A course of Financial Modelling and Pricing Analysis for undergraduates

Lecture 1 - A short introduction

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A short introduction

1. What is financial modelling?
2. Asset Pricing Theory: What and Why?
3. Ideas of Asset Pricing
4. Milestones on the Asset Pricing Theory
5. On the Course

A short introduction

Definition

- **Financial modeling** is the task of building an abstract representation (a model) of a real world financial situation.
- This is a mathematical model designed to represent (a simplified version of) the performance of a financial asset or portfolio of a business, project, or any other investment.
- It is about translating a set of hypotheses about the behavior of markets or agents into numerical predictions.
- Financial modeling entails the development of a sophisticated mathematical model.
- Models here deal with asset prices, market movements, portfolio returns and the like.

The application of financial modeling

Relatedly, applications include:

1. Option pricing and calculation of their "Greeks"
2. Other derivatives, especially interest rate derivatives, credit derivatives and exotic derivatives
3. Corporate financing activity prediction problems
4. Portfolio optimization
5. Real options
6. Risk modeling (Financial risk modeling) and value at risk
7. Dynamic financial analysis

Financial Engineering / Financial Mathematics / Mathematical finance / Quantitative Finance

- These problems are generally stochastic and continuous in nature, and
- models here thus require complex algorithms, entailing computer simulation, advanced numerical methods (such as numerical differential equations, numerical linear algebra, dynamic programming) and/or
- the development of optimization models.

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The aim of asset pricing theory

- The aim of APT is to understand the prices or values of claims to uncertain payments (dividend or cash-flow).
- For this aim, we have to take into account the **delay** and the **risk** of the payments. The effects of the former are easy to work out, but the corrections for the latter are much more difficult and make the asset pricing interesting and challenging.

Why do we study the asset pricing theory?

1. If the prices/returns of the assets are observable:
   - The theory can be used **positively** to understand why the prices/returns are what they are. If the world does not obey a model's predictions, the model needs improvement or the world is wrong. In the latter case, the shrewd investor will then $\cdots$.
2. If the prices/returns of the assets are not observable **(such as public or private investment projects, new financial securities, buyout prospects and complex derivatives)**:
   - The theory can **normatively** establish what the prices of the claims should be.
   - The answers are important guides to public and private decisions.

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Basic Ideas

- The asset pricing theory all stems from the simple concept: **Price equals expected discounted payoff**.
- For this reason, one can say the main task of the theory is to identify the **discount factors**.
- Intuitionally, the discount factor must be an index of "bad times".
- Because investors are willing to pay more for assets that do well in bad times, the risk premium on any asset is determined by how it co-varies with the discount factors.
- Actually, the discount factors can be described by **state prices** or more generally **a state-price deflator**, both of which will be discussed in detail in this course.

Three basic constraints on asset prices

- Absence of arbitrage.
- Single-agent optimality.
- Market equilibrium.

The most important unifying principle

- Any of these three constraints implies that there are "state prices" or discount factors for each state and date.
- The price of any claim is merely the state-price weighted sum of its future payments.

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Milestones on the asset pricing theory

- Arrow (1953; Modigliani and Miller (1958); Sharpe (1964); Lintner (1965); Lucas (1978); Breeden (1979).
- Merton (1973a, 1973b); Black and Scholes (1973); Cox and Ross (1976); Cox, Ross and Rubinstein (1979), Harrison and Kreps (1979), Harrison and Pliska (1981); Delbaen and Schachermayer (1994).
- Hodges S D, Neuberger A. Optimal replication of contingent claims under transaction costs. Review of futures markets, 1989, 8(2): 222-239.

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The plan and our focus

- This course will roughly include 16 lectures in addition to 8 discussions and exercises around pre-assigned topics with 100 minutes for each one.
- After this course study, the students are expected to understand the general principles of asset pricing with the methods of arbitrage, optimality and equilibrium respectively.
- As applications of the methods, the students are hoped to understand the Black-Scholes option pricing theory and the well-known capital asset pricing model.
- We might introduce the corporate security pricing theory depending on the learning competence of students.

References

- Kerry E. Back, Asset Pricing and Portfolio Choice Theory, Oxford University Press, 2010
- Duffie Darrell, Dynamic Asset Pricing Theory, Third edition, Princeton University Press, 2001
- Shreve Steven, Stochastic Calculus and Finance, Springer 2004
- Desmond J . Higham, An Introduction to Financial Option Valuation, 2004
- John Hull, Options, Futures and Other Derivatives, Sixth Edition, 2006

How your score is determined

- Your class attendance and performance account for 20 percent.
- Your assignments account for 20 percent.
- The final exam accounts for 60 percent.


Thank You !
Q & A