



## **MS in Quantitative Economics Course Descriptions**

### **ECON 5101 Microeconomics I**

This is the first course in the microeconomics sequence for the Master's in Quantitative Economics. The purpose of this course is to build a solid background in microeconomic theory. This will be done by giving you the core foundations of microeconomic theory and solidifying these with selected examples. The main topics we will cover include Choice Theory, Consumer Theory, Producer Theory, Uncertainty, General Equilibrium, and Mechanism Design.

### **ECON 5102 Microeconomics II**

The purpose of this course is to introduce you to the strategic foundation of microeconomics from a theoretical perspective. It presents the basic non-cooperative game theory by developing the analysis of static and dynamic games. It proposes an application of game theory to oligopolistic competition. It finally provides a solid introduction to the market failure induced by asymmetric information (adverse selection and moral hazard).

### **ECON 5103 Macroeconomics I**

This is the first course in the macroeconomics sequence for the Master's in Quantitative Economics. Research in quantitative macroeconomics over the last 70 years has brought us important progress in understanding why countries' economies grow, why they experience booms and recessions, and how different countries' economies are linked. Practicing macroeconomists, both in research, in government, in multinational organizations, and in business firms use these models to organize their thinking about these topics. However, there is still plenty of room for work since these models are highly imperfect in many ways. Therefore, the focus of this course will be to learn the basic models of growth and business cycles well enough to understand how to work with them and to understand what they explain convincingly and in what dimensions they fail.

### **ECON 5104 Macroeconomics II**

This course is the continuation of Macroeconomics I. That course introduced the basic tools of neoclassical macroeconomic analysis: Growth Theory and the Stochastic Growth Model otherwise known as Real Business Cycle (RBC) Model. This course focuses on the applications of these tools, with an emphasis on departures from the complete markets, frictionless approach. The course will focus on four types of frictions widely seen to play an important role in macroeconomic analysis: Sticky Prices, Search, Financial Frictions (from moral hazard), and adjustment costs in consumption and investment.

### **ECON 5110 Econometrics**

This course is the second of a two-semester graduate level study of the theory and practice of econometrics. The course assumes a working knowledge of concepts of econometric analysis. The objective is to work through a common set of principles, to formulate the theoretical underpinnings of various models, to study the workings of many econometric



models, to be able to recognize variants of existing models, to develop variations of existing models that fit particular research problems. Hence, the use of MATLAB is going to be an integral part of the course.

### **ECON 5112 Financial Economics**

This course provides an overview of the theory of financial markets from an economic perspective. The major conceptual tool that we will use to study these phenomena is the notion of economic equilibrium. The course is essentially divided up in two parts. In the first, we will build our understanding of the role of financial markets in hedging and insuring participants against risks. In the second, we will study the efficiency properties of financial markets, and stress the perverse equilibrium effects that less-than-perfect financial markets can have: how vulnerable they may be to self-fulfilling prophecies and (ir)rational exuberance; the possibility of financial crises, in particular of bank runs, as self-fulfilling prophecies; and whether or not financial markets transmit and spread information that some traders have privately acquired on companies, currencies and other events. Our analysis of finance uses the modern theory of microeconomics. It aims at constructing (relatively) simple mathematical models to study the welfare properties of financial markets, and the implications for asset prices.

### **ECON 5115 Market Design**

This course introduces basic results in market design, a subfield of microeconomic theory where researchers propose desirable and often practical solutions to allocation problems in reality. Due to such a practical nature of this topic, students should become able to propose appropriate solutions by themselves to various allocation problems.

### **ECON 5201 Mathematics for Economists**

This course covers some basic mathematical techniques for economists. It focuses on the theory and applications of optimization in both static and dynamic settings. It also introduces fixed point theorems that are fundamental for general equilibrium analysis and game theory models with multiple decision-makers.

### **ECON 5202 Mathematical Statistics**

This course is the first of a two-semester graduate level study of the theory and practice of econometrics. The course assumes a working knowledge of concepts of calculus, linear algebra and some introductory probability and statistics. The objective is to work through the fundamentals of theoretical statistics.

### **ECON 5205 Quantitative Macroeconomics**

This course aims to introduce modern quantitative methods in macroeconomics. The class will consist of two parts: The first part (about 40% of the lectures) will review the formal theory of dynamic optimization and recursive methods in macroeconomics. The second part of the class (about 60% of all lectures) will start with a brief introduction to MATLAB followed by detailed lectures on applying computational methods to solve a wide variety of models in macroeconomics. Although computation is a major component of this class, it is



not intended to be a course in computer programming, and the students are expected to learn programming on their own.

### **ECON 5282 Corporate Financial Economics**

This course is a graduate level study of the theory of corporate financial economics. The course will mix some fundamental accounting with contract theory and other aspects of microeconomic theory to discuss the main ideas on firms and their financing relevant to policy-makers and decision-makers. Topics may include: accounting/financial statements; corporate governance; capital structure; capital budgeting; asymmetric information in corporate finance; mergers and acquisitions.

### **MATH 5320 Complex Systems: Financial Time Series**

This course provides a rigorous introduction to modeling and prediction of financial time series. The goals are to learn basic characteristics of financial data, understand the application of financial econometric models, and gain experience in analyzing financial time series. We begin with the basic concepts of linear time series analysis such as stationarity and autocorrelation function, introduce regression models with time series errors, seasonality, unit-root non-stationarity, and long-memory processes. We provide methods of analysis in the presence of conditional heteroscedasticity and serial correlations of asset returns. The course introduces heavy-tailed distributions, and their application to financial risk management. In particular, we discuss modern valuations of credit risk. We introduce multivariate time series analysis and apply the concept of co-integration to investigate arbitrage opportunity in pairs trading. The course places great emphasis on empirical data analysis. We use real examples and exercises in R will be involved. The course aims to broaden the horizons of students in applied mathematics and to provide conceptual background to students who are interested in a career in financial industry.

### **QFIN 5201 Data Science for Quantitative Finance**

This course introduces students to building data science models for financial applications. These models will be created using reproducible data science workflows, using modern statistical programming tools and techniques. The course will first focus on obtaining data from various sources, preparing and transforming data as needed for downstream analysis, and performing exploratory data analysis. We'll then look at the most important descriptive, predictive, and prescriptive analytic techniques for analytical financial modeling. Throughout this project-based course, there will be an emphasis on asking good guiding questions and effectively communicating results through text, tables, and visualizations.