OPTIONS AND MATHEMATICS (7.5 hec)
(CTH[$mve095$], **GU**[$MMA700$] **)**
http://www.math.chalmers.se/Math/Grundutb/CTH/mve095/
http://www.math.chalmers.se/Math/Grundutb/GU/MMA700/

Period 4, spring 2011 (50 hours)

Teachers: Christer Borell, e-mail: borell@chalmers.se, phone: 772 35 53, Hossein Raufi, e-mail: raufi@chalmers.se, phone: 772 49 90

Examiner: Christer Borell

Lectures (Borell): Week 12: Tuesday 10-11^{45} (Euler); Wednesday 8-9^{45} (Euler); Friday 13^{15}-15 (FB). For the remaining lectures, see the schedule at the website
http://www.chalmers.se/math/SV/utbildning/
grundutbildning/kurser/fristaende-kurser/mma700

Exercises: Week 12-15, 18-20: Thursday 13^{15}-15 (MVF23; Borell (Swedish)) and (Pascal; Raufi (English)) .

Textbook: Christer Borell, Introduction to the Black-Scholes Theory, Version: 2011 (see the homepage of the course)

CONTENTS

Week 12

Financial derivatives of European and American types. Forward contracts. The Dominance principle. Put-call parity. Convexity properties of European call and put prices. Introduction to the binomial model.

Exercises: Chapter 1.1: 1, 3, 4, 5, 6, 7, 8, 9

Week 13

The multi-period binomial model. Arbitrage portfolio. Replicating and self-financing strategies. Basic concepts in probability: event, random variable, Markov's inequality, characteristic function.

Exercises: Chapter 2.1: 1, 4; Chapter 2.2: 1, 3, 4, 5, 6; Chapter 2.3: 3 (give an alternative solution)

Week 14

Gaussian stochastic process. Independence. Random walk. Law of Large Numbers. Monte Carlo simulation. Central Limit Theorem. Brownian motion. The geometric Brownian motion model of a stock price. Some remarks on portfolio theory.

Exercises: Chapter 3.1: 2, 3, 4, 5, 6, 7, 8, 9

Week 15

Heat conduction, simple random walk, and Brownian motion. Probabilistic representations of solutions to the heat equation and some other parabolic differential equations. The Black-Scholes model and differential equation.

Exercises: Chapter 3.1: 10, 12, 13; Chapter 3.2: 3; Chapter 4.1: 1; Chapter 4.3: 1, 2, 3

Week 18

More on the Black-Scholes model. Call prices. European and American put prices. Simple currency derivatives. Options on forward contracts. Greeks and sensitivity analysis. The Black-Scholes prices of path-dependent options.

Exercises: Chapter 5.1: 1, 3; Chapter 5.2: 1, 2, 3, 4, 5, 6

Week 19

Implied volatility. Several sources of randomness. Bivariate Brownian motion and option pricing.

Exercises: Chapter 5.3: 1, 2, 3, 4, 5; Chapter 5.4: 2, 4; Chapter 5.5: 1

Week 20

A mean-variance approach to portfolio selection. Options on dividend-paying stocks.

Exercises: Chapter 3.1: 20; Chapter 6.1: 1, 2, 3; Chapter 3.1: 14, 15, 16, 19

EXAMINATION

Assignments handed in to the examiner

A number of exercises solved and handed in at the latest Friday, April 15 at 15^{00} will result in a maximum of 1 point at the final examination in May 2011.

The student may hand in solutions together with at most one other student. However, (due to technical problems) you cannot send your assignments by e-mail. Finally, do not forget to pagenate and write your name(s) on each side and, if possible, do not put your solutions in a plastic case, instead use a stapler!

Written final examination (4 hours)

May 23, 2011, morning, v

August 27, 2011, morning, v

January 2012, ?

Aid not permitted.

The test comprises 15 points (in May 2011 plus the credit from the assignments) and to pass at least 6 points are required (at GU a result greater than or equal to 11 points is graded VG; at Chalmers a result greater than or equal to 9 points and smaller than 12 points is graded 4 and a result greater than or equal to 12 points is graded 5).

At least 6 points are of theoretic nature and at least 3 of these are chosen from the following list:

Theorem 1.1.2; Theorem 1.1.3; Theorem 1.1.4; Theorem 2.1.1; Theorem 2.2.1; Theorem 3.1.1; Theorem 3.3.1; Theorem 4.1.1; Theorem 4.2.1; Theorem 4.3.1; Theorem 4.3.2; Theorem 5.1.1; Theorem 5.2.1; Theorem 5.3.1 (only the formula for delta); Theorem 6.1.1.

Göteborg March 14, 2011
Christer Borell