

## OPTIONS AND MATHEMATICS

(CTH[mve095], GU[MMA700] ) (5 p)

<http://www.math.chalmers.se/Math/Grundutb/CTH/mve095/>

<http://www.math.chalmers.se/Math/Grundutb/GU/MMA700/>

### Period 4, spring 2008

**REMARK :** Students who wish examination according to the course Options and Mathematics (3p) (CTH[tma155]&GU[mam690]) must inform the office at the department of mathematics at the latest one week before the examination.

**Lectures (50 hours):** Monday, Tuesday, Thursday 10-11<sup>45</sup>, every week; Tuesdays 8-9<sup>45</sup>, the weeks 17 and 18.

**Room:** MVF33

**Teacher and examiner:** Christer Borell, e-mail: borell@math.chalmers.se, phone: 772 35 53

**Textbook:** Christer Borell, Introduction to the Black-Scholes Theory (can be purchased at the DC, Maskingränd, Chalmers)

## CONTENTS

### Week 14

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

### Week 15

The Binomial model. Arbitrage portfolio. Replicating and self-financing strategies. Some basic concepts in probability: event, random variable, Markov's inequality, characteristic function.

### **Week 16**

More on basic concepts in probability: Gaussian random variables, independence, random walk, Law of Large Numbers, Monte Carlo simulation.

### **Week 17**

Brownian motion. The geometric Brownian motion model of a stock price. Some remarks on portfolio theory. Heat conduction, simple random walk, and Brownian motion. Probabilistic representations of solutions to the heat equation and some other parabolic differential equations. Simple random walk and the heat equation.

### **Week 18**

The Black-Scholes model and differential equation. Call prices. European and American put prices. Simple currency derivatives.

### **Week 19**

Options on futures contracts. The Greeks and sensitivity analysis. The Black-Scholes prices of path-dependent options. Implied volatility.

### **Week 20**

Bivariate Brownian motion. Change of numéraire. The option to exchange one asset for another. The option on the maximum of two asset prices.

The assignments must be handed in at the latest Thursday May 15 at 11<sup>45</sup>.

### **Week 21**

Calls and puts written on dividend-paying underlying assets.

## **EXAMINATION**

*Assignments handed in to the examiner*

A number of exercises solved and handed in by the student at the latest Thursday May 15 at 11<sup>45</sup> will result in a maximum of 1 point at the final examination in May 2008.

The courses CTH[*tma155*] and GU[*mam690*] have no assignments.

*Written final examination (4 hours)*

May 24, 2008, morning, v

August

January

Aid not permitted.

The test comprises 15 points (in May 2008 plus the credit from the assignments) and to pass at least 6 points are required (at GU 11 points or more 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 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 3.3.1; 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; Example 6.1.1.

Göteborg March 13, 2008

Christer Borell