

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	工程概率统计 Probability and Statistics for Engineering
2.	授课院系 Originating Department	统计与数据科学系 Department of Statistics and Data Science
3.	课程编号 Course Code	STA219
4.	课程学分 Credit Value	3
5.	课程类别 Course Type	专业必修课 Major Compulsory Courses
6.	授课学期 Semester	秋季&春季 Fall & Spring
7.	授课语言 Teaching Language	中英双语 Chinese and 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)	徐匆 Cong Xu 统计与数据科学系 Department of Statistics and Data Science Email: xuc6@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)	120

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				48
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	MA127 高等数学(下) MA113 线性代数				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	CS303 人工智能 CS401 智能机器人 CS405 机器学习				
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

本课程旨在为学生更好地理解现代机器学习算法与人工智能技术奠定概率和统计基础。我们强调在实际应用中重要的知识点。

This course aims to lay the foundation of probability and statistics for students to better understand modern machine learning algorithms and artificial intelligence technology. We emphasize important topics in practical applications.

16. 预达学习成果 Learning Outcomes

基于课程的学习，学生应：

- 深入理解支撑现代机器学习的概率和统计概念及方法，例如随机变量、正态分布、抽样方法、参数估计、假设检验、试验设计等；
- 使用 Python 实现课程中学习的概率和统计方法。

On successful completion of the course, students are expected to:

- Build a solid understanding of the concepts and methods in probability and statistics underpinning modern machine learning, e.g., random variable, normal distribution, sampling methods, parameter estimation, hypothesis testing, design of experiments, etc.
- Use Python to implement the methods in probability and statistics in the course.

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.)

第一章 数据的描述 (3 学时) Data Description

描述数据的图形(条形图、直方图、箱型图、散点图)、常用数据的描述性统计量(均值、方差、标准差、中位数、相关系数)

Data visualization (bar chart, histogram, boxplot, scatterplot), common

第二章 概率论基础 (5 学时) Basic Concepts in Probability

样本空间、随机事件、计数方法、条件概率、独立事件、贝叶斯公式

Sample space, random event, probability calculation, conditional probability, independent event, Bayesian formula

第三章 随机变量与期望 (12 学时) Random Variable and Expectation

离散型随机变量: 概率分布函数, 常见的离散型随机变量, 如伯努利随机变量、二项分布、几何分布、泊松分布等

Discrete random variable: cumulative distribution function, Bernoulli random variables, Binomial distribution, geometric distribution, Poisson distribution

连续型随机变量: 概率密度函数, 常见的连续型随机变量, 如均匀分布、指数分布、正态分布等

Continuous random variable: probability density function, uniform distribution, exponential distribution, normal distribution

随机变量的函数, 随机变量的联合分布函数、边缘分布函数, 独立随机变量, 条件分布, 联合分布的随机变量的函数(t 分布、卡方分布、F 分布)

Functions of random variable, joint distribution, marginal distribution, independent random variables, conditional distribution, functions of joint distribution (t-distribution, chi-square distribution, F-distribution)

随机变量的期望、方差、标准差、协方差、相关系数、条件期望

Expected value, variance, standard deviation, covariance, correlation matrix, conditional expected value

大数定律与中心极限定理

The law of large numbers, central limit theorem

第四章 计算机模拟与蒙特卡洛方法 (3 学时) Computer Simulations and Monte Carlo Methods

随机数的生成、逆变换法、拒绝采样法、蒙特卡洛方法与应用(估计概率、求积分)

Random number generator, inverse transformation method, rejection sampling, Monte Carlo methods and applications (estimating probabilities, numerical integration)

第五章 统计学基础 (5 学时) Basic Concepts in Statistics

样本与总体、常用统计量、点估计(极大似然原理)、区间估计

Sample and population, common statistics, point estimation (maximum likelihood principle), interval estimation

第六章 显著性检验 (8 学时) Hypothesis Testing

显著性与 p 值、两个正态总体均值与方差的比较
卡方检验、非参数检验
Significance level and p-value, the comparison of two normal populations
Chi-square test, non-parametric tests
第七章 贝叶斯推断 (4 学时) Bayesian Inference
先验与后验、贝叶斯估计、贝叶斯假设检验
Prior and posterior, Bayesian estimation, Bayesian hypothesis testing
第八章 试验设计 (4 学时) Design of Experiments
试验设计概要、单因子试验设计、区组设计、正交设计
Single factor experimental design, block design, orthogonal design

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

Textbook:
概率与统计：计算机科学视角 Probability and statistics for computer science. David Forsyth.
Supplementary Readings:
[1] Baron, M (2019). Probability and statistics for computer scientists (3rd ed.). Chapman and Hall/CRC.
[2] Deisenroth, M.P., Faisal, A.A. and Ong, C.S. (2020). <i>Mathematics for machine learning</i> . Cambridge University Press.
[3] Bishop, C.M. and Nasrabadi, N.M. (2006). <i>Pattern recognition and machine learning</i> . New York: Springer.
[4] Wasserman, L. (2004). <i>All of statistics: a concise course in statistical inference</i> . New York: Springer.

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				
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		20		
期中考试		30		

Mid-Term Test				
期末考试 Final Exam		50		
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

田国梁, 2023.10.10