

## 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 <b>Course Title</b>	概率论基础/ <b>Foundation of Probability Theory</b>
2.	授课院系 <b>Originating Department</b>	统计与数据科学系
3.	课程编号 <b>Course Code</b>	STA203
4.	课程学分 <b>Credit Value</b>	3
5.	课程类别 <b>Course Type</b>	专业基础课 Major Foundational Courses (请保留相应选项 <b>Please only keep the relevant information</b> )
6.	授课学期 <b>Semester</b>	秋季 Fall
7.	授课语言 <b>Teaching Language</b>	英文 English (请保留相应选项 <b>Please only keep the relevant information</b> )
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) <b>Instructor(s), Affiliation &amp; Contact</b> (For team teaching, please list all instructors)	张卓松 统计与数据科学系 <a href="mailto:zhangzs3@sustech.edu.cn">zhangzs3@sustech.edu.cn</a>
9.	实验员/助教、所属学系、联系方式 <b>Tutor/TA(s), Contact</b>	待公布 To be announced (请保留相应选项 <b>Please only keep the relevant information</b> )
10.	选课人数限额(可不填) <b>Maximum Enrolment (Optional)</b>	

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
	48	0	0	0	48
学时数 Credit Hours					
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	高等数学(下)/数学分析 II Calculus II/ Mathematical Analysis II MA127 / MA102a				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	数理统计 Mathematical Statistics				
14. 其它要求修读本课程的学系 Cross-listing Dept.					

### 教学大纲及教学日历 SYLLABUS

#### 15. 教学目标 Course Objectives

1. 理解概率论的基本概念和术语, 包括样本空间、事件、概率、条件概率等。
2. 理解离散型和连续型随机变量的概念, 并能够计算随机变量的分布、期望、方差、协方差、条件分布等。
3. 掌握二项分布、泊松分布、正态分布等重要概率分布的基本性质, 并能够应用概率分布解决实际问题。
4. 熟悉大数定律、中心极限定理等重要概率论理论, 理解这些理论在统计学中的应用。
5. 通过课堂练习和作业, 提高学生的数学分析和推理能力, 培养学生的概率论思维和解决实际问题的能力。



1. Understand the basic concepts and terms of probability theory, including sample space, event, probability, conditional probability, etc.
2. Understand the concept of discrete and continuous random variables, and be able to calculate the distribution, expectation, variance, covariance, conditional distribution, etc. of random variables.
3. Master the basic properties of important probability distributions such as binomial distribution, Poisson distribution, normal distribution, etc., and be able to apply probability distributions to solve practical problems.
4. Familiarize oneself with important probability theory theorems such as the law of large numbers, central limit theorem, etc., and understand the application of these theorems in statistics.
5. Through classroom exercises and homework, improve students' mathematical analysis and reasoning abilities, cultivate students' probability thinking and ability to solve practical problems.

#### 16. 预达学习成果 Learning Outcomes

学生在完成本门课程后, 预期能够达到以下学习成果:

1. 具备概率论的基本概念和术语, 包括样本空间、事件、概率、条件概率等, 并能够运用这些概念解决实际问题。
2. 掌握离散型和连续型随机变量的概念, 能够计算随机变量的期望、方差、协方差等, 并能够应用这些知识解决实

际问题。

3. 熟悉二项分布、泊松分布、正态分布等重要概率分布的基本性质，能够运用这些分布解决实际问题，并理解这些分布在实际中的应用。
4. 理解大数定律、中心极限定理等重要概率论理论，并能够应用这些理论解决实际问题。
5. 具备较强的数学分析和推理能力，能够对概率论问题进行建模和分析，并能够应用统计学方法解决实际问题。
6. 具备良好的学术素养和职业竞争力，能够进行科学研究、从事相关工作，并有进一步学习和研究的能力。

Upon completion of this course, students are expected to achieve the following learning outcomes:

1. Have a solid understanding of the basic concepts and terms of probability theory, including sample space, event, probability, conditional probability, etc., and be able to apply these concepts to solve practical problems.
2. Master the concept of discrete and continuous random variables, be able to calculate the expectation, variance, covariance, etc. of random variables, and apply this knowledge to solve practical problems.
3. Be familiar with the basic properties of important probability distributions such as binomial distribution, Poisson distribution, normal distribution, etc., be able to apply these distributions to solve practical problems, and understand the applications of these distributions in practice.
4. Understand important probability theory theorems such as the law of large numbers, central limit theorem, etc., and be able to apply these theorems to solve practical problems.
5. Possess strong mathematical analysis and reasoning abilities, be able to model and analyze probability theory problems, and apply statistical methods to solve practical problems.
6. Possess excellent academic literacy and career competitiveness, be able to conduct scientific research, engage in relevant work, and have the ability to further study and research.

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.)**

第一周:

- 课时 1: 介绍课程内容和教学大纲, 概率的定义和基本性质
- 课时 2-3: 概率的公理化定义和基本概念

第二周:

- 课时 4-5: 条件概率和乘法公式
- 课时 6: 全概率公式和贝叶斯公式

第三周:

- 课时 7: 独立性和乘法公式的推广
- 课时 8-9: 随机变量及其分布函数的定义

第四周:

- 课时 10-11: 离散型随机变量的概率分布和分布函数
- 课时 12: 常见的离散分布: 两点分布、二项分布、几何分布、泊松分布

第五周:

- 课时 13-14: 离散型随机变量的期望和方差: 定义和性质
- 课时 15-16: 连续型随机变量的概率密度函数和分布函数

第六周:

- 课时 17-18: 常见连续分布: 均匀分布、正态分布、指数分布



第七周:

- 课时 19-20: 随机变量函数的分布
- 课时 21-22: 连续型随机变量: 期望和方差

第八周:

- 课时 23-24: 期中考试

第九周:

- 课时 25-26: 二维随机变量的概率分布和分布函数
- 课时 27: 协方差和相关系数

第十周:

- 课时 28-29: 条件分布和条件期望
- 课时 30: 多维随机变量的分布和独立性

第十一周:

- 课时 31-32: 多元正态分布
- 课时 33: 矩、协方差矩阵和特征值分解

第十二周:

- 课时 34-36: 依概率收敛和几乎处处收敛

第十三周:

- 课时 37-38: 强大数定律和弱大数定律
- 课时 39: 大数定律的应用

第十四周:

- 课时 40: 依分布收敛
- 课时 41: 矩母函数和特征函数
- 课时 42: Lindeberg 方法和 Stein 方法

第十五周:

- 课时 43-46: 中心极限定理: 证明及应用

第十六周:

- 课时 47-48: 总复习



Week 1:

- Lesson 1: Introduction to course content and syllabus, definition of probability and basic properties.
- Lessons 2-3: Axiomatic definition of probability and basic concepts.

Week 2:

- Lessons 4-5: Conditional probability and multiplication rule.
- Lesson 6: Law of total probability and Bayes' theorem.

Week 3:

- Lesson 7: Independence and extension of multiplication rule.

- Lessons 8-9: Definition of random variable and distribution function.

Week 4:

- Lessons 10-11: Probability distribution and distribution function of discrete random variables.
- Lesson 12: Common discrete distributions: Bernoulli distribution, binomial distribution, geometric distribution, Poisson distribution.

Week 5:

- Lessons 13-14: Expectation and variance of discrete random variables: definition and properties.
- Lessons 15-16: Probability density function and distribution function of continuous random variables.

Week 6:

- Lessons 17-18: Common continuous distributions: uniform distribution, normal distribution, exponential distribution.

Week 7:

- Lessons 19-20: Distribution of functions of random variables.
- Lessons 21-22: Expectation and variance of continuous random variables.

Week 8:

- Lessons 23-24: Midterm exam.

Week 9:

- Lessons 25-26: Probability distribution and distribution function of two-dimensional random variables.
- Lesson 27: Covariance and correlation coefficient.

Week 10:

- Lessons 28-29: Conditional distribution and conditional expectation.
- Lesson 30: Distribution and independence of multiple random variables.

Week 11:

- Lessons 31-32: Multivariate normal distribution.
- Lesson 33: Moment, covariance matrix and eigen-decomposition.

Week 12:

- Lessons 34-36: Convergence in probability and almost sure convergence.

Week 13:

- Lessons 37-38: Strong law of large numbers and weak law of large numbers.
- Lesson 39: Applications of the law of large numbers.

Week 14:

- Lesson 40: Convergence in distribution.
- Lesson 41: Moment generating function and characteristic function.
- Lesson 42: Lindeberg method and Stein method.

Week 15:

- Lessons 43-46: Central limit theorem: proof and applications.

Week 16:

- Lessons 47-48: Final review.

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

- A First Course in Probability, by Sheldon. M. Ross

《概率论基础教程》（美）谢尔登 M 罗斯（著）



课程评估 ASSESSMENT

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance	每节课	5		
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments	每两周	30		
期中考试 Mid-Term Test	期中	30		
期末考试 Final Exam	期末	35		
期末报告				

**Final Presentation**

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**