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	金融时间序列分析 Analysis of Financial Time Series
2.	授课院系 Originating Department	金融系 Department of Finance
3.	课程编号 Course Code	FIN304
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	中英双语 English & Chinese
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**）	孙便霞，教学讲师，金融系 SUN Bianxia, Lecturer, Department of Finance Email: sunbx@sustech.edu.cn Phone:0755-88018601 办公室：慧园 3 栋 317 Office: Wisdom Valley, 3#317
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	黄孟轩 HUANG Mengxuan Email: 11849388@mail.sustech.edu.cn
10.	选课人数限额(可不填) Maximum Enrolment （Optional）	40

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
	学时数 Credit Hours	48				48

	先修课程、其它学习要求	
12.	**Pre-requisites or Other Academic Requirements**	概率论与数理统计 Probability and Statistics MA212
13.	后续课程、其它学习规划 **Courses for which this course is a pre-requisite**	无 None
14.	其它要求修读本课程的学系 **Cross-listing Dept.**	无 None

教学大纲及教学日历 SYLLABUS

15. 教学目标 **Course Objectives**

此课程旨在讲授金融时间序列分析领域里的经典模型以及分析方法，使学生在掌握时间序列模型理论内容的同时，学会对真实金融市场上的数据进行建模分析。同时，该课程也会介绍目前该领域里处于研究前沿的相关内容和研究方向。

This course aims to teach students the classical models and analysis methods in the field of financial time series. Besides mastering the theoretical knowledge of time series models, students are also expected to be capable of modeling the time series data in real financial markets. In addition, this course also introduces some related contents at the forefront of research in this field.

16. 预达学习成果 **Learning Outcomes**

在课程结束时，学生应该能够

(1) 了解金融时间序列数据的分析流程和方法；

(2) 掌握经典时间序列模型的理论知识，如 ARIMA, VAR, GARCH 等；

(3) 掌握风险测度 VaR 和 ES 的计算原理；

(4) 对真实数据进行建模分析并解释分析结果。

By finishing this course, students should be able to

(1) Learn about the analysis procedure and methods of financial time series data;

(2) Master theoretical knowledge of classical time series models, like ARIMA, VAR, and GARCH models;

(3) Master the methodology of calculating the risk measures, VaR and ES;

(4) Model the real financial data and interpret empirical findings.

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 金融时间序列数据特征 （3 学时）

在本章节中，学习者将了解掌握金融时间序列数据的特征，主要涉及资产收益率的分布性质，时间序列数据的平稳性，及如何检验白噪声序列。以便学习者掌握金融时间序列数据的统计特征，为学习分析金融时间序列的计量经济模型打下基础。

第二章 滑动平均模型的特征、估计及预测 （3 学时）

在本章节中，我们将开始详细介绍在金融收益率建模中的简单计量模型。学习者将了解滑动平均模型，包括滑动平均模型的弱平稳性、可逆性，用自相关函数识别该模型的阶，使用极大似然估计估计该模型，以及使用滑动平均模型做预测。

第三章 自回归模型的特征、估计及预测 （3 学时）

在本章节中，学习者将了解到自回归模型的性质。掌握自回归模型时间序列的平稳性条件，如何识别该模型，即为自回归模型定阶，学会使用最小二乘估计模型参数，以及通过 Ljung-Box 统计量检验模型拟合数据的充分性。在本章节中我们拟采用随堂测验的方式，对学习者的学习效果进行客观、自动化的线上评量。

第四章 自回归滑动平均模型（3 学时）

在本章节中，学习者将掌握到自回归滑动平均模型（ARMA）用以更充分地描述金融数据的动态结构。其中包括：学习 ARMA（1，1）模型的性质，一般的 ARMA 模型的表达形式，利用推广的自相关函数（EACF）来确定 ARMA 过程的阶，以及学会使用 ARMA 模型进行预测。在本章节的学习中我们拟通过统计软件演示如何基于所学模型分析金融数据和进行预测，培养学习者学习应用本课程知识的能力。

第五章 非平稳时间序列及单位根检验方法 （3 学时）

在本章节中，学习者将了解到单位根非平稳时间序列，及带漂移的随机游动时间序列。同时，我们将介绍带趋势项的时间序列和一般的单位根非平稳模型，以及单位根检验方法。我们拟在本章节的学习中加入线上讨论问题，与学习者进行互动。

第六章 多元时间序列及向量自回归模型 （3 学时）

在本章节中，学习者将了解到研究多元时间序列的金融计量模型。在一元时间序列模型的基础上，研究多元序列的动态关系，学习者将掌握交叉相关矩阵的概念，和给收益率建模时简单常用的向量自回归模型（VAR）。其中包括 VAR（1）模型的形式和平稳性条件，以及学习如何对指定 VAR 模型估计参数和模型检验。

第七章 脉冲响应函数与方差分解 （3 学时）

在本章节中，学习者将了解到什么是所拟合向量自回归模型的脉冲响应函数，以及方差分解。在本章节的学习中我们拟通过统计软件演示如何基于向量自回归模型分析金融数据和进行预测，培养学习者学习应用本课程知识的能力。

第八章 协整检验与误差调整模型 （3 学时）

在本章节中，学习者将了解到什么是协整，协整 VAR 模型的估计和协整的检验方法，以及误差调整模型。我们拟在本章节的学习中加入线上讨论问题，与学习者进行互动。

期中内容回顾 （2 学时）

第九章 自回归条件异方差（ARCH）模型的性质、估计和预测 （3 学时）

在本章节中，学习者将开始了解资产收益率的波动率建模的统计方法和计量经济模型。我们将首先介绍自回归条件异方差（ARCH）模型，主要包括波动率的特征，ARCH 模型的特征，阶的确定，参数的估计和模型的检验。我们拟通过实际数据的例子来介绍模型建立的过程，帮助学习者高效使用统计软件应用 ARCH 模型。

第十章 广义自回归条件异方差（GARCH）模型的性质、估计和预测 （3 学时）

在本章节中，学习者将学习到能够更加充分地描述资产收益率的波动率过程的模型：广义自回归条件异方差（GARCH）模型。我们将介绍 GARCH 模型的性质，模型有哪些优点和缺点，两步估计方法估计 GARCH 模型，以及评估模型的预测。我们拟通过实际数据的例子来介绍模型建立的过程，帮助学习者高效使用统计软件应用 GARCH 模型。

第十一章 非对称 GARCH 模型的性质、估计和预测 （3 学时）

在本章节中，学习者将了解到非对称 GARCH 模型。我们会介绍 EGARCH 模型在正和负的资产收益率的非对称效应，模型的估计方法，以及如何用非对称 GARCH 模型进行预测。在本章节中我们拟采用随堂测验的方式，对学习者的学习效果进行客观、自动化的线上评量。

第十二章 基于高频数据的波动率估计方法 （3 学时）

在本章节中，学习者将了解到金融高频数据的独特特征，高频数据波动率的估计方法。在本章节的学习中我们拟通过统计软件演示如何基于所学模型分析金融数据和进行预测，培养学习者学习应用本课程知识的能力。

第十三章 市场微观结构 （3 学时）

在本章节中，学习者将了解到市场微观结构的相关内容。我们将介绍非同步交易，买卖报价差，交易数据的经验特征，价格变化模型和持续期模型。我们拟在本章节的学习中加入线上讨论问题，与学习者进行互动。

第十四章 风险价值（VaR）的计算方法 （3 学时）

在本章节中，学习者将了解到计算风险价值（VaR）的各种方法。我们将介绍风险价值的概念，风险度量制和 VaR 计算的计量经济方法。在本章节中我们拟采用随堂测验的方式，对学习者的学习效果进行客观、自动化的线上评量。

第十五章 因子模型概述 （2 学时）

在本章节中，学习者将了解到宏观因子模型、基本面因子模型，以及统计因子模型的基础知识。基本面因子模型中，会简单介绍 BARRA 因子模型的估计方法。

期末内容回顾 （2 学时）

Chapter 1: characteristics of financial time series data（3 Hours）

In this chapter, students will learn about the characteristics of financial time series data, mainly related to the distribution of asset returns, the stability of time series data, and how to test white noise sequences. So that students can have a better foundation for future learning of financial time series models.

Chapter 2: Properties, estimate, and forecast of Moving Average models（3 Hours）

In this chapter, we will illustrate the simple financial econometric model for modelling asset returns. Students will learn the moving average model, including weak stationary property, reversible property. We will also explain how to identify the order of the moving average model by using the autocorrelation function. Estimating the parameters of the model using maximum likelihood estimation is quite essential. We will introduce how to use the moving average model for prediction as well.

Chapter 3: Properties, estimate, and forecast of Auto-Regressive models（3 Hours）

In this chapter, students will learn about the characteristics of Auto-Regressive models. In detail, students will grasp the stationary condition of time series for Auto-Regressive model, how to identify the model's moment, how to use the least squares estimation to estimate model's parameters, and how to test the model's sufficiency of fitting the data through the Ljung-Box statistic test. In this chapter we intend to use a quiz to evaluate the learning outcomes through an objective, automated online assessment system.

Chapter 4: Properties, estimate, and forecast of Auto-Regressive and Moving Average models（3 Hours）

In this chapter, students will master the Auto-Regressive Moving Average Model (ARMA) which could fully describe the dynamic structure of financial data. We will introduce the characteristics of the ARMA (1,1) model, and the general ARMA model representation. And the students will learn about using the extended autocorrelation function (EACF) to determine the order of the ARMA model, and how to use the ARMA model for prediction. In the process of learning, we intend to demonstrate how to analyze financial data and make predictions based on the learned models through statistical software, in order to develop students' ability to apply the knowledge learned from this course.

Chapter 5: Non-stationary time series and unit root test（3 Hours）

In this chapter, students will learn about the unit root non-stationary time series and the random walk time series with drift. At the same time, we will introduce the time series with trend and the general unit root non-stationary model, as well as the unit root test method. We intend to add online discussion questions to interact with students in this chapter.

Chapter 6: Multivariate time series and Vector Auto-Regressive models（3 Hours）

In this chapter, students will learn about financial econometrics models for studying multivariate time series. For studying the dynamic relationship of multivariate sequences, students will grasp the concept of cross-correlation matrix and the simple commonly used vector autoregressive model (VAR). We will illustrate the form and stationary conditions of the VAR(1) model, how to estimate the parameters and how to test for the specified VAR model.

Chapter 7: Impulse response function and variance decomposition（3 Hours）

In this chapter, students will learn the impulse response function of the fitted vector autoregressive model, and the variance decomposition. In the process of learning, we intend to demonstrate how to analyze financial data and make predictions based on the learned models through statistical software, in order to develop students' ability to apply the knowledge learned from this course.

Chapter 8: Co-integration test and Error Correction Model（3 Hours）

In this chapter, students will learn co-integration, co-integration VAR model estimation. We will explain co-integration test methods and error adjustment models. We intend to add online discussion questions to interact with students in this chapter.

Mid-term Review （2 hours）

Review all of the contents covered in the former half semester and make students prepare for the mid-term exam.

Chapter 9: Properties, estimate, and forecast of ARCH models（3 Hours）

In this chapter, students will begin to learn about the econometric models of volatility modeling of asset returns. We will introduce the characteristics of volatility, and basic properties of the ARCH model. We will also illustrate the determination of the order for ARCH model, the estimation of the parameters and the test of the model. In the process of learning, we intend to demonstrate how to analyze financial data and make predictions based on the learned models through statistical software, in order to develop students' ability to apply the knowledge learned from this course.

Chapter 10: Properties, estimate, and forecast of GARCH models（3 Hours）

In this chapter, students will learn about a model that could more fully describe the volatility process of assets' return: the generalized autoregressive conditional heteroskedasticity (GARCH) model. We will introduce the basic properties of the GARCH model, what are the pros and cons of the model. At the same time, we will also explain how to estimate the GARCH model by the two-step estimation method, and the prediction of the model. In the process of learning, we intend to demonstrate how to analyze financial data and make predictions based on the learned models through statistical software, in order to develop students' ability to apply the knowledge learned from this course.

Chapter 11: Properties, estimate, and forecast of asymmetric GARCH models（3 Hours）

In this chapter, students will learn about asymmetric GARCH models. We will introduce the asymmetric effects of the EGARCH model on positive and negative return of assets, the estimation methods of the model, and how to use the asymmetric GARCH model for prediction. In this chapter we intend to use a quiz to evaluate the learning outcomes through an objective, automated online assessment system.

Chapter 12: Volatility estimates based on high-frequency data（3 Hours）

In this chapter, students will learn about the unique characteristics of financial high-frequency data and how to estimate the volatility of high-frequency data. In the process of learning, we intend to demonstrate how to analyze financial data and make predictions based on the learned models through statistical software, in order to develop students' ability to apply the knowledge learned from this course.

Chapter 13: Market microstructure（3 Hours）

In this chapter, students will learn about the market microstructure. We will introduce asynchronous

transactions, bid and offer spread, and empirical characteristics of trading data. We will also explain price change models and duration models. We intend to add online discussion questions to interact with students in this chapter.

Chapter 14: Risk measures and calculating methods of VaR（3 Hours）
In this chapter, students will learn about the various ways to calculate the value of risk (VaR). We will introduce the concept of risk value, risk measurement system and econometric methods of VaR calculation. In this chapter we intend to use a quiz to evaluate the learning outcomes through an objective, automated online assessment system.

Chapter 15: Introduction to factor models（2 Hours）
In this chapter, students will learn the basic knowledge of macroeconomic factor models, fundamental factor models, and statistical factor models. In the part of fundamental factor models, the estimate methodology of BARRA model will be introduced briefly.

Final Review （2 hours）
Review all of the contents covered in this course and make students prepare for the final exam.

---

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

指定教材 Textbook：
Ruey S. Tsay, Analysis of Financial Time Series, 3rd edition, Wiley, 2010.

参考教材 Reference book：
张成思，金融计量学---时间序列分析视角，中国人民大学出版社，2013.

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		10		
课程项目 Projects		15		
平时作业 Assignments		15		
期中考试 Mid-Term Test		30		
期末考试 Final Exam		30		
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