课程大纲
COURSE SYLLABUS

1.	**课程代码/名称** **Course Code/Title**	**MAT8031 高等统计学 MAT8031 Advanced Statistics**
2.	**课程性质** **Compulsory/Elective**	专业选修课 Major Elective Courses
3.	**课程学分/学时** **Course Credit/Hours**	3/48
4.	**授课语言** **Teaching Language**	英文 English
5.	**授课教师** **Instructor(s)**	蒋学军 JIANG Xuejun
6.	**是否面向本科生开放** **Open to undergraduates or not**	是 Open to undergraduates
7.	**先修要求** **Pre-requisites**	（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.） 数学分析 III(MA203a) (或数学分析精讲（MA213）) Mathematical Analysis III (MA203a) (or Real Analysis (MA213)) 数理统计 (Mathematical Statistics), 线性模型(linear models), 多元统计分析(Multivariate statistical analysis)

8. 教学目标
Course Objectives

本课程为统计学研究生和博士生基础课，旨在帮助研究生或高年级的本科同学掌握高等统计学的基本概念和原理，为今后从事统计学方面的研究打下扎实的基础。从概率论的原理出发，我们使用微积分，统计学概念和原理发展出统计推断理论。本课程是理论课，将会有大量作业，强烈建议同学们独立完成，如实在有困难，可以咨询其他同学但要确保真正理解。本课程涵盖以下主题:
1.基本概率理论; 2. 变换和期望; 3 常见的分布族; 4, 多维随机向量; 5, 随机抽样的性质; 6, 数据降维原理; 7, 点估计和假设检验; 8, 区间估计; 9, 渐近评估.
This course serves as the fundamental course of our M.Phil. and Ph.D. programs in statistics with the aim of helping postgraduate students and senior undergraduates to master some basic concepts and theories in Advanced Statistics so as to lay a solid foundation for the research in statistics. Starting from the first principles of probability theory, we develop the theory of statistical inference using calculus, statistical concepts and principles. Home works (assignments) are essential to understand the subject so I strongly encourage all the students try to finish them, please try first independently, if there is difficulty, consult the others, but make sure you can do them next time around.
This course will cover the following topics:
1. Basic probability theory; 2. Transformations and expectations; 3 Common families of distributions; 4, Multiple random variable; 5, Properties of a random sample; 6, Principle of data reduction; 7, Point estimation and hypothesis testing; 8, Interval estimation; 9, Asymptotic evaluation.

9. 教学方法
Teaching Methods

讲授 Lectures

10. 教学内容
Course Contents

Section 1	Probability Theory Background
Section 2	Transformations and Expectations ----moments and moment generating functions, differentiating under an integral sign

	Section 3	Common Families of Distributions ---exponential families, location and scale families, inequalities and identities
	Section 4	Multiple Random Variables ----bivariate transformation; hierarchical models and mixture distribution; covariance and correlation; multivariate distribution
	Section 5	Properties of a Random Sample ----basic concepts of random samples; sampling from normal distribution; order statistics; convergence concepts; generating a random variable
	Section 6	Principle of Data Reduction ----sufficient statistics; minimal sufficient statistics; complete statistics; likelihood function; formal likelihood principle
	Section 7	Point Estimation ----moments estimator; maximum likelihood estimators; bayes estimators; EM algorithm; sufficiency and unbiasedness; best unbiased estimators
	Section 8	Hypothesis Testing ----likelihood ratio tests; bayesian tests; error probability; power function; most powerful tests; p-values; loss function optimality
	Section 9	Interval Estimation ----inverting a test statistic; pivotal quantities; pivoting the CDF; bayesian intervals; size and converge probability; test related optimality; loss function optimality
	Section 10	Asymptotic Evaluations ----consistency and efficiency; bootstrap standard errors; M-estimators; Asymptotic distribution of LRTs; other large sample tests; approximate maximum likelihood intervals; other large sample intervals
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11. 课程考核
Course Assessment

（①考核形式 Form of examination；②.分数构成 grading policy；③如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）
课堂表现 Class Performance 5%
平时作业 Assignments 25%
期中考试 Mid- Term Test 30%
期末考试 Final Exam 40%

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

[1] Lehmann, E. L. and Casella, G. (1998). Theory of Point Estimation (2nd Edition). Springer Texts in Statistics, Springer-Verlag, New York. [Each student will be provided an e-book of this monograph]
[2] Lehmann, E. L. (1999). Elements of Large-Sample Theory. Springer Texts in Statistics, Springer-Verlag, New York. [Each student will be provided an e-book of this monograph]