



T-815-FIXE

FIXED INCOME AND INTEREST RATE MODELLING

8 ECTS

Year of study:	5 th year (2 nd year MSc).
Semester:	Fall.
Level of course:	6. Second cycle, advanced.
Type of course:	Core for MSc Financial Engineering, elective for other programs.
Prerequisites:	Undergraduate degree in engineering plus selected finance courses such as Securities, Derivatives, Corporate Finance and Risk Management. Other recommended prerequisites: Financial engineering of the firm (T-814-FINA) and Derivatives and Risk Management (T-814-DERI).
Schedule:	Runs for 12 weeks – a total of 72 teaching hours.
Supervisor:	Sverrir Ólafsson.
Lecturer:	Sverrir Ólafsson.

Learning outcome: At the end of the course the student will have an appreciation of the important role fixed income and interest rate models play in financial engineering. They will be familiar with a whole range of different fixed income instruments, ranging from conventional Government bonds to instruments that have cash flows contingent on market indices, the price of various commodities or the inflation level in the economy.

Different risk management techniques in fixed income will be introduced such as those based on duration and convexity. Techniques to immunize bond portfolios against movements in interest rates will be introduced and applied to concrete government and corporate bonds.

Techniques to extract the term structure of interest rate from interest rate sensitive instruments, such as bonds, swaps and Libor contracts will be discussed and applied. For this purpose we will consider various curve and parameter fitting techniques, such as cubic and constrained splines as well as maximum likelihood estimation.

Finally, stochastic interest rate models will be introduced and their relationship to the term-structure equation (a partial differential equation) discussed. Within this framework we will discuss how the parameters of some stochastic models can be fixed on historical data and under what technical conditions the term-structure equation

Knowledge: On completion of this course the students will appreciate the structure of fixed income instruments and the fixed income markets. They will be familiar with techniques to price different instruments, from simple Government bonds to complex corporate instruments with payoffs contingent on the behavior of some market variables – including Libor rates. They will also appreciate the risks in issuing or holding fixed income instruments and how these risks can be hedged.

Skills: On completion of this course the students will be able to apply basic and advanced techniques to price and hedge different positions in fixed income instruments. They will be able to construct bespoke structured financial instruments with terminal payoff profiles designed to manage the risk exposure of the issuer to whole range of market variables, such as inflation and oil market prices. They will be aware of the alternative use of these instruments to the more conventional contracts in vanilla derivatives.

Competence: On completion of this course the students will have an extensive understanding of the fixed income markets, including its important role for companies seeking debt funding as an alternative to bank loans or equity. They know how to price and risk manage various fixed income instruments and have an understanding of the interconnection between the prices of fixed income instruments and the term structure of interest rates.

All course descriptions may be subject to change. Revised information on the course schedule, reading material, teaching and learning activities, and assessment methods will be introduced in the learning management system Canvas at the beginning of the semester.



Content: The focus of this course is on fixed income securities. Various types of bonds will be introduced, such as fixed and variable rate bonds, zero coupon and coupon paying bonds. Also, bonds that include various options, such as equity conversion, withdrawal rights (callable bonds) and sell back rights (puttable bonds) will be discussed. Various models for the term structure of interest rates will be introduced as well as techniques to construct the term structure by using a range of different interest rate instruments.

Risk modelling for fixed income securities is an important activity for bond portfolios. We will demonstrate, with the use of models and examples, how value at risk, duration and convexity are applied in managing and quantifying bond portfolio risks. We will discuss the immunization of bond portfolios and the construction of bond portfolios that cover certain future cash flow liabilities. To manage inflation risk we introduce inflation indexed instruments such as bonds and swap contracts.

Finally, we will cover basic stochastic processes for fixed income analysis and use both binomial trees and continuous processes for the construction of some well-known interest rate models such as, Vasicek, Hull-White, Ho-Lee, and Black-Derman-Toy. These models will be applied to the construction of the term structure of interest rates and to the pricing of bonds and derivatives on interest rate instruments.

Reading material: Provided by teacher, will be introduced in the first lectures. Additional material: Pietro Veronesi, *Fixed Income Securities*, John Wiley, 2010, ISBN 978-0-470-10910-6.

Teaching and learning activities: Interactive lectures, projects and class exams.

Assessment methods: Continuous assessment; 35 - 40% projects, 60 – 65% class exams. No final exam.

Language of instruction: Icelandic/English.

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