Interest Rate and Credit Risk Models

MASTER IN MATHEMATICAL FINANCE
2018/2019

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PROGRAM

Part I. FIXED INCOME MARKETS AND INTEREST RATE RISK

1. Introduction
    - 1.1. Definitions
    - 1.2. From bonds to interest rates
    - 1.3. Yield-to-maturity
2. Term Structures
    - 2.1. Types of Term Structures
    - 2.2. Dynamics of the Term Structures
    - 2.3. Stylized Facts
    - 2.4. Theories of the Term Structure
3. Hedging interest rate risk
    - 3.1. Duration
    - 3.2. Convexity
4. Interest Rate Derivatives

Part II. INTEREST RATE MODELS

1. Static Interest Rate Models
    - 1.1 Fitting the Term Structure of Interest Rates
        - 1.1.1 Direct Methods
        - 1.1.2 Spline Methods
        - 1.1.3 Deterministic Methods

2. Stochastic Interest Rate Models
    - 2.1. Continuous Time Finance Recap
    - 2.2. Short-rate models
        - 2.2.1 Interest Rate Trees
        - 2.2.2 Continuous-time Single-factor models
        - 2.2.3 Continuous-time Multi-factor models
    - 2.3. Affine Models of the Term Structure
    - 2.4. HJM model

Part III. CREDIT RISK MODELS

1. Introduction
2. Structural Models of Credit Risk
3. Reduced-form Models of Credit Risk
4. Credit Rating Models
5. Default Correlation Models
6. Recovery Issues

Part IV. RISK-NEUTRAL DENSITY FUNCTIONS

STRUCTURE

Lectures will have a significant theoretical component, even though with practical examples whenever appropriate. Students are expected to have a strong background in financial maths and some background in finance, namely financial instruments.

LANGUAGE

The course will be taught in English (unless all participants are Portuguese speakers). All materials are in English and available in Aquila platform.

ASSESSMENT

There are two assessment components:

- Mini-tests/Practical works/Participation in lectures (T) - 30%
- Final Exam (FE) - 70%

Final grade: **Max (0.3T+0.7FE; FE)**

To pass each student must have a minimum of 8 points (out of 20) in the Final Exam. The continuous evaluation grades may only be used during the 2018-2019 exam periods, and only once.

The exam is done on an open book basis.

REFERENCES

Background literature

- Fabozzi, Frank J., (2007), "Bond Markets, Analysis and Strategies", 7th Ed., Prentice-Hall International Ed., Englewood Cliffs, New Jersey.

Main References

- Björk, Tomas (2004), "Arbitrage Theory in Continuous Time", second edition, Oxford University Press.
- Schönbucher, Phillip J. (2003), Credit Derivatives Pricing Models, Wiley Finance.

Other References

- Anderson, Nicola, Francis Breedon, Mark Deacon, Andrew Derry, Gareth Murphy (1996), "Estimating and Interpreting the Yield Curve", Wiley.
- Campbell, John Y and Andrew W. Lo (1997), "The Econometrics of Financial Markets", Princeton University Press.
- Cassola, Nuno and Jorge Barros Luís (1996), "The term structure of interest rates: a comparison of alternative estimation methods with an application to Portugal", Banco de Portugal, WP 17-96, Oct..
- Cassola, Nuno and Jorge Barros Luís (2003), "A two-factor model of the German term structure of interest rates", with Nuno Cassola, Applied Financial Economics, Vol. 13, No. 11 and ECB WP Nº.46.
- Cassola, Nuno and Jorge Barros Luís (2203), "Modelling the term structure of interest rates: an application of Gaussian affine models to the German yield curve", in Applied Quantitative Methods for Trading and Investment, edited by Christian Dunis, Jason Laws and Patrick Naim, Wiley.
- Cochrane, John H. (2005), "Asset Pricing", Revised Edition, Princeton University Press.
- Cont, R. and P.Tankov (2004), "Financial Modelling with jump processes", Chapman & Hall Financial Mathematical Series
- Duffie, Darrell and Kenneth J. Singleton (2003), "Credit Risk – pricing, measurement and management", Princeton Series in Finance
- Hull, John (2017), "Options, Futures and Other Derivatives", 10^{h} Edition, Prenctice-Hall.
- Lando, David (2004), "Credit Risk Modelling – theory and applications", Princeton Series in Finance.