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**	计算统计 Computational Statistics
2.	**授课院系 Originating Department**	数学系 Department of Mathematics
3.	**课程编号 Course Code**	MAT7035
4.	**课程学分 Credit Value**	3
5.	**课程类别 Course Type**	专业选修课 Major Elective Courses
6.	**授课学期 Semester**	秋季 Fall
7.	**授课语言 Teaching Language**	英文 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）**	田国梁教授 Professor Guoliang TIAN
9.	**实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact**	无 NA / 待公布 To be announced / 已确定的实验员/助教联系方式 Please list all Tutor/TA(s) **（请保留相应选项 Please only keep the relevant information）**
10.	**选课人数限额(可不填) Maximum Enrolment （Optional）**	

11.		**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**
	授课方式 Delivery Method					
	学时数 Credit Hours					

12.	先修课程、其它学习要求 **Pre-requisites or Other Academic Requirements**	MA329 统计线性模型 MA329 Statistical Linear Models
13.	后续课程、其它学习规划 **Courses for which this course is a pre-requisite**	
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**

本课程旨在为数学系研究生(特别是统计学科的研究生)提供常用的现代复杂计算方法。它强调计算作为一个基本工具在数据分析、统计推断、统计理论与方法的发展中的中心地位。

This course aims to provide postgraduate students (especially, majoring in statistics) a background in modern computationally-intensive methods in statistics. It emphasizes the role of computation as a fundamental tool of discovery in data analysis, of statistical inference, and for development of statistical theory and methods.

16. **预达学习成果 Learning Outcomes**

On successful completion of the course, students should be able to:

understand the importance of the technique for generating random variables in Bayesian statistics, Monte Carlo integration and bootstrapping methods;

realize the advantages and disadvantages of the Newton-Raphson algorithm and the Fisher scoring algorithm and apply them to fit generalized linear models;

understand the essence and basic principle of the EM-type algorithms and MM-type algorithms, realize their range of application, and apply them to solve practical problems;

apply EM-type algorithms to find the posterior mode and apply Markov chain Monte Carlo methods to generate posterior samples;

apply bootstrap methods to obtain estimated standard errors of estimators and confidence intervals of parameters for both parametric and non-parametric cases.

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.)

Chapter 1 ： Generation of Random Variables including the inversion method, the grid method, the sampling/importance re-sampling method, the stochastic representation method, and the conditional sampling method (12 hours)
Chapter 2： Optimization techniques including Newton’ s method, Fisher scoring algorithm, expectation-maximization (EM) algorithm and its variants, and minorization-maximization (MM) algorithm.(15 hours)

Chapter 3:Integration including Laplace approximations, Riemannian simulation, the importance sampling method and the variance reduction techniques.(5 hours)

Chapter 4:Markov chain Monte Carlo methods including data augmentation algorithm, Gibbs sampler, and the exact inverse Bayes formulae sampling.(8 hours)

Chapter 5:Bootstrap methods including parametric/nonparametric bootstrap confidence intervals, and hypothesis testing with the bootstrap.(8hours)

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

In this course, no single textbook can cover all the topics. Relevant references are as follows:

[1] Tan, M., Tian, G.L. and Ng, K.W. (2010). *Bayesian Missing Data Problems: EM, Data Augmentation and Non-iterative Computation*. Chapman & Hall/CRC, Boca Raton.

[2] Givens, G.H. and Hoeting, J.A. (2005). *Computational Statistics.* Wiley, New York.

[3] Gentle, J.E. (2002). *Elements of Computational Statistics.* Springer, New York.

[4] Gentle, J.E. (2003). *Random Number Generation and Monte Carlo Methods.* Springer, New York.

[5] Robert, C.P. and Casella, G. (2005). *Monte Carlo Statistical Methods (2nd Ed.).* Springer, New York.

[6] Tanner, M.A. (1996). Tools for Statistical Inference: Methods for the Exploration of Posterior Distributions and Likelihood Functions (3rd Ed.). Springer, New York.

[7] McLachlan, G.J. and Krishnan, T. (1997). *The EM Algorithm and Extensions*. Wiley, New York.

[8] Gilks, W.R., Richardson, S. and Spiegelhalter, D.J. (1996). *Markov Chain Monte Carlo in Practice*. Chapman & Hall, London.

[9] Efron, B. and Tibshirani, R.J. (1993). *An Introduction to the Bootstrap*. Chapman & Hall, London.

[10] Davison, A.C. and Hinkley, D.V. (1997). Bootstrap Methods and Their Application. Cambridge University Press, New York.

[11] Lange, K. (1999). *Numerical Analysis for Statistics.* Springer, New York.

[12] Lange, K. (2004). *Optimization.* Springer, New York.

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		25		
期中考试 Mid-Term Test		25		

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