

随机过程 教学大纲

Stochastic Processes Subject Syllabus

一、课程信息 Subject Information

课程编号: Subject ID	3100313010	开课学期: Semester	5
课程分类: Category		所属课群: Section	专业方向类课程
课程学分: Credit Points	3.5	总学时/周: Total Hours/Weeks	56
理论学时: LECT. Hours	56	实验学时: EXP. Hours	0
PBL学时: PBL Hours	0	实践学时/周: PRAC. Hours/Weeks	0
开课学院: College	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	张永超, 胡海娟	成绩记载方式: Result Type	百分制 Marks
先修课程: Requisites	数学分析与建模导论, 概率论与随机变量, 微分方程		
英文参考教材: EN Textbooks	Elements of Stochastic Modelling [Borokov, 2014] A Benchmark Approach to Quantitative Finance [Platen and Heath, 2006] Stochastic Calculus for Finance I [Shreve, 2005] Stochastic Calculus for Finance II [Shreve, 2004] (advanced)		

	Financial Modelling with Jump Processes [Cont and Tankov, 2004] (advanced)		
中文参考教材: CN Text books	无		
教学资源: Resources	https://lms.cloudcampus.com.cn/login/canvas https://canvas.uts.edu.au/courses/22701/pages/computational-software?module_item_id=862426		
课程负责人(撰写人): Subject Director	张永超	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	张永超, 胡海娟		
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>展示数学科学的理论和技术知识，包括微积分、离散数学、线性代数、概率、统计学和定量管理。</p> <p>评估解决问题、分析、应用和批判性思维的数学和统计方法，以进行数学论证，并基于分析、数值、统计算法进行实验，以解决新问题。</p> <p>Demonstrate theoretical and technical knowledge of mathematical sciences including calculus, discrete mathematics, linear algebra, probability, statistics and quantitative management.</p> <p>Evaluate mathematical and statistical approaches to problem solving, analysis, application, and critical thinking to make mathematical arguments, and conduct experiments based on analytical, numerical, statistical, algorithms to solve new problems.</p>	
<p>(1) 专业目标: Professional Ability</p>	<p>1-1</p>	<p>定义并说明概率和随机过程中使用的术语。</p> <p>Define and illustrate the terms used in probability and stochastic processes.</p>
	<p>1-2</p>	<p>讨论和演示概率中使用的证明技术以及随机过程理论中重要的一些数学推导。</p> <p>Discuss and demonstrate the techniques of proof used in probability and some of the mathematical derivations that are important in the theory of stochastic processes.</p>
	<p>1-3</p>	<p>陈述并应用概率的基本极限定理。</p> <p>State and apply the basic limit theorems of probability.</p>
	<p>1-4</p>	<p>展示使用数学技术分析各种随机过程行为的能力，尤其是长期或稳态行为。</p> <p>Demonstrate an ability to use mathematical techniques to analyse the behaviour of various stochastic processes, especially the long-run or steady state behaviour.</p>
	<p>1-5</p>	<p>制定和解决涉及概率和随机过程的应用和理论问题。</p> <p>Formulate and solve applied and theoretical problems involving probability and stochastic processes</p>
	<p>1-6</p>	<p>清楚地传达概率和随机进程主题的知识以及涉及这些主题的问题的解决方案。</p> <p>Communicate clearly knowledge of the subject matter of probability and stochastic processes and solutions to problems involving these topics.</p>
<p>(2) 德育目标: Essential Quality</p>	<p>2-1</p>	<p>自主工作或团队合作，展示对需要应用数学和统计学的现实生活问题的专业和负责任的分析。</p> <p>Work autonomously or in teams to demonstrate professional and responsible analysis of real-life problems that require application of mathematics and statistics.</p>
	<p>2-2</p>	<p>使用各种方法，简洁准确地表达推理和结论，向各种受众传达数学解决方案及其含义。</p>

		Use succinct and accurate presentation of reasoning and conclusions to communicate mathematical solutions, and their implications, to a variety of audiences, using a variety of approaches.
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。	指标点 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—1-6
5、使用现代工具：能够针对复杂实际问题，开发、选择与使用恰当的技术、资源、现代信息技术工具，包括对复杂实际问题的预测与模拟，并能够理解其局限性。	指标点 5-3：能够针对本专业相关复杂实际问题，选择与使用恰当的技术、资源、现代信息技术工具。	2-1, 2-2

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, 1-2, 1-6, 2-2
知识单元名称 Unit Title	公理化方法介绍, 概率基础 Introduction to axiomatic approach, probability basics		
知识点: Knowledge Delivery	概率论历史 History of probability theory		
	频率方法 Frequency approach to probability		
	Kolmogorov 公理化方法 Introduction to Kolmogorov's axiomatic approach		
	条件概率与独立事件 Conditional probability and independent events		
	随机变量 Scalar RVs		
学习目标: Learning Objectives	了解: Recognize	概率论历史 History of probability theory	
	理解: Understand	频率方法、Kolmogorov 公理化方法 Frequency approach to probability, Introduction to Kolmogorov's axiomatic approach	
	掌握: Master	条件概率与独立事件、随机变量 Conditional probability and independent events, Scalar RVs	
德育目标 Moral Objectives	使用各种方法，简洁准确地表达推理和结论，向各种受众传达数学解决方案及其含义。 Use succinct and accurate presentation of reasoning and conclusions to		

	communicate mathematical solutions, and their implications, to a variety of audiences, using a variety of approaches.
重点: Key Points	条件概率与独立事件、随机变量 Conditional probability and independent events, Scalar RVs
难点: Focal points	Kolmogorov 公理化方法, Introduction to Kolmogorov's axiomatic approach

知识单元序号: Knowledge Unit No.	2	支撑教学目标: SLOs Supported	1-1, 1-2, 1-6, 2-2
知识单元名称 Unit Title	多元 Gauss 随机变量 Multivariate Gaussian random variables		
知识点: Knowledge Delivery	Gauss 随机向量的构造 Constructing Gaussian vector RVs		
	Gauss 随机向量的仿射变换 Affine-linear transform of Gaussian vector RVs		
	正态相关定理 Theorem on normal correlation		
学习目标: Learning Objectives	了解: Recognize		
	理解: Understand		
	掌握: Master	Gauss 随机向量的构造、Gauss 随机向量的仿射变换、正态相关定理 Constructing Gaussian vector RVs, Affine-linear transform of Gaussian vector RVs, Theorem on normal correlation	
德育目标 Moral Objectives	使用各种方法, 简洁准确地表达推理和结论, 向各种受众传达数学解决方案及其含义。 Use succinct and accurate presentation of reasoning and conclusions to communicate mathematical solutions, and their implications, to a variety of audiences, using a variety of approaches.		
重点: Key Points	Gauss 随机向量的构造、Gauss 随机向量的仿射变换、正态相关定理 Constructing Gaussian vector RVs, Affine-linear transform of Gaussian vector RVs, Theorem on normal correlation		
难点: Focal points	正态相关定理 Theorem on normal correlation		

知识单元序号: Knowledge Unit No.	3	支撑教学目标: SLOs Supported	1-1, 1-2, 1-3, 1-6, 2-1, 2-2
知识单元名称 Unit Title	随机模拟方法 Methods of stochastic simulation		
知识点: Knowledge Delivery	随机变量的收敛性 Convergence of RVs		
	极限定理 Limit theorems		
	随机模拟 Stochastic simulation		
	随机变量的随机模拟 Simulation of RVs		
学习目标: Learning Objectives	了解: Recognize	随机变量的收敛性 Convergence of RVs	
	理解:	极限定理、随机模拟 Limit theorems, Stochastic	

	Understand	simulation
	掌握: Master	随机变量的随机模拟 Simulation of RVs
德育目标 Moral Objectives	<p>自主工作或团队合作, 展示对需要应用数学和统计学的现实生活问题的专业和负责任的分析。</p> <p>使用各种方法, 简洁准确地表达推理和结论, 向各种受众传达数学解决方案及其含义。</p> <p>Work autonomously or in teams to demonstrate professional and responsible analysis of real-life problems that require application of mathematics and statistics.</p> <p>Use succinct and accurate presentation of reasoning and conclusions to communicate mathematical solutions, and their implications, to a variety of audiences, using a variety of approaches.</p>	
重点: Key Points	随机变量的随机模拟 Simulation of RVs	
难点: Focal points	随机变量的收敛性、随机模拟 Convergence of RVs, Stochastic simulation	

知识单元序号: Knowledge Unit No.	4	支撑教学目标: SLOs Supported	1-1, 1-2, 1-4, 1-5, 1-6, 2-2
知识单元名称 Unit Title	随机过程介绍, Gauss 随机过程, 平稳随机过程 Introduction to stochastic processes, Gaussian SPs, stationary SPs		
知识点: Knowledge Delivery	一般定义 General definitions		
	Gauss 过程 Gaussian processes		
	平稳过程 Stationary processes		
学习目标: Learning Objectives	了解: Recognize		
	理解: Understand	一般定义 General definitions	
	掌握: Master	Gauss 过程、平稳过程 Gaussian processes, Stationary processes	
德育目标 Moral Objectives	<p>使用各种方法, 简洁准确地表达推理和结论, 向各种受众传达数学解决方案及其含义。</p> <p>Use succinct and accurate presentation of reasoning and conclusions to communicate mathematical solutions, and their implications, to a variety of audiences, using a variety of approaches.</p>		
重点: Key Points	Gauss 过程 Gaussian processes		
难点: Focal points	Gauss 过程 Gaussian processes		

知识单元序号: Knowledge Unit No.	5	支撑教学目标: SLOs Supported	1-1, 1-2, 1-4, 1-5, 1-6, 2-2
知识单元名称	Markov 过程, 离散时间 Markov 链 Markov processes, discrete-time		

Unit Title	Markov chains	
知识点: Knowledge Delivery	定义和一般性质 Definition and general properties	
	Gauss Markov 过程 Gaussian Markov processes	
	Chapman-Kolmogorov 方程 Chapman-Kolmogorov equations	
	离散时间齐次 Markov 链 Discrete-time homogenous Markov chains	
学习目标: Learning Objectives	了解: Recognize	
	理解: Understand	定义和一般性质 Definition and general properties
	掌握: Master	Gauss Markov 过程、Chapman-Kolmogorov 方程、离散时间齐次 Markov 链、Gaussian Markov processes , Chapman-Kolmogorov equations , Discrete-time homogenous Markov chains
德育目标 Moral Objectives	使用各种方法，简洁准确地表达推理和结论，向各种受众传达数学解决方案及其含义。 Use succinct and accurate presentation of reasoning and conclusions to communicate mathematical solutions, and their implications, to a variety of audiences, using a variety of approaches.	
重点: Key Points	Gauss Markov 过程、离散时间齐次 Markov 链 Gaussian Markov processes , Discrete-time homogenous Markov chains	
难点: Focal points	路由算法的意义及评价	

知识单元序号: Knowledge Unit No.	6	支撑教学目标: SLOs Supported	1-1, 1-2, 1-4, 1-5, 1-6, 2-2
知识单元名称 Unit Title	连续时间 Markov 链, 复合 Poisson 过程 Continuous-time Markov chains, compound Poisson processes		
知识点: Knowledge Delivery	连续时间齐次 Markov 链 Continuous-time homogenous Markov chains		
	复合 Poisson 过程 Compound Poisson processes		
学习目标: Learning Objectives	了解: Recognize		
	理解: Understand		
	掌握: Master	连续时间齐次 Markov 链、复合 Poisson 过程 Continuous-time homogenous Markov chains , Compound Poisson processes	
德育目标 Moral Objectives	使用各种方法，简洁准确地表达推理和结论，向各种受众传达数学解决方案及其含义。 Use succinct and accurate presentation of reasoning and conclusions to communicate mathematical solutions, and their implications, to a variety of audiences, using a variety of approaches.		
重点: Key Points	连续时间齐次 Markov 链、复合 Poisson 过程 Continuous-time homogenous Markov chains, Compound Poisson processes		

难点: Focal points	连续时间齐次 Markov 链、复合 Poisson 过程 Continuous-time homogenous Markov chains, Compound Poisson processes
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知识单元序号: Knowledge Unit No.	7	支撑教学目标: SLOs Supported	1-1, 1-2, 1-4, 1-5, 1-6, 2-2
知识单元名称 Unit Title	ARMA 过程 ARMA processes		
知识点: Knowledge Delivery	定义、动机 Definitions, Motivation		
	虑子 Filters		
	移位算子演算 Calculus of shift operator		
	平稳性 Stationarity		
	因果性和可逆性 Causality and invertibility		
	非平稳性 Non-stationarity		
学习目标: Learning Objectives	了解: Recognize	定义、动机 Definitions, Motivation	
	理解: Understand	虑子、因果性和可逆性、非平稳性 Filters, Causality and invertibility, Non-stationarity	
	掌握: Master	移位算子演算、平稳性 Calculus of shift operator, Stationarity	
德育目标 Moral Objectives	使用各种方法, 简洁准确地表达推理和结论, 向各种受众传达数学解决方案及其含义。 Use succinct and accurate presentation of reasoning and conclusions to communicate mathematical solutions, and their implications, to a variety of audiences, using a variety of approaches.		
重点: Key Points	移位算子演算、平稳性 Calculus of shift operator, Stationarity		
难点: Focal points	移位算子演算 Calculus of shift operator		

知识单元序号: Knowledge Unit No.	8	支撑教学目标: SLOs Supported	1-1, 1-2, 1-4, 1-5, 1-6, 2-2
知识单元名称 Unit Title	扩散过程基础, 随机积分, Ito 公式 Elements of diffusion processes, stochastic integration, Ito formula		
知识点: Knowledge Delivery	定义 Definitions		
	转移密度 Transition densities		
	Black-Scholes 模型中的 Kolmogorov 向后方程 Kolmogorov backward equation in Black-Scholes model		
	关于 Brown 运动的随机积分 Stochastic integrals with respect to Brownian motion		
学习目标: Learning Objectives	了解: Recognize		
	理解: Understand	定义、转移密度 Definitions, Transition densities	
	掌握:	Black-Scholes 模型中的 Kolmogorov 向后方程、关于	

	Master	Brown 运动的随机积分 Kolmogorov backward equation in Black-Scholes model, Stochastic integrals with respect to Brownian motion
德育目标 Moral Objectives		使用各种方法，简洁准确地表达推理和结论，向各种受众传达数学解决方案及其含义。 Use succinct and accurate presentation of reasoning and conclusions to communicate mathematical solutions, and their implications, to a variety of audiences, using a variety of approaches.
重点: Key Points		关于 Brown 运动的随机积分 Stochastic integrals with respect to Brownian motion
难点: Focal points		关于 Brown 运动的随机积分 Stochastic integrals with respect to Brownian motion

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.
公理化方法介绍，概率基础 Introduction to axiomatic approach, probability basics	6			
多元 Gauss 随机变量 Multivariate Gaussian random variables	8			
随机模拟方法 Methods of stochastic simulation	6			
随机过程介绍，Gauss 随机过程，平稳随机过程 Introduction to stochastic processes, Gaussian SPs, stationary SPs	8			
Markov 过程，离散时间 Markov 链 Markov processes, discrete-time Markov chains	8			
连续时间 Markov 链，复合 Poisson 过程 Continuous-time Markov chains, compound Poisson processes	8			
ARMA 过程 ARMA processes	6			
扩散过程基础，随机积分，Ito 公式 Elements of diffusion processes, stochastic integration, Ito formula	6			
总计 Total	56			

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 ethics 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	张永超, 胡海娟
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	50
考核方式: Measures	出勤 100 分, 每次考勤计 10 分, 缺勤不得分, 缺勤五次及以上取消考试资格。每次作业计 100 分, 抄袭、给他人抄袭或未交作业不得分, 作业成绩为各次作业的平均分。平时成绩为出勤成绩×0.4+作业成绩×0.6。		

考核环节: Assessment Content	期末 Final	环节负责人: Director	张永超, 胡海娟
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。		

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