《计量经济学》教学大纲

The Course Outline of Econometrics

课程编号：150143A

课程类型：学科基础课

总 学 时：48 讲课学时：48 实验（上机）学时：0

学　　分：3

适用对象：金融学（数据与计量分析）

先修课程：微观经济学、宏观经济学、概率与统计、线性代数、微积分

**Course Code:** 150143A

**Course Type:** Discipline basic course

**Periods:** 48  **Lecture:** 48 **Experiment (Computer):** 0

**Credits:** 3

**Applicable Subjects:** Finance

**Preparatory Courses:** Microeconomics, Macroeconomics, Probability and Statistics, Linear Algebra, Mathematical Analysis

一、课程的教学目标

本课程是面向经济学、管理学及金融学专业本科学生开设的计量经济学入门课程。计量经济学是经济学科中的核心必修课程，它为经济研究者提供了在分析经济数据、归纳经济现象、和总结经济规律时所必需的实证研究工具。作为计量经济学入门课程，我们希望学生通过课堂学习与实际操作，掌握计量经济学的基础理论和基本分析方法，能够利用统计软件处理经济数据，建立线性回归模型，估计模型并进行假设检验。本课程将为学习中级计量经济学、金融计量经济学、和学生从事独立实证研究奠定扎实的基础。本课程可以使学生对我国的经济发展有更清晰的了解，对我国发展教育事业的重要意义有进一步的认识，增强学生的爱国情怀，帮助学生提高对社会正能量价值观的认同感。

This course is an introduction to Econometrics, tailored for undergraduate students whose major is Economics, Management, or Finance. Econometrics is a core subject in Economics, equipping researchers with essential tools for analyzing economic data, and discovering the regularities underlying the seemingly perplexing economic phenomena. As an introductory course, we expect students to be able to comprehend basic concepts and master basic methods in Econometrics. Through learning in class and practicing using computer software, students should be capable of handling economic data, constructing a linear regression model, estimating the model, and performing hypothesis testing. This course will provide solid foundations for further study in the courses, such as Intermediate Econometrics and Financial Econometrics, and for students’ own empirical research. This course will lead students to have a clearer understanding of economic development in China and better recognize the great importance of educational development in China. In addition, this course will strengthen the patriotic feelings of students, and help students have a better recognition of positive values.

**二、教学基本要求**

本课程教学的基本要求是，对计量经济学要理论学习与实际应用并重。作为入门课程，理论学习强调对计量经济学理论的整体把握，对基础概念与原理的准确理解，和对基本估计与检验方法的精通掌握。理论学习涵盖以下内容：一元线性回归模型的估计与假设检验，多元线性回归模型的估计和假设检验，以及对模型设定的评价。在时间允许的情况下，本课程还将介绍面板数据回归与工具变量法的基本原理与方法。本课程将围绕如何判断自变量与因变量之间的因果关系这一核心问题展开，重点讲解如何利用多元线性回归模型分析横截面数据中的因果关系。计量经济学理论学习必须结合实际应用。本课程将结合课本中各章节的实例，利用相关数据，讲授如何使用计算机软件（如STATA，EViews 或者R语言）实现模型估计与检验。

本课程教学方法将以课堂讲授为主。由于课程内容难度相对较大，我们鼓励学生课前预习，课上积极参与讨论，并课后复习和独立完成作业。计算机语言的学习以课堂展示和学生上机实际操作的方式完成。我们将结合教学实例，为学生提供完整的计算机语言操作说明，并安排上机作业。

课程考核由一般作业、上机作业、随堂测验、期中和期末考试组成。考核成绩为百分制，各项分数分配见表（一）。随堂测验、期中和期末考试均为闭卷考试。为了减少“死记硬背”，我们允许学生在期中和期末考试中携带一张“小抄”用来记忆定理与公式。为了鼓励学生参与课堂讨论，我们将给予表现积极的学生最高5%的奖励分。

|  |  |
| --- | --- |
| 表（一）：分数分配方式 | |
| 一般作业 | 15% |
| 上机作业 | 5% |
| 随堂测试 | 10% |
| 期中考试 | 30% |
| 期末考试 | 40% |

This course emphasizes on both theoretical learning and real applications. At an introductory level, the course expects that students will comprehend the general framework of Econometrics, accurately understand the basic concepts and theories, and master the fundamental methods of estimation and inference. Serving for these ends, the contents of this course cover, but not limited to, the single and multiple ordinary least squares (OLS) regression estimation, hypothesis testing, model specification assessment, panel data regression, and instrumental variables regression. The core subject of this course is how to use a multiple regression model to analyze the causal relationship between the dependent variable and the independent variables when using cross-sectional data. Moreover, the course stresses the importance of real applications along with theoretical learning. Students will learn how to use computer software (such as STATA，Eviews or R programming language) to implement estimation and inference of multiple regression models using the real data of the applications in each chapter in the textbook.

The basic teaching strategy of this course mainly involves in-class lectures. Due to the difficulty of the course, we encourage students to browse the assigned reading materials before class, to proactively participate discussions in class, and to peruse lecture notes and independently complete homework after class. Students will learn programming language through in-class instructions and practice. With the data of real applications in the textbook, we will provide students with complete tutorials and assign empirical exercises for practice.

The methods of the course evaluation include general homework, practical exercises, quiz, mid-term and final exams. The grade distribution of each component within one hundred percentage points is presented in Table 1. The quiz, mid-term and final exams are all closed-book exams. To prevent students from cramming for the exams, we allow students to bring a cheat-sheet for reminding themselves of important theorems and formula when taking the mid-term and final exams. Finally, to promote class participation, we will award the students engaging frequent in-class discussions for as high as 5% bonus points.

|  |  |
| --- | --- |
| Table 1: The grade distribution | |
| Homework | 15% |
| Practical Exercises | 5% |
| Quiz | 10% |
| Midterm exam | 30% |
| Final exam | 40% |

**三、**各教学环节学时分配

**教学课时分配 (The assignment of hours of instruction)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 序号(No.) | 章节内容  (Content) | 讲课(Lecture) | 实验(Experiment) | 其他(Others) | 合计(Total) |
| 1 | 导论 (Introduction) | 1 |  |  | 1 |
| 2 | 概率论回顾 (Review of Probability) | 2 |  |  | 2 |
| 3 | 数理统计回顾 (Review of Statistics) | 2 |  |  | 2 |
| 4 | 线性代数回顾 与计算机语言初步(Review of Linear Algebra and Introduction to programming language) | 1 | 1 |  | 2 |
| 5 | 随堂测试 (Quiz) | 1 |  |  | 1 |
| 6 | 一元线性回归模型 (Linear Regression with One Regressor) | 2 | 2 |  | 4 |
| 7 | 一元线性回归模型假设检验 (Hypothesis Test of Linear Regression with a Single Regressor) | 2 | 2 |  | 4 |
| 8 | 期中考试 (Mid-term exam) | 2 |  |  | 2 |
| 9 | 多元线性回归模型 (Linear Regression with Multiple Regressors) | 3 | 3 |  | 6 |
| 10 | 多元线性回归模型假设检验 (Hypothesis Tests in Multiple Regression) | 3 | 3 |  | 6 |
| 11 | 非线性回归方程 (Nonlinear Regression Functions) | 3 | 2 |  | 5 |
| 12 | 回归模型评价 (Assessing Studies Based on Multiple Regression) | 4 |  |  | 4 |
| 13 | 面板数据回归 (Regression with Panel Data) | 2 | 2 |  | 4 |
| 14 | 工具变量法 (Instrumental Variables Regression) | 3 | 1 |  | 4 |
| 15 | 回顾与总结 (Review and Summary) | 1 |  |  | 1 |
| 合计(Total) |  | 32 | 16 |  | 48 |

**四、教学内容**（黑体，小四号字）

**第一讲 导论**

第一节 什么是计量经济学

第二节 计量经济学中的研究问题

第三节 因果关系与实验方法

1. 因果关系估计
2. 随机控制实验

第四节 数据来源与类型

1. 实验数据与观测数据
2. 数据类型

教学重点、难点：了解计量经济学在经济学科中的地位和作用，理解如何通过随机实验推断变量间因果关系。

课程的考核要求：课后阅读

**第二讲 概率论回顾**

第一节 随机变量与概率分布

1. 概率、样本空间与随机变量
2. 离散随机变量的概率分布
3. 连续随机变量的概率分布

第二节 随机变量的期望与方差

1. 随机变量的期望
2. 标准差与方差

第三节 两个随机变量的联合分布与协方差

1. 联合分布与边际分布
2. 条件分布
3. 独立、协方差与相关性

第四节 正态分布、开方分布、t分布与F分布

1. 正态分布
2. 开方分布
3. t分布
4. F分布

第五节 随机样本与样本均值的抽样分布

1. 随机抽样
2. 样本均值的抽样分布

第六节 大样本的渐进分布

1. 大数定律与一致性
2. 中心极限定理

教学重点、难点：掌握计算随机变量期望、方差、条件期望和协方差的公式，了解样本均值的大样本特征。

课程的考核要求：课后阅读、完成作业

**第三讲 数理统计回顾**

第一节 总体均值的估计

1. 估计量及其特征
2. 随机抽样的重要性

第二节 关于总体均值的假设检验

1. 零假设与备择假设
2. t统计量及其大样本分布
3. 显著性水平、临界值和p值

第三节 总体均值的置信区间

第四节 散点图、样本协方差和相关系数

教学重点、难点：理解假设检验的基本原理，掌握p值、临界值和置信区间的计算。

课程的考核要求：课后阅读、完成作业

**第四讲 线性代数回顾与R语言初步**

第一节 向量与矩阵

第二节 矩阵的运算

第三节 逆矩阵

第四节 线性独立

第五节 特征值与正定性

第六节 R语言初步

教学重点、难点：熟练掌握用向量和矩阵表示一组变量的样本值，掌握矩阵的基本运算。

课程的考核要求：课后阅读、完成作业、完成上机练习

**第五讲 一元线性回归模型**

第一节 线性回归模型

第二节 估计线性回归模型中的参数

1. 最小二乘估计量
2. 估计参数的解释

第三节 模型拟合的衡量

1. 拟合优度(R2)
2. 回归标准差(SER)

第四节 最小二乘估计的假设

第五节 最小二乘估计量的抽样分布

教学重点、难点：熟练掌握最小二乘估计法，掌握最小二乘估计量的推导与公式，理解最小二乘估计的假设

课程的考核要求：课后阅读、完成作业、完成上机练习

**第六讲 一元线性回归模型假设检验**

第一节 单系数的假设检验

1. 关于斜率的双边与单边检验
2. 关于截距的检验

第二节 回归系数的置信区间

第三节 虚拟变量

1. 回归系数的解释

第四节 异方差与同方差

1. 异方差与同方差的定义
2. 同方差的数学含义

第五节 最小二乘法的理论基础

1. 高斯-马科夫定理

教学重点、难点：熟练掌握单参数假设检验的方法，掌握虚拟变量在回归模型中的作用，理解异方差和高斯-马科夫定理

课程的考核要求：课后阅读、完成作业、完成上机练习

**第七讲 多元线性回归模型**

第一节 多元回归模型

1. 总体回归线
2. 总体多元回归模型
3. 多元回归模型的矩阵表示

第二节 多元回归模型的最小二乘估计量

1. 最小二乘估计量
2. 估计系数的解释

第三节 多元回归模型拟合的衡量

1. 回归标准差(SER)
2. 拟合优度(R2)
3. 调整拟合优度(Adjusted R2)

第四节 多元回归的最小二乘假设

第五节 多元回归最小二乘估计量的统计特性

第六节 缺失变量误差

第七节 多重共线性

第八节 我国地区经济发展和地区教育支出和教育消费的关系

教学重点、难点：熟练掌握多元回归模型的最小二乘估计法，掌握运用矩阵表示回归模型与估计量，理解估计量的统计特性、缺失变量误差和多重共线性。通过学习我国地区经济发展和地区教育支出和教育消费的关系，学生会对我国经济发展会有更清晰的了解，对我国发展教育事业的重要意义有进一步的认识。

课程的考核要求：课后阅读、完成作业、完成上机练习

**第八讲 多元线性回归模型假设检验**

第一节 单系数的假设检验和置信区间

1. 最小二乘估计量的标准差
2. 单系数的假设检验
3. 单系数的置信区间

第二节 联合假设的检验

1. 联合假设的形式
2. F统计量
3. 同方差下的F统计量

第三节 多系数的置信集合

第四节 我国地区经济发展和地区教育支出和教育消费的关系的假设检验

教学重点、难点：熟练掌握运用F统计量推断联合假设，掌握联合假设的形式，和理解F统计量的含义。 通过学习我国地区经济发展和地区教育支出和教育消费的关系的假设检验，学生会对我国经济发展有清晰的了解，对我国发展教育事业的重要意义有进一步的认识。

课程的考核要求：课后阅读、完成作业、完成上机练习

**第九讲 非线性回归方程**

第一节 非线性回归方程的一般形式

第二节 单自变量的非线性方程变换

1. 多项式
2. 对数函数

第三节 自变量的交互效应

1. 虚拟变量的交互效应
2. 虚拟变量与连续变量的交互效应
3. 连续变量的交互效应

教学重点、难点：熟练掌握非线性回归模型的基本形式，掌握回归系数的正确解释方法

课程的考核要求：课后阅读、完成作业、完成上机练习

**第十讲 评价回归模型**

第一节 内部和外部有效性

1. 对内部有效性的威胁
2. 对外部有效性的威胁

第二节 回归模型的内部有效性问题

1. 缺失变量误差
2. 模型形式的错误设定
3. 测量误差及其估计偏差
4. 缺失数据与样本选择性
5. 双向因果关系

教学重点、难点：理解内部和外部有效性的定义，掌握影响回归模型内部有效性的因素

课程的考核要求：课后阅读、完成作业

**第十一讲 面板数据回归**

第一节 面板数据

第二节 两时期面板数据：事前事后比较法

第三节 固定效应回归模型

1. 固定效应回归模型的估计与推断

第四节 加入时间固定效应

教学重点、难点：掌握固定效应面板数据回归的基本估计方法

课程的考核要求：课后阅读、完成作业、完成上机练习

**第十二讲 工具变量法**

第一节 单自变量与单工具变量的回归模型

1. 工具变量与假设
2. 二阶段最小二乘法

第二节 一般回归模型的工具变量估计法

1. 多元回归模型中的二阶段最小二乘法
2. 工具变量的相关性和外生性
3. 工具变量回归模型的假设与二阶段最小二乘估计量的抽样分布
4. 工具变量回归模型的假设检验

第三节 检验工具变量的有效性

教学重点、难点：理解工具变量法的基本原理，掌握二阶段最小二乘法

课程的考核要求：课后阅读、完成作业、完成上机练习

**Lecture 1 Introduction**

Section 1.1 What is Econometrics About?

Section 1.2 Economic Questions We Examine

Section 1.3 Causal Effects and Idealized Experiments

1. Estimation of Causal Effects
2. Randomized Controlled Experiments

Section 1.4 Data Sources and Types

1. Experimental Versus Observational Data
2. Data Types

**Key and Difficult Points**: Know the roles and status of Econometrics in the subject of Economics, and understand how to use randomized controlled experiments to assess the causal relationship among variables.

**Evaluation Requirements**: Reading relevant materials

**Lecture 2 Review of Probability**

Section 2.1 Random Variables and Probability Distributions

1. Probabilities, the Sample Space, and Random Variables
2. Probability Distribution of a Discrete Random Variable
3. Probability Distribution of a Continuous Random Variable

Section 2.2 The Expected Value and the Variance of a Random Variable

1. The Expected Value of a Random Variable
2. The Standard Deviation and Variance

Section 2.3 Two Random Variables

1. Joint and Marginal Distributions
2. Conditional Distributions
3. Independence, Covariance, and Correlation

Section 2.4 The Normal, Chi-Squared, Student t, and F Distributions

1. The Normal Distribution
2. The Chi-Squared Distribution
3. The Student t Distribution
4. The F Distribution

Section 2.5 Random Sampling and the Distribution of the Sample Average

1. Random Sampling
2. The Sampling Distribution of the Sample Average

Section 2.6 Large-Sample Approximations to Sampling Distributions

1. The Law of Large Numbers and Consistency
2. The Central Limit Theorem

**Key and Difficult Points**: Master the calculation of the expected value, variance, covariance, and conditional mean, and understand the large-sample properties of the sample average.

**Evaluation Requirements**: Reading materials, and finishing homework

**Lecture 3 Review of Statistics**

Section 3.1 Estimation of the Population Mean

1. Estimators and Their Properties
2. The Importance of Random Sampling

Section 3.2 Hypothesis Testing Concerning the Population Mean

1. Null and Alternative Hypotheses
2. The t-Statistic and its Sampling Distribution with Large Samples
3. The Significance Level, the Critical Value, and the p-Value

Section 3.3 Confidence Intervals for the Population Mean

Section 3.4 Scatterplots, the Sample Covariance, and the Sample Correlation

**Key and Difficult Points:** Understand the basic philosophy of hypothesis testing, and master the calculation of the p-value, the critical value, and the confidence interval concerning the population mean.

**Evaluation Requirements:** Reading materials, and finishing homework

**Lecture 4 Review of Linear Algebra and an Introduction to R**

Section 4.1 Vectors and Matrices

Section 4.2 Matrix Operations

Section 4.3 Inverse Matrix

Section 4.4 Linear Independence

Section 4.5 Eigenvalues and Positive-Definiteness

Section 4.6 Introduction to R

**Key and Difficult Points:** Master the method of representing the observations of a group of variables using vectors and matrices, and grasp basic matrix operations.

**Evaluation Requirements:** Reading materials, finishing homework, completing the practical exercises

**Lecture 5 Linear Regression with One Regressor**

Section 5.1 The Linear Regression Model

Section 5.2 Estimating the Coefficients of the Linear Regression Model

1. The OLS estimators
2. Interpretation of the estimated coefficients

Section 5.3 Measures of Fit

1. R2
2. The Standard Error of Regression (SER)

Section 5.4 The Least Squares Assumptions

Section 5.5 Sampling Distribution of the OLS Estimators

**Key and Difficult Points:** Master the OLS estimation method, grasp the derivation of the formula of the OLS estimators, and understand the least squares assumptions

**Evaluation Requirements:** Reading materials, finishing homework, and completing practical exercises

**Lecture 6 Hypothesis Test of Linear Regression with a Single Regressor**

Section 6.1 Testing Hypotheses about One of the Regression Coefficients

1. Two-Sided and One-Sided Hypotheses Concerning the Slope
2. Hypotheses Concerning the Intercept

Section 6.2 Confidence Intervals for a Regression Coefficient

Section 6.3 Regression When X is a Binary Variable

1. Interpretation of the Regression Coefficients on a Binary Variable

Section 6.4 Heteroskedasticity and Homoskedasticity

1. What are heteroskedasticity and homoskedasticity?
2. Mathematical Implications of Heteroskedasticity

Section 6.5 The Theoretical Foundations of Ordinary Least Squares

1. The Gauss-Markov Theorem

**Key and Difficult Points:** Master the approach to hypothesis testing concerning one coefficient, grasp the use of a binary variable in regression, and understand heteroskedasticity and the Gauss-Markov theorem.

**Evaluation Requirements:** Reading materials, finishing homework, and completing practical exercises

**Lecture 7 Linear Regression with Multiple Regressors**

Section 7.1 The Multiple Regression Model

1. The Population Regression Line
2. The Population Regression Model
3. Matrix Notation of the Multiple Regression Model

Section 7.2 The OLS Estimator in Multiple Regression

1. The OLS Estimators
2. Interpretation of the Estimated Coefficients

Section 7.3 Measures of Fit in Multiple Regression

1. The Standard errors of the regression (SER)
2. R2
3. The Adjusted R2

Section 7.4 The Least Squares Assumptions in Multiple Regression

Section 7.5 The Statistical Properties of the OLS Estimators in Multiple Regression

Section 7.6 The Omitted Variable Bias

Section 7.7 Multicollinearity

Section 7.8 The Relationship Between Regional Economic Development in China and Two Factors: Regional Educational Expenses and Educational Consumption.

**Key and Difficult Points:** Master the OLS estimation method in multiple regression, grasp the way to represent the multiple regression model and the OLS estimators using matrices, and understand the statistical properties of the OLS estimators, and the concepts of the omitted variable bias and multicollinearity. By studying the relationship between regional economic development in China and two factors (i.e. regional educational expenses and educational consumption), the students will have a clearer understanding of economic development in China and better recognize the great importance of educational development in China.

**Evaluation Requirements:** Reading materials, finishing homework, and completing practical exercises

**Lecture 8 Hypothesis Tests in Multiple Regression**

Section 8.1 Hypothesis tests and confidence intervals for a single coefficient

1. Standard errors for the OLS estimators
2. Hypothesis Tests for a Single Coefficient
3. Confidence Intervals for a Single Coefficient

Section 8.2 Tests of joint hypotheses

1. The Forms of Joint hypothesis
2. The F-Statistic
3. The Homoskedasticity-Only F-Statistic

Section 8.3 Confidence Sets for Multiple Coefficients

Section 8.4 Testing Hypotheses on the Relationship Between Regional Economic Development in China and Two Factors: Regional Educational Expenses and Educational Consumption.

**Key and Difficult Points:** Master the approach to using the F-statistic for joint hypothesis testing, grasp the various forms of joint hypotheses, and understand the implication of the F-statistic. By testing hypotheses on the relationship between regional economic development in China and two factors (i.e. regional educational expenses and educational consumption), the students will have a clearer understanding of economic development in China and better recognize the great importance of educational development in China.

**Evaluation Requirements:** Reading materials, finishing homework, and completing practical exercises

**Lecture 9 Nonlinear Regression Functions**

Section 9.1 A General Strategy for Modeling Nonlinear Regression Functions

Section 9.2 Nonlinear functions of a single independent variable

1. Polynomials
2. Logarithms

Section 9.3 Interactions between independent variables

1. Interactions between two binary variables
2. Interactions between a continuous and a binary variable
3. Interactions between two continuous variables

**Key and Difficult Points:** Master the basic forms of nonlinear regression functions, and master the correct interpretation of coefficients in nonlinear regression functions.

**Evaluation Requirements:** Reading materials, finishing homework, and completing practical exercises

**Lecture 10 Assessing Studies Based on Multiple Regression**

Section 10.1 Internal and external validity

1. Threats to Internal Validity
2. Threats to External Validity

Section 10.2 Threats to internal validity of multiple regression analysis

1. Omitted Variable Bias
2. Misspecification of the Functional Form of the Regression Function
3. Measurement Error and Errors-In-Variable Bias
4. Missing data and Sample Selection
5. Mutual Causality

**Key and Difficult Points:** Understand the concepts of interval and external validity, grasp the threats to interval validity in multiple regression analysis

**Evaluation Requirements:** Reading materials, and finishing homework

**Lecture 11 Panel Data Regression**

Section 11.1 Panel Data

Section 11.2 Panel Data with Two Time Periods: “Before and After” Comparisons

Section 11.3 Fixed Effects Regression

1. Estimation and Inference of the Fixed Effects Regression Model

Section 11.4 Regression with Time Fixed Effects

**Key and Difficult Points:** Grasp the basic method of estimation and inference of the fixed effects regression model.

**Evaluation Requirements:** Reading materials, finishing homework, and completing practical exercises

**Lecture 12 Instrumental Variables Regression**

Section 12.1 The IV Estimator with a Single Regressor and a Single Instrument

1. The IV Model and Assumptions
2. The Two Stage Least Squares Estimator

Section 12.2 The General IV Regression Model

1. TSLS in the General IV Model
2. Instrument Relevance and Exogeneity
3. The IV Regression Assumptions and Sampling Distribution of the TSLS Estimator
4. Inference Using the TSLS Estimator

Section 12.3 Checking Instrument Validity

**Key and Difficult Points:** Grasp the basic theory and method of the TSLS estimation

**Evaluation Requirements:** Reading materials, finishing homework, and completing practical exercises

**五、主要参考书**（黑体，小四号字）

[1] 詹姆斯·斯托克 (James H. Stock) ， 马克·沃森 (Mark W. Watson). 计量经济学(第3版)(英文版) ( Introduction to Econometrics, 3d Edition). 格致出版社,上海人民出版社. 2015年1月1日

[2] 杰弗里·伍德里奇 (Jeffrey M. Wooldridge). 计量经济学导论:现代观点(第5版) (Introductory Econometrics: A Modern Approach, 5th Edition). 清华大学出版社.2014年2月1日.

[3] Christian Kleiber, Achim Zeileis. Applied Econometrics with R. Springer. 2008