东北大学秦皇岛分校本科课程教学大纲

一、课程基本信息

<table>
<tr><td>开课单位</td><td colspan="3">悉尼智能科技学院</td><td>课程代码</td><td colspan="6">3100313034</td></tr>
<tr><td>中文名称</td><td colspan="9">数理统计</td></tr>
<tr><td>英文名称</td><td colspan="9">Mathematical Statistics</td></tr>
<tr><td>总学时</td><td>56</td><td rowspan="2">理论学时</td><td rowspan="2">56</td><td rowspan="2">实验学时</td><td rowspan="2">0</td><td rowspan="2">上机学时</td><td rowspan="2">0</td><td rowspan="2">设计学时</td><td rowspan="2">0</td><td rowspan="2">课外学时</td><td rowspan="2">0</td></tr>
<tr><td>学　分</td><td>3.5</td></tr>
<tr><td>课程类型</td><td colspan="9">☑理论课程　☐理论（含实验）课程　☐实践类课程</td></tr>
<tr><td>课程类别</td><td colspan="9">☐通识类　☐学科基础类　☑专业方向类　☐实践类</td></tr>
<tr><td>适用专业</td><td colspan="9">应用统计学</td></tr>
<tr><td>先修课程</td><td colspan="9">概率论与随机变量</td></tr>
<tr><td>建议开课学期</td><td colspan="9">☐1-1 ☐1-2 ☐2-1 ☑2-2 ☐3-1 ☐3-2
☐4-1 ☐4-2 ☐5-1 ☐5-2 ☐*（代表每学期都开设）</td></tr>
<tr><td>考核方式</td><td colspan="3">☑考试 ☐考查</td><td>成绩分制</td><td colspan="5">☑百分制 ☐五级制 ☐二级制</td></tr>
<tr><td>使用教材</td><td colspan="9">1、Stephen Woodcock 自编资料
2、 Grimmett G and Stirzaker D, Probability and Random Processes. 3rd Edition, Oxford 2001.
3、Rubinstein R and Kroese D, Simulation and the Monte Carlo Method, 3rd Edition, Wiley 2017.</td></tr>
<tr><td>参考书及教学资源</td><td colspan="9">1、https://lms.cloudcampus.com.cn/login/canvas</td></tr>
<tr><td>其他说明</td><td colspan="9">无</td></tr>
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二、课程简介

中文描述

本课程是应用统计学专业重要的专业基础课程之一。本课程涵盖了概率和频率统计中较深入的内容，包括拟合优度检验和回归模型，并探讨了这些数学概念的基础及其应用。最后，介绍了贝叶斯统计和贝叶斯统计常用的现代程序，如马尔可夫链蒙特卡罗(MCMC)方法。

English Description

Mathematical Statistics is one of the important professional basic courses of students majoring in Statistics. This subject covers more advanced topics in both probability and frequentist statistics, including goodness-of-fit tests and regression models, and explores the mathematical and conceptual foundations of these as well as their application. Finally, Bayesian statistics is introduced alongside modern procedures commonly employed for Bayesian statistics, such as Markov Chain Monte Carlo (MCMC) methods.

三、课程目标

1、知识目标：

1-1：掌握常见离散型和连续型随机变量的模拟，随机变量函数的分布。了解弱大数定律。

1-2：理解 t 分布、卡方分布、F 分布，参数估计，了解广义线性模型。

1-3：理解马氏链 Monte Carlo(MCMC)方法。

2、能力目标：

2-1：会用软件模拟随机变量，得到积分的估计值；

2-2：会对线性回归模型中参数进行估计和假设检验；

2-3：能利用贝叶斯统计进行参数估计。

3、德育/素养目标：

3-1：介绍数理统计的发展简史，树立正确的科学观。

3-2：在探讨式案例教学中进行课程思政，树立理想信念、创新意识和职业道德。

表 1 课程目标与毕业要求的对应关系

毕业要求	指标点	课程目标	关联 (H/M/L)
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 、 1.2 、 1.3 、 2.1 、 2.2、 2.3	H
	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。	1.2 、 1.3 、 2.1、2.2、2.3	H
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 、 1.2 、 1.3 、 2.1 、 2.2、 2.3	M
	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。	2.1 、 2.2 、 2.3、3.1、3.2	L

四、主要教学内容

（一）理论教学

第 1 章：Simulation of discrete random variables（支撑教学目标 1-1、2-1、3-1）

【1】知识点：

(1) Introduction to simulation.

(2) Simulation of discrete random variables.

(3) Revision of Bernoulli, binomial and geometric variables.

【2】学习目标：

理解：Bernoulli, binomial and geometric variables.

掌握：Simulation of discrete random variables.

【3】重点内容：

(1) Bernoulli, binomial and geometric variables.

(2) Simulation of discrete random variables.

【4】难点内容：

(1) Simulation of discrete random variables.

【5】思政案例：

The brief history of the development of mathematical statistics is introduced to establish a correct view of science.

第 2 章：Simulation of continuous random variables（支撑教学目标 1-1、2-1）

【1】知识点：

(1) Exponential and Poisson random variables.

(2) Simulation of continuous random variables.

【2】学习目标：

理解：Distribution of exponential and Poisson random variables.

掌握：Simulation of continuous random variables.

【3】重点内容：

(1) Distribution of exponential and Poisson random variables.

(2) Simulation of continuous random variables.

【4】难点内容：

(1) Simulation of continuous random variables.

第 3 章：Multivariate distributions（支撑教学目标 1-1、2-1）

【1】知识点：

(1) Multivariate distributions.

(2) Distributions of functions of random variables.

【2】学习目标：

理解：Multivariate distributions.

掌握：Distributions of functions of random variables.

【3】重点内容：

(1) Joint distributions.

(2) Marginal distribution, conditional distribution.

【4】难点内容：

(1) Distributions of functions of random variables.

第 4 章：Distributions in Statistics（支撑教学目标 1-2、2-1）

【1】知识点：

(1) t-distribution.

(2) Chi-Squared distribution.

(3) F-distribution.

【2】学习目标：

理解：The density functions of the three distributions.

掌握：The properties of the three distributions.

【3】重点内容：

(1) The properties of the three distributions.

【4】难点内容：

(1) The density functions of the three distributions**.**

第 5 章：Limit theorems and Monte Carlo integrals（支撑教学目标 1-1、2-1）

【1】知识点：

(1) Weak law of large numbers.

(2) Markov and Chebyshev inequalities.

(3) Monte Carlo method for definite integrals.

【2】学习目标：

理解：Weak law of large numbers and Markov and Chebyshev inequalities.

掌握：Monte Carlo method for definite integrals.

【3】重点内容：

(1) Monte Carlo method for definite integrals.

【4】难点

(1) Weak law of large numbers.

(2) Markov and Chebyshev inequalities.

第 6 章：Estimation（支撑教学目标 1-2、2-2）

【1】知识点：

(1) Method of moments.

(2) Maximum likelihood estimation.

【2】学习目标：

理解：Method of moments and Maximum likelihood estimation.

掌握：Method of moments and Maximum likelihood estimation.

【3】重点内容：

(1) Method of moments.

(2) Maximum likelihood estimation.

【4】难点内容：

(1) Maximum likelihood estimation.

第 7 章：Linear regression（支撑教学目标 1-2、2-2、3-2）

【1】知识点：

(1) Linear regression.

(2) Least squares estimation.

(3) Access model fit.

【2】学习目标：

理解：Linear regression model.

掌握：Least squares estimation and Access model fit.

【3】重点内容：

(1) Least squares estimation.

(2) Access model fit.

【4】难点内容：

(1) Generalized least squares.

【5】思政案例：

The two kinds of errors in hypothesis testing mainly explain that hypothesis testing is a kind of falsified logic rather than a confirmed logic, and explain the asymmetry of hypothesis testing. Understand the idea of small probability through cases.

第 8 章：Confidence intervals（支撑教学目标 1-2、2-2）

【1】知识点：

(1) Confidence intervals.

(2) Prediction intervals.

(3) Bias.

【2】学习目标：

理解：Confidence intervals、Prediction intervals.

掌握：Bias..

【3】重点内容：

(1) Confidence intervals.

(2) Prediction intervals.

(3) Bias.

【4】难点内容：

(1) Bias.

第 9 章：Generalised linear models（支撑教学目标 1-2、2-2）

【1】知识点：

(1) Generalised linear models.

(2) Exponential family.

【2】学习目标：

理解：Generalised linear models.

掌握：Exponential family.

【3】重点内容：

(1) Exponential family.

【4】难点内容：

(1) Generalised linear models.

第 10 章：Markov chain Monte Carlo（支撑教学目标 1-3、2-1）

【1】知识点：

(1) Markov chain Monte Carlo.

(2) Metropolis-Hastings algorithm.

【2】学习目标：

理解：Markov chain Monte Carlo.

掌握：Metropolis-Hastings algorithm.

【3】重点内容：

(1) Markov chain Monte Carlo.

(2) Metropolis-Hastings algorithm.

【4】难点内容：

(1) Metropolis-Hastings algorithm.

第 11 章：Bayesian inference and conjugate priors（支撑教学目标 1-3、2-3）

【1】知识点：

(1) MCMC Diagnostics.

(2) Bayesian inference and conjugate priors.

【2】学习目标：

理解：MCMC Diagnostics.

掌握：Bayesian inference and conjugate priors.

【3】重点内容：

(1) MCMC Diagnostics.

(2) Bayesian inference and conjugate priors.

【4】难点内容：

(1) MCMC Diagnostics.

五、教学安排与学时分配

This course is based on classroom teaching. Classroom teaching focuses on the basic concepts, basic theories and basic principles of this course. The course focuses on the fundamental task of

cultivating morality and cultivating people, with the general goal of cultivating socialist builders and successors with all-round development of morality, intelligence, physique, beauty and labor, enriching the feelings for the country and the concept of strengthening the country, consolidating basic knowledge, improving innovation ability, and establishing a correct outlook on life, world outlook and values. The distribution of class hours is shown in Table 2.

表 2 学时分配表

讲 课 内 容		学时				
		讲课	实验	上机	设计	课外
第 1 章	Simulation of discrete random variables	5	0	0	0	0
第 2 章	Simulation of continuous random variables	5	0	0	0	0
第 3 章	Multivariate distributions	5	0	0	0	0
第 4 章	Distributions in Statistics	5	0	0	0	0
第 5 章	Limit theorems and Monte Carlo integrals	5	0	0	0	0
第 6 章	Estimation	5	0	0	0	0
第 7 章	Linear regression	5	0	0	0	0
第 8 章	Confidence intervals	5	0	0	0	0
第 9 章	Generalised linear models	6	0	0	0	0
第 10 章	Markov chain Monte Carlo	5	0	0	0	0
第 11 章	Bayesian inference and conjugate priors	5	0	0	0	0
小计		56	0	0	0	0
总计	56					

六、教学方法

1、Multi-media-based lecturing.

2、Combining theory with industrial practical problems.

3、Knowledge delivery with ethic education.

七、成绩评定

1. The score is assessed by the hundred-percent system. The course assessment consists of three parts, namely attendance, homework and closing exam. Specific requirements and scoring methods are as follows:

(1) Usual behavior scores account for 50%, mainly including attendance, homework, etc.

(2) The final exam is 50% of the total score.

2. Students who are missing more than 1/3 of the required homework, or who are missing more than 1/3 of the planned class hours, will be disqualified from the course assessment.

八、评价及持续改进

1、教学大纲

考核周期：4 年，修订周期：4 年。

改进措施：课程负责人组织课程团队所有教师讨论后提出改进意见，经教研室主任审核后由教学院长批准。

1. Teaching syllabus

Assessment period: 4 years, revision period: 4 years.

Improvement measures: The course leader organizes all teachers in the course team to discuss and put forward improvement suggestions, which are reviewed by the director of the teaching and research department and approved by the dean of teaching.

2、成绩评定考核

考核周期：1 学年，评价依据：学生最终成绩综合分析。

改进措施：根据学生最终成绩的分布，进行相应的内容调整和优化，并改进教学方法。

2. Performance assessment

Assessment period: 1 academic year, evaluation basis: comprehensive analysis of students' final scores.

Improvement measures: According to the distribution of students' final scores, adjust and optimize the corresponding content, and improve the teaching method.

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审核： 韩鹏

批准： 史闻博

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