

Modelling Firms and Markets

Module Introduction and Overview

Contents

1	Introduction to the Module	2
2	Module Author	2
3	Study Resources	3
4	Module Overview	3
5	Learning Outcomes	6

1 Introduction to the Module

Welcome to the module Modelling Firms and Markets – an introduction to the economics of information and uncertainty. Multi-person decision problems under uncertainty have always played a crucial role in financial markets. For instance, if you buy a stock in a firm, your profit will depend on whether or not its market goes up. To understand decision-making processes and find their possible solutions in real-world problems (such as contracts, mechanisms, bank runs, *etc*) you first need to learn how to think strategically. For this, you need to understand some basic and standard market problems among players.

The first half of the module deals with game theory analysis, which studies links between players and market environments. In any game, the outcome depends on the interaction of strategies played by each agent. Therefore, game theory uses simplified real-world examples to examine how market players interact and make decisions, and to predict the possible outcomes. Units 1 to 4 provide a solid foundation of game theory – the interpretation of main concepts and their applications. This will give you the theoretical background to make insights into a wide range of applied financial economic events, and to analyse multi-person decision problems under uncertainty.

The second half of the module goes beyond this by introducing the concept of ‘incomplete information’ into the games, and its applications. It will investigate the strategic interaction in economics, both in full-information settings (*ie* all parties have all the information needed) and under uncertainty (at least one party has imperfect information). You will have an opportunity to evaluate a variety of simplified economic and financial situations (such as the relationship between managers and employees, between insurance companies and their clients *etc*), in which some agents possess private information and channel self-interest to the public interest. In this section, we aim to analyse how informational problems affect market outcomes and determine the conditions under which incentive and screening mechanisms generate socially efficient outcomes. In studying this module, you will be able to evaluate how the theory of strategic behaviours drives financial markets and develop optimal strategies given possible information.

2 Module Author

Sha Luo, who developed the module in collaboration with the Centre’s programme directors and specialists in Financial Sector Management and Quantitative Finance, holds an MSc and a PhD in Economics from Birkbeck College, University of London. Her research focused on Industrial Economics and Applied Economics. She began her career, in 2005, by lecturing on Quantitative Techniques and Economics at Birkbeck. From 2008, she worked with the Centre for Financial and Management Studies

at the SOAS as an author for the MSc Quantitative Finance distance-learning programme. In 2010, Sha joined CRU International, a research and consultancy firm for the mining, metals and energy industry, as an applied economist.

3 Study Resources

This module is comprised of a set of lecture notes (study guide) based on selected chapters from these two key texts:

Robert Gibbons (1992) *A Primer in Game Theory*. New York/London: Harvester Wheatsheaf.

Donald E Campbell (2018) *Incentives: Motivation and the Economics of Information*. 3rd Edition. Cambridge UK: Cambridge University Press.

The text by Gibbons is also published as *Game Theory for Applied Economists*.

In addition to the study guide and the key texts, a collection of scholarly and case-study articles from other sources will be provided as module readings.

Throughout this module, it is essential that you do all the readings and solve all the exercises. In this module, each idea builds on the previous ones in a logical fashion, and it is important that each idea is clear to you before you move on. You should, therefore, take special care not to fall behind with your schedule of studies.

4 Module Overview

In order to study financial markets, it is necessary for you to study the strategic behaviours among the players. This module aims to introduce the theoretical concepts of strategic behaviours and their applications in economics, where there are differing degrees of information and uncertainty. The module begins with the basic concepts and insights of game-theoretic reasoning. With this groundwork, you will be able to consider the problems of decision-making in a multi-person environment. You will then examine the problems of private information. You will learn to analyse the role of asymmetric information in market interactions – in particular, the problems known as *moral hazard* (hidden actions) and *adverse selection* (hidden characteristics) under various economics contexts. You will also learn how these informational problems affect the market outcome and whether they lead to market inefficiencies, as well as the possible solutions to this.

The module consists of eight units with corresponding readings and exercise sets. Theoretical concepts will be applied and exercises will be discussed throughout the module.

Unit 1 Static Games of Complete Information

- 1.1 Normal (Strategic) Form Game and Iterated Deletion
- 1.2 Nash Equilibrium
- 1.3 Mixed-Strategy Nash Equilibrium
- 1.4 Existence of Nash Equilibrium
- 1.5 Applications of Nash Equilibrium
- 1.6 Conclusion

This unit starts with some fundamental concepts of game theory by introducing normal-form games and discussing pure- and mixed-strategy Nash equilibrium in finite games. The unit applies the concept of Nash equilibrium to various situations. We particularly focus on two typical oligopoly models in the market – Cournot and Bertrand models – and evaluate the optimal solutions for the firms.

Unit 2 Dynamic Games of Complete Information

- 2.1 Dynamic Games of Complete and Perfect Information
- 2.2 Subgame Perfection – Generalisation of the Backwards induction
- 2.3 Repeated Games

Whilst Unit 1 examines simultaneous-move games, many games involve sequential moves among the players, such as repeat price competition between firms. In the real world, neither do all players move simultaneously nor are all interactions ‘one-shot’. To model these slightly more complicated moves in the dynamic games of complete information, Unit 2 presents games in extensive forms and illustrates the methods of ‘backward induction’, ‘subgame perfection’ and ‘folk theorem’. We then will apply the concept of subgame perfection to some real-market finitely and infinitely repeated games and show that subgame perfection eliminates the Nash equilibriums that are not credible.

Unit 3 Static Games of Incomplete Information

- 3.1 Cournot Competition of Incomplete information
- 3.2 Normal-Form Representation of Static Bayesian Games and Bayesian Nash Equilibrium
- 3.3 Applications
- 3.4 The Revelation Principle
- 3.5 Conclusion

In any game, players do not always know all aspects of the game structure. If at least one player is uncertain about another player’s game structure, then the games are called ‘Bayesian games’. Unit 3 focuses on these games of ‘incomplete information’. It discusses the normal-form representation of a static Bayesian game and its Bayesian Nash equilibrium. Then, it considers three relevant applications and explains the concept of the ‘revelation principle’.

Unit 4 Dynamic Games of Incomplete Information

- 4.1 Perfect Bayesian Equilibrium
- 4.2 Application

- 4.3 Refinements of Perfect Bayesian Equilibrium
- 4.4 Conclusion

In Unit 4, we tackle the dynamic games of incomplete information. Similar to the refinement of Nash equilibrium to subgame-perfect Nash equilibrium in games of complete information, the concept of Bayesian Nash equilibrium may predict some unreasonable outcomes in extensive-form games and is refined to ‘perfect Bayesian’ equilibrium. Therefore, in this unit you will study the perfect Bayesian equilibrium in dynamic games of incomplete information. Then, we will investigate the set of possible strategy-solutions for various applications.

Unit 5 Hidden Action (Moral Hazard)

- 5.1 Introduction
- 5.2 Examples of the Hidden Action Problems
- 5.3 Moral Hazard and Insurance
- 5.4 Principal–Agent Problem: The Model and Optimal Wage Contract
- 5.5 Conclusion

Unit 5 introduces the economics of information and uncertainty. You will examine a wide variety of issues with hidden action, in which some agents possess private information and channel self-interest to the public interest. You will also learn about the problem of moral hazard and the principal–agent problem.

Unit 6 Hidden Characteristics (Adverse Selection)

- 6.1 Responding to Hidden Information – Price Discrimination
- 6.2 Sellers with Private Information – the Market for Lemons
- 6.3 Credit Rationing and the Stiglitz-Weiss Model
- 6.4 Bundling and Product Quality
- 6.5 Adverse Selection and Insurance
- 6.6 Conclusion

Unit 6 investigates another problem of private information – ‘adverse selection’. This involves a situation in which individuals have hidden characteristics and a selection process results in a pool of individuals with undesirable characteristics. These problems are analysed in different microeconomic contexts. The examples include ‘Akerlof’s model of lemons’, credit rationing and the insurance market. You will also study the explanations for why and how corresponding markets operate.

Unit 7 Auctions

- 7.1 Four Types of Auctions
- 7.2 Outcome Equivalence for Private Value Auctions
- 7.3 Sealed-Bid Auction
- 7.4 Revenue Equivalence
- 7.5 Common Value Auctions
- 7.6 Conclusion

Unit 7 introduces the basic concept of auctions and ‘revenue equivalence’. In particular, it discusses four different types of auctions and analyses which type should be adopted in specific situations.

Unit 8 General Competitive Equilibrium

- 8.1 General Equilibrium in a Pure Exchange Economy
- 8.2 The Arrow-Debreu Model
- 8.3 The Fundamental Theorems of Welfare Economics
- 8.4 Externality
- 8.5 The Issue of Convexity
- 8.6 Common Property Resources
- 8.7 Conclusion

Given the hidden information problem, Unit 8 aims to investigate the possible mechanisms that lead to market-allocation efficiency. It also considers a specific incentive issue – the ability of a trader to advantageously manipulate prices.

5 Learning Outcomes

Upon completion of this module and its readings, you will be able to:

- explain basic equilibrium concepts such as the Nash equilibrium (pure and mixed)
- apply the Nash equilibrium in oligopoly competition (Cournot and Bertrand)
- solve simple repeated games using backward induction and define subgame perfect equilibrium
- identify the concept of a Bayesian game and find its equilibrium
- define perfect Bayesian equilibrium and explain the signalling problem
- apply the concepts of adverse selection and moral hazard in different microeconomic contexts and explain how risk and information asymmetry affect the efficiency of contracting
- discuss the role of incentives and optimal contracting in addressing this issue related to asymmetric information
- outline and discuss the various types of auctions and the revenue equivalence principle
- derive the general equilibrium of specific economies.