

Master of Science
Fixed Income
(Advanced methods)
Code 8223

Syllabus

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Università Luigi Bocconi
Academic Year 2005-06

1 Syllabus

Lecture 1: Basic elements of financial math. Building Blocks: Money Market Rates, TBills, FRA, Eurofutures, Swaps.

Lecture 2: Yield Curve Stripping. Caps and Swaptions.

Lecture 3: Stochastic Calculus.

Lecture 3: The Black Model.

Lecture 4: Building an interest rate model. The Heath-Jarrow-Morton framework.

Lecture 5: Gaussian Heath-Jarrow-Morton Models.

Lecture 6: Why a multifactor model? PCA analysis of the term structure. Multivariate HJM models.

Lecture 7: The Libor and the swap market models: Introduction and motivation.

Lecture 8: The Libor market model. Derivation and Pricing of Caplets and Swaptions. Calibration and diagnostics.

Lecture 9: The swap market model. Analytical approximations and further developments on calibration.

Lecture 10: Pricing of structured products in the Libor Market Model: Libor in Arrears, CMS, Ratchets, ZC Swaptions.

Lecture 11: Introduction to the volatility smile. Smile modeling in interest rate markets.

Lecture 12: Smile-extensions of the market models.

Computer Applications: Yield Curve Stripping, Pricing a Floating Rate Note, Bootstrapping the Implied Volatility Curve, Pricing a Structured Product, Calibration of HJM Gaussian models, Pricing exotic derivatives in the HJM model by simulation.

2 Exam

The exam can have two different modalities:

- Two midterm examinations (closed books) are planned. The first follows the initial six lectures and is based on the first part of the course. The second examination will occur at the end of the course and is based on the second part of the course. Grades will be assigned as follows: 40% for each midterm examination plus a take home examination (20%), for which the use of a computer will be required. Groupwork (no more than 5 persons) is allowed for the take home examination. The deadline for the take home examination will be set before the end of the course.
- A Final Examination at the end of the course is planned, and will be based on the entire course. No take home examination is planned.

3 Main Readings

1. Brigo Damiano and Fabio Mercurio, *Interest Rate Models: Theory and Practice*, Springer Finance 2001.
2. Martellini Lionel, Priaulet Philippe and Priaulet Stéphane, *Fixed Income Securities*, Wiley Finance, 2003.

4 Reference papers

1. Black, F., Derman, E. and Toy, W. 1990 A one-factor model of interest rates and its application to Treasury bond options. *Financial Analysts Journal*. 46(1), 33-39.
2. Black, F. and Karasinski, P. 1991 Bond and option pricing when short rates are lognormal. *Financial Analysts Journal*. 47(4), 52-59.
3. Brace, A., Gatarek, D. and Musiela, M. 1997 The market model of interest rate dynamics. *Mathematical Finance* 7, 127-154.
4. Cox, J.C., Ingersoll, J. and Ross, S. 1985 An intertemporal general equilibrium model of asset prices. *Econometrica*, 53, 363-384.
5. Cox, J.C., Ingersoll, J. and Ross, S. 1985 A theory of the term structure of interest rates. *Econometrica*, 53, 385-407.
6. Heath, D., Jarrow, R. and Morton, A. 1990 Bond pricing and the term structure of interest rates: a discrete time approximation. *Journal Financial and Quantitative Analysis* 25, 419-440.
7. Heath, D., Jarrow, R. and Morton, A. 1992 Bond pricing and the term structure of interest rates: a new methodology for contingent claims valuation. *Econometrica*, 60(1), 77-105.
8. Ho, T. and Lee, S. 1986 Term structure movements and pricing interest rates contingent claims. *Journal of Finance*. 41, 1011-1029.
9. Hull, J. and White, A. 1990 Pricing interest rate derivatives securities. *Review of Financial Studies*, 3, 573-592.
10. Jamshidian, F. 1997 Libor and swap market models and measures. *Finance and Stochastics* 1, 291-328.
11. Nelson C. and A. F. Siegel, 1987, Parsimonious Modeling of Yield Curve, *Journal of Business*, vol. 60, no. 4, 473-489.
12. Vasicek, O.A. 1977 An equilibrium characterization of the term structure. *Journal of Financial Economics* 5, 177-188.

5 Additional References

1. Bjork Tomas, *Arbitrage Theory in Continuous Time*, Oxford Finance Press, 2nd ed. 2004.
2. Britten-Jones Mark, *Fixed Income and Interest Rate Derivative Analysis*, Butterworth-Heinemann Finance, 1998.
3. Clelow Les and Chris Strickland, *Implementing Derivatives models*, Wiley series in Financial Engineering, chapter 7.
4. Flavell Richard, *Swaps and Other Instruments*, John Wiley & Sons, 2002.
5. Hull John, *Opzioni, futures e altri derivati*, Il sole 24h e Prentice-Hall International, 3. ed., cap. 16.
6. James Jessica and Nick Webber, *Interest Rate Modelling*, Wiley series in Financial Engineering, 2000.
7. Martin John, *Applied Math for Derivatives*, Wiley Finance, 2001.
8. Pellser Antoon, *Efficient Methods for Valuing Interest Rate Derivatives*, Springer, 2000.
9. Rebonato, Riccardo. *Interest-Rate Option Models : Understanding, Analysing, and Using Models for Exotic Interest-Rate Options* , Wiley Series in Financial Engineering, 1997.
10. Rebonato, Riccardo. *Modern Pricing of Interest-Rate Derivatives: The LIBOR Market Model and Beyond*, Princeton University Press, 2002.