

A Student Guide for the Course “Analytical Finance I”, 7,5 points

Course code: MMA707

Level C

Educational Programme: Analytical Finance

Department: IMa

Language: English

Examination: Exam - 6 points, Seminars – 1,5 points

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N	Time/Place	Lecture (Preliminary!)
1	Mo, 28/8 18:15-21:00	Introduction, Risk, Pricing via Arbitrage. Binomial models.
2	We, 30/8 18:15-21:00	Black-Scholes smoothing. Richardson extrapolation. Finite difference methods. Monte Carlo. Probability theory,
3	Mo, 4/9 18:15-21:00	Probability theory, spaces and martingales. Radon-Nikodym
4	We, 6/9 18:15-21:00	The Itô lemma. Stopping times and American options
5	Mo, 11/9 18:15-21:00	Brownian motion. Itô-integration.
6	We, 13/9 18:15-21:00	PDE and the Black-Scholes.
7	Mo, 18/9 18:15-21:00	The solution to Black-Scholes.
8	We, 20/9 18:15-21:00	Diffusion models in general
9	Mo, 25/9 18:15-21:00	Analytical Models for American options
10	We, 27/9 18:15-21:00	Girsanov Theorem, Hedging
11	Mo, 2/10 18:15-21:00	Strategies, Volatility surface, Securities with Dividends
12	We, 4/10 18:15-21:00	Exotic options and Something about Deflators
13	Mo, 9/10 18:15-21:00	Interest Rate and Interest Rate Products
14	We, 11/10 18:15-21:00	Interest Rate and Interest Rate Products
15	We, 16/10 18:15-21:00	Interest Rate and Interest Rate Products
S	Mo, 18/10 18:15-21:00	Seminar
T	Mo, 30/10	Exam (preliminary!) Remember to sign up for the exam!

Literature

Analytical Finance I & II by Jan Röman (2017), Analytical Finance III (problems with solutions) by Jan Röman , Glossary in finance by Jan Röman

Reference literature

Hull, John C. Option, Futures and Other Derivatives. Any edition. Prentice Hall.

Course content

In this course we will cover most of what you need to manage the equity markets. This includes the ability to value most kinds of equity derivatives, hedge and to calculate risk measures. Also you will learn how to derive and solve Parabolic Partial Differential Equations, such as the Black-Scholes equation. You will also learn many numerical methods used in Quantitative Finance, such as different kinds of Binomial models, Value-at-Risk, Finite Difference methods, Newton-Raphson and Richardson Extrapolation etc. You will perfectly understand Martingale measure and be able to use Girsanov transformations to change the numeraire (measure). Furthermore you will know about Exotic Derivatives, how to create structured products and build your own strategies with derivatives.

This course is **not** pure academic; it describes how financial modelling works in a real market. Therefore, after the course you can continue with the Fixed-Income market to become a Quant, a Risk Modeller, Risk Manager or a successful trader. You are also able to do your own research in Risk and mathematical Finance.

In a seminar you shall, in groups of 2-3 students, create a working model that is general enough to be used by traders or quants. With these requirements, you need to do many hours per week of self-study. This includes solving many different kinds of problems, including solving partial differential equations etc.

The course will cover: **Products on the markets. Derivatives:** Options, warrants, forwards, futures and exotics. **Trading:** Construction of synthetic contracts and trading strategies. **Costs:** Margin requirements and collaterals. **Options:** American-, Bermudan- European- and Asian types of options. **Binomial models:** Trees, hedging, no arbitrage and the continuous-time limit. **Random behaviour of assets:** Drift, volatility, random walk and the Wiener processes. **Elementary stochastic processes:** Markov- and martingale properties, Brownian motion, stochastic integration and stochastic differential equations. Itô's lemma etc. **The Black-Scholes model:** Assumptions and weaknesses, delta and delta-gamma hedging. **The Greeks:** Delta, gamma, theta, vega, rho etc. **Introduction to exotic and path dependent options. Numerical methods in finance:** Finite-difference methods and Monte Carlo simulations, Value at Risk etc.. **Changing measures and Girsanov theorem. Interest Rate,** risk free interest rate and discounting.

Seminar

There will be one seminar in the end of the course. The topics of the seminars will be chosen in the beginning of the course. The presentation should be done in the end of the course. Before the seminar you have to deliver a report and a working application of a financial model. All students in the group should actively take part in the preparation of the reports and the presentations.

Marks and Grades

The exam consists of 50 points. To pass (G/C) you need at least 20 points. To pass with distinction (VG) you need at least 30 for a B and 40 for an A. A very successful seminar with a perfect working financial model, you can reach a better grade than given by the exam. This means that, if you are close to B or A, a good seminar can increase the grade.

Problems

Problems (with solutions) are and old exams can be found at <http://janroman.dhis.org/AFI>.