时: PBL Hours	0	实践学时/周: PRAC. Hours/Weeks	0
开课学院: College	东北大学 悉尼智能科技学院	适用专业: Stream	应用统计学 AS
课程属性: Pattern	必修 Compulsory	课程模式: Mode	引进 UTS
中方课程协调人: NEU Coordinator	胡海娟 Haijuan Hu	成绩记载方式: Result Type	百分制 Marks
先修课程: Requisites	概率论与随机变量 Probability and random variables		
英文参考教材: EN Textbooks	Rubinstein R and Kroese D, Simulation and the Monte Carlo Method, 3rd Edition, Wiley 2017. Grimmett G and Stirzaker D, Probability and Random Processes. 3rd Edition, Oxford 2001.		
中文参考教材: CN Textbooks	周永道, 贺平和宁建辉, 随机模拟的方法和应用, 高等教育出版社, 2021		
教学资源: Resources	https://lms.cloudcampus.com.cn/courses/38		
课程负责人(撰写人): Subject Director	胡海娟 Haijuan Hu	提交日期: Submitted Date	单击或点击此处输入日期。
任课教师(含负责人): Taught by	胡海娟 Haijuan Hu	Stephen Woodcock Stephen Woodcock	
审核人: Checked by	韩鹏	批准人: Approved by	史闻博
		批准日期: Approved Date	单击或点击此处输入日期。

二、教学目标 Subject Learning Objectives (SLOs)

注：毕业要求及指标点可参照悉尼学院本科生培养方案，可根据实际情况增减行数

Note: GA and index can be referred from undergraduate program in SSTC website. Please add/reduce lines based on subject.

<p>整体目标: Overall Objective</p>	<p>《智能仿真建模技术》是应用统计学专业重要的专业基础课程之一。本课程包括随机变量的生成、并用于模拟随机过程，包括泊松过程、随机游走和排队系统、计算数值积分。所考虑的模拟方法包括接受-拒绝、重要性抽样、蒙特卡罗和 Metropolis-Hastings 算法。此外还介绍统计中的三大分布，参数估计，广义线性模型。</p> <p>Applied regression analysis is one of the important professional basic courses of students majoring in Statistics. This subject considers the generation of random variables and their use to simulate random processes including Poisson processes, random walks and queuing systems, perform numerical integration, and solve difference equations. The methods of simulation considered include acceptance-rejection, importance sampling, Monte Carlo, and the Metropolis-Hastings algorithm. In addition, this subject also consider t-distribution, Chi-Squared distribution, F-distribution, Estimation, Generalised linear models.</p>	
<p>(1) 专业目标: Professional Ability</p>	1-1	<p>仿真模拟简介 Introduction to simulation</p>
	1-2	<p>常见离散型和连续型随机变量的模拟; Simulation of common random variables</p>
	1-3	<p>随机变量函数的分布 Distributions of functions of random variables</p>
	1-4	<p>t 分布; 卡方分布; F 分布 t-distribution; Chi-Squared distribution; F-distribution</p>
	1-5	<p>弱大数定律 Weak law of large numbers</p>
	1-6	<p>参数估计 Estimation</p>
	1-7	<p>广义线性模型 Generalised linear models</p>
	1-8	<p>生灭过程和排队模型 Birth-death processes/Queuing models</p>
	1-9	<p>马氏链 Monte Carlo(MCMC)方法 Markov chain Monte Carlo (MCMC)</p>
<p>(2) 德育目标: Essential Quality</p>	2-1	<p>培养遵守法律、懂规则、守规则的新时代公民 Cultivate citizens of the new era who abide by the law, understand and obey the rules</p>
	2-2	<p>了解主要矛盾和次要矛盾, 在面对复杂问题的时候要实事求是、抓住主要矛盾 Understand the main contradiction and secondary contradiction, seek truth from facts and grasp the main contradiction in the face of complex problems</p>
	2-3	<p>培养服务意识, 具有“以人为本”的服务精神</p>

		Cultivate service consciousness and have the service spirit of "people-oriented"
	2-4	培养具有不畏困难、不惧失败、锲而不舍、敢于尝试、迎难而上的精神,并在学习过程中培养自己的细心和耐心的勇气和精神 Cultivate the spirit of not fearing difficulties or failure, perseverance, daring to try, and cultivate their own careful and patient courage and spirit in the process of learning
	2-5	培养有条理和计划,做到心中有数、有条不紊、循序渐进地完成一项工作 Cultivate a sense of order and plan, and complete a work in an orderly and gradual manner
课程教学目标与毕业要求的对应关系 Matrix of GA & SLOs		
毕业要求 GA	指标点 GA Index	教学目标 SLOs
1、理学知识:具有扎实的数学基础,能够将数学、自然科学和专业知识用于解决复杂实际问题。	1-1: 具有较强的演绎推理能力、准确计算能力、分析归纳能力、抽象思维能力,掌握数学、自然科学和相关专业知识,并使用其建立正确的数学、物理学等模型以解释复杂实际问题;	1-1 到 1-9
	1-2: 掌握统计调查、统计数据处理、统计分析、计算机与统计软件使用等应用统计学的基本理论、知识与方法,具备采集、处理、分析数据的能力,熟悉预研报告、可行性分析报告、研究方案等文档的撰写规范;	
2、问题分析:能够借助应用统计学的基本原理、方法和手段,识别、表达、并通过文献研究分析复杂实际问题,以获得有效结论。	2-1: 能够借助应用统计学的基本原理、方法和手段,分析、识别、表达本专业相关的复杂实际问题;	1-1 到 1-9
	2-2: 能够借助应用统计学的基本原理、方法和手段,针对复杂实际问题设计针对性的方案,并综合运用文献、科学理论和技术手段予以解决。	
11、项目管理与财务:理解并掌握工程管理原理与经济决策方法,并能在多学科环境中应用。	11-1: 掌握基本的工程管理原理和经济决策方法,能对应用统计相关领域的新技术、新应用进行技术分析和比较;	1-1 到 1-9

三、教学内容 Content (Topics)

注:以中英文填写,各部分内容的表格可根据实际知识单元数量进行复制、扩展或缩减

Note: Filled in both CN and EN, extend or reduce based on the actual numbers of knowledge unit

(1) 理论教学 Lecture

知识单元序号: Knowledge Unit No.	1	支撑教学目标: SLOs Supported	1-1、2-4
知识单元名称 Unit Title	仿真模拟简介 Introduction to simulation		
知识点: Knowledge Delivery	仿真模拟简介 A brief Introduction to simulation		
学习目标: Learning Objectives	了解: Recognize	仿真模拟的背景 Background of simulations	
		仿真模拟的应用 The applications of simulations	
	理解: Understand	仿真模拟的目的 The aim of simulations	
德育目标 Moral Objectives	培养具有不畏困难、不惧失败、锲而不舍、敢于尝试、迎难而上的精神，并在学习过程中培养自己的细心和耐心的勇气和精神 Cultivate the spirit of not fearing difficulties or failure, perseverance, daring to try, and cultivate their own careful and patient courage and spirit in the process of learning		
	培养服务意识，具有“以人为本”的服务精神 Cultivate service consciousness and have the service spirit of "people-oriented"		
	培养遵守法律、懂规则、守规则的新时代公民 Cultivate citizens of the new era who abide by the law, understand and obey the rules		
重点: Key Points	仿真模拟的目的 The aim of simulation		
难点: Focal Points	仿真模拟的应用 The applications of simulations		

知识单元序号: Knowledge Unit No.	2	支撑教学目标: SLOs Supported	1-2, 2-2
知识单元名称 Unit Title	常见离散型和连续型随机变量的模拟 Simulation of common random variables		
知识点: Knowledge Delivery	贝努利分布、二项分布、几何分布的模拟 Simulation of Bernoulli, binomial and geometric variables		
	指数分布、波松分布的模拟; Simulation of exponential and Poisson random variables		
学习目标: Learning Objectives	理解: Understand	贝努利分布、二项分布、几何分布的模拟 Simulation of Bernoulli, binomial and geometric variables	
		指数分布、波松分布的模拟; Simulation of exponential and Poisson random variables	
	掌握: Master	贝努利分布、二项分布、几何分布的模拟 Simulation of Bernoulli, binomial and geometric	

		variables 指数分布、波松分布的模拟; Simulation of exponential and Poisson random variables
德育目标 Moral Objectives	了解主要矛盾和次要矛盾, 在面对复杂问题的时候要实事求是、抓住主要矛盾 Understand the main contradiction and secondary contradiction, seek truth from facts and grasp the main contradiction in the face of complex problems	
重点: Key Points	贝努利分布、二项分布、几何分布的模拟 Simulation of Bernoulli, binomial and geometric variables 指数分布、波松分布的模拟; Simulation of exponential and Poisson random variables	
难点: Focal points	贝努利分布、二项分布、几何分布的模拟 Simulation of Bernoulli, binomial and geometric variables 指数分布、波松分布的模拟; Simulation of exponential and Poisson random variables	

知识单元序号: Knowledge Unit No.	3	支撑教学目标: SLOs Supported	1-3, 2-5
知识单元名称 Unit Title	随机变量函数的分布 Distributions of functions of random variables		
知识点: Knowledge Delivery	多维变量分布 Multivariate distributions 随机变量函数的分布 Distributions of functions of random variables		
学习目标: Learning Objectives	了解: Recognize	多维变量分布 Multivariate distributions	
	理解: Understand	随机变量函数的分布 Distributions of functions of random variables	
	掌握: Master	随机变量函数的分布 Distributions of functions of random variables	
德育目标 Moral Objectives	培养有条理和计划, 做到心中有数、有条不紊、循序渐进地完成一项工作 Cultivate a sense of order and plan, and complete a work in an orderly and gradual manner		
重点: Key Points	随机变量函数的分布 Distributions of functions of random variables		
难点: Focal points	随机变量函数的分布 Distributions of functions of random variables		

知识单元序号: Knowledge Unit No.	4	支撑教学目标: SLOs Supported	1-4, 2-3
知识单元名称 Unit Title	t 分布、卡方分布和 F 分布 t-distribution, Chi-Squared distribution and F-distribution		

知识点: Knowledge Delivery	t 分布 t-distribution	
	卡方分布 Chi-Squared distribution	
	F 分布 F-distribution	
学习目标: Learning Objectives	理解: Understand	三个分布的构成 Construction of t-distribution, Chi-Squared distribution and F-distribution
	掌握: Master	三个分布的构成 Construction of t-distribution, Chi-Squared distribution and F-distribution
德育目标 Moral Objectives	培养服务意识, 具有“以人为本”的服务精神 Cultivate service consciousness and have the service spirit of "people-oriented"	
重点: Key Points	三个分布的构成 Construction of t-distribution, Chi-Squared distribution and F-distribution	
难点: Focal points	三个分布的构成 Construction of t-distribution, Chi-Squared distribution and F-distribution	

知识单元序号: Knowledge Unit No.	5	支撑教学目标: SLOs Supported	1-5, 2-3
知识单元名称 Unit Title	弱大数定律 Weak law of large numbers		
知识点: Knowledge Delivery	弱大数定律 Weak law of large numbers		
	Markov 和 Chebyshev 不等式 Markov and Chebyshev inequalities		
	Monte Carlo 方法计算定积分 Monte Carlo method for definite integrals		
学习目标: Learning Objectives	了解: Recognize	弱大数定律 Weak law of large numbers	
		Markov 和 Chebyshev 不等式 Markov and Chebyshev inequalities	
	理解: Understand	Monte Carlo 方法计算定积分 Monte Carlo method for definite integrals	
		掌握: Master	
德育目标 Moral Objectives	培养服务意识, 具有“以人为本”的服务精神 Cultivate service consciousness and have the service spirit of "people-oriented"		

重点: Key Points	Monte Carlo 方法计算定积分 Monte Carlo method for definite integrals
难点: Focal points	Monte Carlo 方法计算定积分 Monte Carlo method for definite integrals

知识单元序号: Knowledge Unit No.	6	支撑教学目标: SLOs Supported	1-6, 2-5
知识单元名称 Unit Title	参数估计 Estimation		
知识点: Knowledge Delivery	矩估计和最大似然估计 Method of moments; Maximum likelihood estimation		
	线性回归 Linear regression		
	最小二乘估计 Least squares estimation		
	置信区间 Confidence intervals;		
	预测区间 Prediction intervals;		
	偏差 Bias		
	学习目标: Learning Objectives	了解: Recognize	预测区间 Prediction intervals;
偏差 Bias			
理解: Understand		最小二乘估计 Least squares estimation	
		置信区间 Confidence intervals;	
掌握: Master		矩估计和最大似然估计 Method of moments; Maximum likelihood estimation	
		线性回归 Linear regression	
德育目标 Moral Objectives	培养有条理和计划,做到心中有数、有条不紊、循序渐进地完成一项工作 Cultivate a sense of order and plan, and complete a work in an orderly and gradual manner		
重点: Key Points	矩估计和最大似然估计 Method of moments; Maximum likelihood estimation		
	线性回归 Linear regression		

难点: Focal points	矩估计和最大似然估计 Method of moments and Maximum likelihood estimation
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知识单元序号: Knowledge Unit No.	7	支撑教学目标: SLOs Supported	1-7, 2-1
知识单元名称 Unit Title	广义线性模型 Generalised linear models		
知识点: Knowledge Delivery	广义线性模型 Generalised linear models		
	指数族 Exponential family		
学习目标: Learning Objectives	理解: Understand	广义线性模型 Generalised linear models	
		指数族 Exponential family	
	掌握: Master	广义线性模型 Generalised linear models	
		指数族 Exponential family	
德育目标 Moral Objectives	培养遵守法律、懂规则、守规则的新时代公民 Cultivate citizens of the new era who abide by the law, understand and obey the rules		
重点: Key Points	指数族 Exponential family		
难点: Focal points	广义线性模型 Generalised linear models		

知识单元序号: Knowledge Unit No.	8	支撑教学目标: SLOs Supported	1-8, 2-5
知识单元名称 Unit Title	生灭过程和排队模型 Birth-death processes and queuing models		
知识点: Knowledge Delivery	生灭过程 Birth-death processes		
	排队模型 Queuing models		
学习目标: Learning Objectives	理解: Understand	生灭过程 Birth-death processes	
		排队模型 Queuing models	
德育目标 Moral Objectives	培养有条理和计划，做到心中有数、有条不紊、循序渐进地完成一项工作 Cultivate a sense of order and plan, and complete a work in an orderly and gradual manner		

重点: Key Points	生灭过程 Birth-death processes
难点: Focal points	排队模型 Queuing models

知识单元序号: Knowledge Unit No.	9	支撑教学目标: SLOs Supported	1-9, 2-5
知识单元名称 Unit Title	马氏链 Monte Carlo(MCMC)方法 Markov chain Monte Carlo (MCMC)		
知识点: Knowledge Delivery	马氏链 Monte Carlo(MCMC)方法 Markov chain Monte Carlo (MCMC)		
	Metropolis-Hastings 方法 Metropolis-Hastings algorithm		
	MCMC 诊断 MCMC Diagnostics		
	贝叶斯推断和共轭先验 Bayesian inference and conjugate priors		
学习目标: Learning Objectives	了解: Recognize	MCMC 诊断 MCMC Diagnostics	
	理解: Understand	马氏链 Monte Carlo(MCMC)方法 Markov chain Monte Carlo (MCMC)	
		Metropolis-Hastings 方法 Metropolis-Hastings algorithm	
	掌握: Master	Metropolis-Hastings 方法 Metropolis-Hastings algorithm	
		贝叶斯推断和共轭先验 Bayesian inference and conjugate priors	
	德育目标 Moral Objectives	培养有条理和计划，做到心中有数、有条不紊、循序渐进地完成一项工作 Cultivate a sense of order and plan, and complete a work in an orderly and gradual manner	
重点: Key Points	马氏链 Monte Carlo(MCMC)方法 Markov chain Monte Carlo (MCMC)		
难点: Focal points	贝叶斯推断和共轭先验 Bayesian inference and conjugate priors		

(2) 实验教学 Experiments

注：可根据实际情况增减行数。实验类型可分为验证性、设计性、综合性，实验性质可分为选做、必做。

Note: Please add/reduce lines based on subject. The Type contains Verify, Design, and Comprehensive, while the Pattern contains Required and Elective

序号 No.	实验项目名称 Experiment Topic	学时 Hours	每组人数 MPG*	实验类型 Type	实验性质 Pattern
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1	离散事件、离散型变量、连续型随机变量模拟 Discrete event and discrete variable simulation; Simulation of continuous random variables	2	1	验证性 Verify	必做 Elec
2	Monte Carlo 方法计算定积分 Monte Carlo method for definite integrals	2	1	验证性 Verify	必做 Elec
3	马氏 Monte Carlo(MCMC)方法; Metropolis-Hastings 方法 Markov chain Monte Carlo (MCMC) ; Metropolis-Hastings algorithm	2	1	验证性 Verify	必做 Elec
总计 Total		6			

*MPG: Members per group

实验项目序号: Experiment No.	1	支撑教学目标: SLOs Supported	1-2
每组成员: Members per Group	1	指导教师: Tutor	胡海娟 Haijuan Hu
实验名称: Experiment Title	常见随机变量模拟 Simulation of common random variables		
实验内容: Content	离散事件、离散型变量、连续型随机变量模拟 Discrete event and discrete variable simulation and simulation of continuous random variables		
学习目标: Learning Objectives	掌握常见随机变量的模拟方法 Master the method of Simulation of common random variables		
教学要求: Requirements	会模拟常见的随机变量。 Know how to simulate common random variables		
实验场地: Location	实验室/机房 (科技楼 5082) Computer room 5082		
实验软硬件设备: Software/Hardware	计算机 Computer		

实验项目序号: Experiment No.	2	支撑教学目标: SLOs Supported	1-5
每组成员: Members per Group	1	指导教师: Tutor	胡海娟 Haijuan Hu
实验名称: Experiment Title	Monte Carlo 方法计算定积分 Monte Carlo method for definite integrals		
实验内容: Content	用 Monte Carlo 方法计算定积分 Monte Carlo method for definite integrals		

学习目标: Learning Objectives	会用 Monte Carlo 方法计算定积分 Master Monte Carlo method for definite integrals
教学要求: Requirements	会用 Monte Carlo 方法计算定积分 Master Monte Carlo method for definite integrals
实验场地: Location	实验室/机房 (科技楼 5082) Computer room 5082
实验软硬件设备: Software/Hardware	计算机 Computer

实验项目序号: Experiment No.	3	支撑教学目标: SLOs Supported	1-9
每组成员: Members per Group	1	指导教师: Tutor	胡海娟 Haijuan Hu
实验名称: Experiment Title	马氏 Monte Carlo(MCMC)法和 Metropolis-Hastings 方法 Markov chain Monte Carlo (MCMC) and Metropolis-Hastings algorithm		
实验内容: Content	用 Metropolis-Hastings 方法解决应用问题 Solve problems using Metropolis-Hastings algorithm		
学习目标: Learning Objectives	会用 Metropolis-Hastings 方法解决应用问题 Solve problems using Metropolis-Hastings algorithm		
教学要求: Requirements	会用 Metropolis-Hastings 方法解决应用问题 Solve problems using Metropolis-Hastings algorithm		
实验场地: Location	实验室/机房 (科技楼 5082) Computer room 5082		
实验软硬件设备: Software/Hardware	计算机 Computer		

四、教学安排 Teaching Schedule

注：可根据实际情况增减行数

Note: Please add/reduce lines based on subject.

教学内容 Teaching Content	学时(周) Hour(Week)			
	理论 LECT.	实验 EXP.	课外实践 PBL	集中实践 PRAC.
仿真模拟简介 Introduction to simulation	4	0		
常见离散型和连续型随机变量的模拟; Simulation of common random variables	4	2		
随机变量函数的分布	4	0		

Distributions of functions of random variables				
t 分布; 卡方分布; F 分布 t-distribution; Chi-Squared distribution; F-distribution	4	0		
弱大数定律 Weak law of large numbers	4	2		
参数估计 Estimation	12	0		
广义线性模型 Generalised linear models	6	0		
生灭过程和排队模型 Birth-death processes/Queuing models	4	0		
马氏链 Monte Carlo(MCMC)方法 Markov chain Monte Carlo (MCMC)	8	2		
总计 Total	50	6		

五、教学方法 Teaching Methodology

注: 可根据实际情况增减行数或修改内容

Note: Please add/reduce lines or revise content based on subject.

勾选 Check	教学方法与特色 Teaching Methodology & Characters
<input checked="" type="checkbox"/>	多媒体教学: 基于信息化设备的课堂教学 Multi-media-based lecturing
<input checked="" type="checkbox"/>	实践能力传授: 理论与行业、实际案例相结合 Combining theory with industrial practical problems
<input checked="" type="checkbox"/>	课程思政建设: 知识讲授与德育相结合 Knowledge delivery with ethic education
<input type="checkbox"/>	PBL 教学: 问题驱动的分组学习与交流 Problem-based learning
<input type="checkbox"/>	其他:单击或点击此处输入文字。 Other:单击或点击此处输入文字。

六、成绩评定 Assessment

注: 可根据实际情况增减行数或修改内容

Note: Please add/reduce lines or revise content based on subject.

考核环节: Assessment Content	平时 Behavior	环节负责人: Director	胡海娟 Haijuan Hu
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	40
考核方式: Measures	满分 100 分, 使用“学习通”进行。出勤, 50 分; 作业, 50 分。 The full score is 100 points. Students' usual classroom performance is		

	recorded by "XueXiTong". 5 points are counted for each attendance, and no score is given for absence. And 5 points are counted for each assignment, no score for plagiarism, plagiarism for others or no assignment. The final total score is not more than 100 points, not less than 0 points
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考核环节: Assessment Content	实验 Experiment	环节负责人: Director	胡海娟 Haijuan Hu
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	10
考核方式: Measures	满分 100 分, 共 3 次上机实验课, 共需要提交两个报告, 每次报告 50 分。 The full score is 100 points. There are 3 computer experiment classes in total. Two reports are needed to be submitted, with 50 points for each report.		

考核环节: Assessment Content	期末 Final	环节负责人: Director	胡海娟 Haijuan Hu
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	50
考核方式: Measures	满分 100 分, 通过批阅期末考试试卷给出学生成绩。 The full score is 100, and the students' scores are given by marking the final examination papers.		

七、改进机制 Improvement Mechanism

注: 未尽事宜以教学团队以及学院教学指导委员会商定为准。

Note: Matters not covered in this file shall be determined by TAB of SSTC, NEU.

教学大纲改进机制 Subject Syllabus Improvement Mechanism			
考核周期(年): Check Period (YR)	4	修订周期(年): Revise Period (YR)	4
改进措施: Measures	课程负责人根据课程教学内容与人才培养目标组织课程团队讨论并修改教学大纲, 报分管教学工作副院长审核后由执行院长批准。 The subject coordinator shall be responsible for the syllabus discussion and improvement, and the revised version shall be submitted to deputy dean (teaching affairs) for reviewing then to executive dean for approval		
成绩评定改进机制 Assessment Improvement Mechanism			
考核周期(年): Check Period (YR)	1	修订周期(年): Revise Period (YR)	1
改进措施: Measures	课程负责人根据课程教学内容、课堂教学效果以及成绩分布, 对课程教学方法和成绩评定环节进行改进, 并同步优化评定办法。		

	The subject coordinator shall revise the syllabus based on the teaching content, effect and result distribution while optimize the assessment measures.
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