高级统计建模 课程教学大纲

Generalised Linear Models Subject Syllabus

一、课程信息 Subject Information

课程编号: Subject ID	3100313008	开课学期: Semester	5
课程分类: Category	专业教育 PA	所属课群: Section	专业平台 MT
课程学分: Credit Points	3.5	总学时/周: Total Hours/Weeks	56
理论学时: LECT. Hours	32	实验学时: EXP. Hours	24
PBL 学时: PBL Hours	0	实践学时/周: PRAC. Hours/Weeks	0
开课学院: College	东北大学 悉尼智能科技学院	适用专业: Stream	应用统计学 AS
课程属性: Pattern	必修 Compulsory	课程模式: Mode	引进 UTS
课程协调人: Coordinator	李晓奇 Li Xiaoqi	成绩记载方式: Result Type	百分制 Marks
先修课程: Requisites	概率论与随机变量 Probability Theory and Random Variables 应用回归分析 Regression Analysis		
英文参考教材: EN Textbooks	1. Dobson, A. J.. (2002) An Introduction to Generalized Linear Models (Links to an external site.) Links to an external site., 2nd Edition, CRC. 2. Draper, N.R., Smith, H. (1998) Applied Regression Analysis, 3rd edition, Wiley.		
中文参考教材: CN Textbooks	无		
教学资源: Resources	https://www.sas.com/en_au/software/on-demand-for-academics.html (Links to an external site.)		
课程负责人(撰写人): Subject Director	李晓奇 Li Xiaoqi	提交日期: Submitted Date	4/29/2023
任课教师(含负责人): Taught by	詹姆斯·布朗、李晓奇、张建波、韩鹏 James Brown、Li Xiaoqi、Zhang Jianbo、Han Peng		
审核人: Checked by	韩鹏	批准人: Approved by	史闻博
		批准日期: Approved Date	单击或点击此处输入日期。

二、教学目标 Subject Learning Objectives (SLOs)

注：毕业要求及指标点可参照悉尼学院本科生培养方案，可根据实际情况增减行数

Note: GA and index can be referred from undergraduate program in SSTC website. Please add/reduce lines based on subject.

整体目标: Overall Objective	高级统计建模是应用统计学专业的专业方向类课程，主要包括一元线性回归、多元线性回归、广义线性模型、逻辑回归、顺序逻辑回归、多项逻辑回归、泊松回归等。本课程培养学生运用回归和分类模型解决复杂问题的能力，对取得的成果进行评价和分析，并以各种方式向不同的受众（专家和非专家）简洁准确地表达信息、推理和结论。 Advanced Statistical Modeling is a professional direction course for Applied Statistics majors, which mainly includes unitary linear regression, multiple linear regression, generalized linear model, logical regression, Ordinal Logistic Regression, Multinomial Logistic Regression, Poisson regression, etc. This course cultivates students' ability to use regression and classification models to solve complex problems, evaluate and analyze the results achieved, and express information, reasoning, and conclusions succinctly and accurately to different audiences (experts and non experts) in various ways.	
（1）专业目标: Professional Ability	1-1	掌握各类回归模型的建模条件和方法，会对模型进行评价，并运用 SAS 在计算机实现。 Master the modeling conditions and methods of various regression models, be able to evaluate the models, and use SAS to implement them on a computer.
	1-2	培养研究技能和解决问题的能力，在证据的基础上进行论证，并在选择方法的基础上进行模拟。 Cultivate research skills and problem-solving abilities, conduct argumentation based on evidence, and simulate based on selecting methods.
	1-3	在个人或团队环境下高效、负责地工作的能力。Ability to work effectively and responsibly in an individual or team context.
	1-4	展示个人和独立学习策略，扩展现有知识。培养信息检索和整合技能。Present personal and independent learning strategies to expand existing knowledge. Developing information retrieval and integration skills
（2）德育目标: Essential Quality	2-1	培养责任感与团队协作精神，以及职业道德与行为规范。 Cultivate a sense of responsibility and teamwork spirit, as well as professional ethics and behavioral norms.
	2-2	通过对模型的拟合优度分析以及残差分析，树立正确、严密的思维习惯。Through the Goodness of fit analysis and residual analysis of the model, establish correct and rigorous thinking habits.

三、教学内容 Content (Topics)

注：以中英文填写，各部分内容的表格可根据实际知识单元数量进行复制、扩展或缩减

Note: Filled in both CN and EN, extend or reduce based on the actual numbers of knowledge unit

(1) 理论教学 Lecture

知识单元序号: Knowledge Unit No.	1	支撑教学目标: SLOs Supported	1-1，1-2，1-4，1-5
知识单元名称 Unit Title	线性回归模型 The Linear Regression Model		
知识点: Knowledge Delivery	模型的建立 Specifying the Model		
	最小二乘估计 Estimation with Least Squares		

	评估模型拟合 Assessing Model Fit	
学习目标: Learning Objectives	了解: Recognize	模型的建立 Specifying the Model
	理解: Understand	最小二乘估计 Estimation with Least Squares
	掌握: Master	评估模型拟合 Assessing Model Fit
重点: Key Points	最小二乘估计 Estimation with Least Squares	
难点: Focal points	评估模型拟合 Assessing Model Fit	

知识单元序号: Knowledge Unit No.	2	支撑教学目标: SLOs Supported	1-1，1-2，1-4，1-5
知识单元名称 Unit Title	多元线性回归模型 Multiple Linear Regression Model		
知识点: Knowledge Delivery	多元线性回归模型 The Model for Multiple Linear Regression		
	最小二乘的矩阵形式 OLS in matrix form		
	模型构建和解释 Model building and interpretation		
学习目标: Learning Objectives	了解: Recognize	多元线性回归模型 The Model for Multiple Linear Regression	
	理解: Understand	最小二乘的矩阵形式 OLS in matrix form	
	掌握: Master	模型构建和解释 Model building and interpretation	
重点: Key Points	最小二乘的矩阵形式 OLS in matrix form		
难点: Focal points	模型构建和解释 Model building and interpretation		

知识单元序号: Knowledge Unit No.	3	支撑教学目标: SLOs Supported	1-1，1-2，1-4，1-5
知识单元名称 Unit Title	广义线性建模框架 Generalized Linear Modelling Framework		
知识点: Knowledge Delivery	指数分布族 The Exponential Family of Distributions		
	指数族的一般极大似然估计 General MLE for the Exponential Family		
	广义线性建模框架		

	The Generalized Linear Modelling Framework	
	正态分布示例 Example with the Normal Distribution	
学习目标: Learning Objectives	了解: Recognize	指数分布族 The Exponential Family of Distributions
	理解: Understand	广义线性建模框架 The Generalized Linear Modelling Framework
	掌握: Master	正态分布示例 Example with the Normal Distribution
重点: Key Points	广义线性建模框架 The Generalized Linear Modelling Framework	
难点: Focal points	正态分布示例 Example with the Normal Distribution	

知识单元序号: Knowledge Unit No.	4	支撑教学目标: SLOs Supported	1-1，1-2，1-4，1-5
知识单元名称 Unit Title	逻辑回归导论 Introduction to Logistic Regression		
知识点: Knowledge Delivery	逻辑回归模型 The Logistic Regression Model		
	应用于二进制数据-分类 x Application to binary data – categorical x		
	二进制数据的应用——连续 x Application to binary data – continuous x		
	评估模型的拟合 Assessing the fit of the model		
学习目标: Learning Objectives	了解: Recognize	逻辑回归模型 The Logistic Regression Model	
	理解: Understand	应用于二进制数据-分类 x Application to binary data – categorical x	
	掌握: Master	评估模型的拟合 Assessing the fit of the model	
重点: Key Points	应用于二进制数据-分类 x Application to binary data – categorical x		
难点: Focal points	评估模型的拟合 Assessing the fit of the model		

知识单元序号: Knowledge Unit No.	5	支撑教学目标: SLOs Supported	1-1，1-2，1-4，1-5
知识单元名称 Unit Title	更复杂的 Logistic 回归模型 More Complex Logistic Regression Models		
知识点: Knowledge Delivery	评估模型的适拟合 Assessing the fit of the model		

	具有多个类别的分类变量 Categorical variables with multiple categories	
	多元逻辑回归 Multiple Logistic Regression	
	添加交叉项 Adding Interaction Terms	
学习目标: Learning Objectives	了解: Recognize	具有多个类别的分类变量 Categorical variables with multiple categories
	理解: Understand	多元逻辑回归 Multiple Logistic Regression
	掌握: Master	添加交叉项 Adding Interaction Terms
重点: Key Points	多元逻辑回归 Multiple Logistic Regression	
难点: Focal points	添加交叉项 Adding Interaction Terms	

知识单元序号: Knowledge Unit No.	6	支撑教学目标: SLOs Supported	1-1，1-2，1-4，1-5
知识单元名称 Unit Title	有序回归 Ordinal Regression		
知识点: Knowledge Delivery	有序逻辑回归模型 The Ordinal Logistic Regression Model		
	有序数据的应用——分类和连续 x Application to ordinal data – categorical & continuous x		
	评估模型的拟合性 Assessing the fit of the model		
	扩展线性预测 Extending the linear predictor		
学习目标: Learning Objectives	了解: Recognize	有序逻辑回归模型 The Ordinal Logistic Regression Model	
	理解: Understand	有序数据的应用——分类和连续 x Application to ordinal data – categorical & continuous x	
	掌握: Master	评估模型的拟合性 Assessing the fit of the model	
		扩展线性预测 Extending the linear predictor	
重点: Key Points	有序数据的应用——分类和连续 x Application to ordinal data – categorical & continuous x		
难点: Focal points	评估模型的拟合性 Assessing the fit of the model		

<table>
<tr><td>知识单元序号:
Knowledge Unit No.</td><td colspan="2">7</td><td>支撑教学目标:
SLOs Supported</td><td>1-1，1-2，1-4，1-5</td></tr>
<tr><td>知识单元名称
Unit Title</td><td colspan="4">名义变量/多项式回归
Nominal / Multinomial Regression</td></tr>
<tr><td rowspan="4">知识点:
Knowledge Delivery</td><td colspan="4">名义变量/多项式逻辑回归模型
The Nominal / Multinomial Logistic Regression Model</td></tr>
<tr><td colspan="4">分类数据的应用——分类和连续 x
Application to categorical data – categorical & continuous x</td></tr>
<tr><td colspan="4">评估模型的拟合性
Assessing the fit of the model</td></tr>
<tr><td colspan="4">扩展线性预测
Extending the linear predictor</td></tr>
<tr><td rowspan="4">学习目标:
Learning Objectives</td><td>了解:
Recognize</td><td colspan="3">名义变量/多项式逻辑回归模型
The Nominal / Multinomial Logistic Regression Model</td></tr>
<tr><td>理解:
Understand</td><td colspan="3">分类数据的应用——分类和连续 x
Application to categorical data – categorical & continuous x</td></tr>
<tr><td rowspan="2">掌握:
Master</td><td colspan="3">评估模型的拟合性
Assessing the fit of the model</td></tr>
<tr><td colspan="3">扩展线性预测
Extending the linear predictor</td></tr>
<tr><td>重点:
Key Points</td><td colspan="4">分类数据的应用——分类和连续 x
Application to categorical data – categorical & continuous x</td></tr>
<tr><td>难点:
Focal points</td><td colspan="4">评估模型的拟合性
Assessing the fit of the model</td></tr>
</table>

<table>
<tr><td>知识单元序号:
Knowledge Unit No.</td><td colspan="2">8</td><td>支撑教学目标:
SLOs Supported</td><td>1-1，1-2，1-4，1-5</td></tr>
<tr><td>知识单元名称
Unit Title</td><td colspan="4">泊松回归
Poisson Regression</td></tr>
<tr><td rowspan="4">知识点:
Knowledge Delivery</td><td colspan="4">泊松回归模型
The Poisson Regression Model</td></tr>
<tr><td colspan="4">计数数据的应用——分类和连续 x
Application to count data – categorical & continuous x</td></tr>
<tr><td colspan="4">评估模型的拟合性
Assessing the fit of the model</td></tr>
<tr><td colspan="4">扩展线性预测
Extending the linear predictor</td></tr>
<tr><td rowspan="3">学习目标:
Learning Objectives</td><td>了解:
Recognize</td><td colspan="3">泊松回归模型
The Poisson Regression Model</td></tr>
<tr><td>理解:
Understand</td><td colspan="3">计数数据的应用——分类和连续 x
Application to count data – categorical & continuous x</td></tr>
<tr><td>掌握:
Master</td><td colspan="3">评估模型的拟合性
Assessing the fit of the model</td></tr>
</table>

		扩展线性预测 Extending the linear predictor
重点: Key Points	计数数据的应用——分类和连续 x Application to count data – categorical & continuous x	
难点: Focal points	评估模型的拟合性 Assessing the fit of the model	

知识单元序号: Knowledge Unit No.	9	支撑教学目标: SLOs Supported	1-1，1-2，1-3，1-4，1-5
知识单元名称 Unit Title	多级（混合）建模简介 Introduction to Multilevel (Mixed) Modelling		
知识点: Knowledge Delivery	数据结构的作用 The role of data structures		
	处理分层数据结构 Handling hierarchical data structures		
	基本多层次方法 Basic multilevel approach		
	参数解释 Parameter interpretation		
	简单示例 Simple example		
学习目标: Learning Objectives	了解: Recognize	数据结构的作用 The role of data structures	
		处理分层数据结构 Handling hierarchical data structures	
	理解: Understand	基本多层次方法 Basic multilevel approach	
	掌握: Master	参数解释 Parameter interpretation	
重点: Key Points	基本多层次方法 Basic multilevel approach		
难点: Focal points	参数解释 Parameter interpretation		

(2)实验教学 Experiments

注：可根据实际情况增减行数

Note: Please add/reduce lines based on subject.

序号 No.	实验项目名称 Experiment Topic	学时 Hours	每组人数 MPG*	实验类型 Type	实验性质 Pattern
1	简单线性回归模型 Simple Linear Regression	2	1	综合型 Comprehensive	必做 Required

2	多元线性回归模型 Multiple Linear Regression Model	4	1	综合型 Comprehensive	必做 Required
3	广义线性建模框架 Generalized Linear Modelling Framework	2	1	综合型 Comprehensive	必做 Required
4	逻辑回归 Logistic Regression	4	1	综合型 Comprehensive	必做 Required
5	有序回归 Ordinal Regression	4	1	综合型 Comprehensive	必做 Required
6	多项式回归 Multinomial Regression	4	1	综合型 Comprehensive	必做 Required
7	泊松回归 Poisson Regression	4	1	综合型 Comprehensive	必做 Required
总计 Total		24			

*MPG: Members per group

实验项目序号: Experiment No.	1	支撑教学目标: SLOs Supported	1-1，1-4，2-2
每组成员: Members per Group	1	指导教师: Tutor	张建波 Zhang Jianbo
实验名称: Experiment Title	简单线性回归模型 Simple Linear Regression Model		
实验内容: Content	能用 SAS 的 prog reg 语句实现简单线性回归，并能分析结果 Be able to implement SLR using *proc reg* statement of SAS, and analysis the regression result		
	能根据结果写出回归方程 Be able to give the regression equation by the regression result		
学习目标: Learning Objectives	了解简单线性回归的 proc reg 语句实现；能对回归结果进行分析 Learn to implement the SLR using *proc reg* statement of SAS, and be able to analysis the result		
实验场地: Location	机房 Computer Room		
实验软硬件设备: Software/Hardware	计算机、SAS Computer, SAS Software		

实验项目序号: Experiment No.	2	支撑教学目标: SLOs Supported	1-1，1-4，2-2
每组成员: Members per Group	1	指导教师: Tutor	张建波 Zhang Jianbo
实验名称: Experiment Title	多元线性回归模型 Multiple Linear Regression Model		
实验内容: Content	能用 SAS 的 prog reg 语句实现多元线性回归，并能分析结果 Be able to implement MLR using *proc reg* statement of SAS, and analysis the regression result		

	能根据结果写出回归方程 Be able to give the regression equation by the regression result
学习目标: Learning Objectives	了解多元线性回归的 proc reg 语句实现；能对回归结果进行分析 Learn to implement the MLR using *proc reg* statement of SAS, and be able to analysis the result
实验场地: Location	机房 Computer Room
实验软硬件设备: Software/Hardware	计算机、SAS Computer, SAS Software

实验项目序号: Experiment No.	3	支撑教学目标: SLOs Supported	1-1，1-4，2-2
每组成员: Members per Group	1	指导教师: Tutor	张建波 Zhang Jianbo
实验名称: Experiment Title	广义线性建模框架 Generalized Linear Modelling Framework		
实验内容: Content	能用 SAS 的 proc genmod 语句实现广义线性建模，并能分析结果 Be able to implement GLMs using *proc genmod* statement of SAS, and analysis the regression result		
	能根据结果写出回归方程 Be able to give the regression equation by the regression result		
学习目标: Learning Objectives	了解广义线性建模的 proc genmod 语句实现；能对回归结果进行分析 Learn to implement the GLMs using *proc genmod* statement of SAS, and be able to analysis the result		
实验场地: Location	机房 Computer Room		
实验软硬件设备: Software/Hardware	计算机、SAS Computer, SAS Software		

实验项目序号: Experiment No.	4	支撑教学目标: SLOs Supported	1-1，1-4，2-2
每组成员: Members per Group	1	指导教师: Tutor	张建波 Zhang Jianbo
实验名称: Experiment Title	逻辑回归模型 Logistic Regression Models		
实验内容: Content	能用 SAS 实现逻辑回归，并能分析回归结果 Be able to implement logistic regression using SAS, and analysis the regression result		
	能根据结果写出回归模型 Be able to give the regression model by the regression result		

学习目标: Learning Objectives	了解逻辑回归的 SAS 实现；能对回归结果进行分析 Learn to implement the logistic regression using SAS, and be able to analysis the result
实验场地: Location	机房 Computer Room
实验软硬件设备: Software/Hardware	计算机、SAS Computer, SAS Software

实验项目序号: Experiment No.	5	支撑教学目标: SLOs Supported	1-1，1-4，2-2
每组成员: Members per Group	1	指导教师: Tutor	张建波 Zhang Jianbo
实验名称: Experiment Title	有序回归 Ordinal Regression		
实验内容: Content	能用 SAS 实现有序回归，并能分析回归结果 Be able to implement ordinal regression using SAS, and analysis the regression result		
	能根据结果写出回归模型 Be able to give the regression model by the regression result		
学习目标: Learning Objectives	了解有序回归的 SAS 实现；能对回归结果进行分析 Learn to implement the ordinal regression using SAS, and be able to analysis the result		
实验场地: Location	机房 Computer Room		
实验软硬件设备: Software/Hardware	计算机、SAS Computer, SAS Software		

实验项目序号: Experiment No.	6	支撑教学目标: SLOs Supported	1-1，1-4，2-2
每组成员: Members per Group	1	指导教师: Tutor	张建波 Zhang Jianbo
实验名称: Experiment Title	多项式回归 Multinomial Regression		
实验内容: Content	能用 SAS 实现多项式回归，并能分析回归结果 Be able to implement multinomial regression using SAS, and analysis the regression result		
	能根据结果写出回归模型 Be able to give the regression model by the regression result		
学习目标: Learning Objectives	了解多项式回归的 SAS 实现；能对回归结果进行分析 Learn to implement the multinomial regression using SAS, and be able to analysis the result		
实验场地: Location	机房 Computer Room		

实验软硬件设备: Software/Hardware	计算机、SAS Computer, SAS Software

实验项目序号: Experiment No.	7	支撑教学目标: SLOs Supported	1-1，1-4，2-2
每组成员: Members per Group	1	指导教师: Tutor	张建波 Zhang Jianbo
实验名称: Experiment Title	泊松回归 Poisson Regression		
实验内容: Content	能用 SAS 实现泊松回归 Be able to implement Poisson regression using SAS		
	能根据结果写出回归方程 Be able to give the regression equation by the regression result		
学习目标: Learning Objectives	了解泊松回归的 SAS 实现；能对回归结果进行分析 Learn to implement the Poison Regression using SAS, and be able to analysis the result		
实验场地: Location	机房 Computer Room		
实验软硬件设备: Software/Hardware	计算机、SAS Computer, SAS Software		

四、教学安排 Teaching Schedule

注：可根据实际情况增减行数

Note: Please add/reduce lines based on subject.

教学内容 Teaching Content	学时(周)Hour(Week)			
	理论 LECT.	实验 EXP.	实践 PRAC.	PBL
线性回归模型 The Linear Regression Model	2	2		
多元线性回归模型 Multiple Linear Regression Model	2	4		
广义线性建模框架 Generalized Linear Modelling Framework	4	2		
正态分布示例 Example with the Normal Distribution	2			
逻辑回归导论 Introduction to Logistic Regression	4	2		
复杂逻辑回归模型 More Complex Logistic Regression Models	4	2		
有序回归 Ordinal Regression	4	4		
名义变量/多项式回归	4	4		

Nominal / Multinomial Regression				
泊松回归 Poisson Regression	4	4		
多级（混合）建模简介 Introduction to Multilevel (Mixed) Modelling	2			
总计 Total	32	24		

五、教学方法 Teaching Methodology

注：可根据实际情况增减行数或修改内容

Note: Please add/reduce lines or revise content based on subject.

勾选 Check	教学方法与特色 Teaching Methodology & Characters
☑	多媒体教学：基于信息化设备的课堂教学 Multi-media-based lecturing
☑	实践能力传授：理论与行业、实际案例相结合 Combining theory with industrial practical problems
☑	课程思政建设：知识讲授与德育相结合 Knowledge delivery with ethic education
□	PBL 教学：问题驱动的分组学习与交流 Problem-based learning
□	其他:单击或点击此处输入文字。 Other:单击或点击此处输入文字。

六、成绩评定 Assessment

注：可根据实际情况增减行数或修改内容

Note: Please add/reduce lines or revise content based on subject.

考核环节: Assessment Content	平时成绩 Regular grades	环节负责人: Director	韩鹏 Han Peng
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	10
考核方式: Measures	平时成绩，以学生出勤、课堂表现、作业完成等情况综合评定。 Regular grades are comprehensively evaluated based on students' attendance, classroom performance, and homework completion.		

考核环节: Assessment Content	实验 Experiment	环节负责人: Director	张建波 Zhang Jianbo
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	20

考核方式: Measures	类型：项目 Type: Project 分组：每组 4-5 人 Groupwork: Group, 4-5 individuals/group 方式：每组提交一份实验报告 Method: Each group provide a report for each Computer Lab (all three)

考核环节: Assessment Content	期中考试 midterm examination	环节负责人: Director	张建波 Zhang Jianbo
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	30
考核方式: Measures	依据外方提供的三次大作业为考核内容布置学生完成。 Assign students to complete the assessment content based on the three major assignments provided by the foreign party.		

考核环节: Assessment Content	期末考试 final exam	环节负责人: Director	李晓奇 Li Xiaoqi
给分形式: Result Type	百分制 Marks	课程总成绩比重(%): Percentage (%)	40
考核方式: Measures	期末考试包括本课程介绍的所有理论内容。采取开卷方式，每个人独立答题。 The final exam includes all the theoretical content introduced in this course. Adopt an open book approach, with each person answering questions independently.		

七、改进机制 Improvement Mechanism

注：未尽事宜以教学团队以及学院教学指导委员会商定为准。

Note: Matters not covered in this file shall be determined by AAB of SSTC, NEU

教学大纲改进机制 Subject Syllabus Improvement Mechanism			
考核周期(年): Check Period (YR)	4	修订周期(年): Revise Period (YR)	4
改进措施: Measures	课程负责人根据课程教学内容与人才培养目标组织课程团队讨论并修改教学大纲，报分管教学工作副院长审核后由执行院长批准。 The subject coordinator shall be responsible for the syllabus discussion and improvement, and the revised version shall be submitted to deputy dean (teaching affairs) for reviewing then to executive dean for approvement.		
成绩评定改进机制 Assessment Improvement Mechanism			
考核周期(年): Check Period (YR)	1	修订周期(年): Revise Period (YR)	1

改进措施: Measures	课程负责人根据课程教学内容、课堂教学效果以及成绩分布，对课程教学方法和成绩评定环节进行改进，并同步优化评定办法。 The subject coordinator shall revise the syllabus based on the teaching content, effect and result distribution while optimize the assessment measures.