

## **OPTIONS AND MATHEMATICS (CTH[*TMA155*]&GU[*MAM690*])**

<http://www.math.chalmers.se/Math/Grundutb/CTH/tma155/>

<http://www.math.chalmers.se/Math/Grundutb/GU/MAM690/>

### **Period 4, spring 2006**

**Lectures (40 hours) in room MVF31:** Weeks 11-14, 17-20: Wednesday 10-12, Thursday 10-12 ; Weeks 12, 14, 18, 20: Tuesday 15-17

**Teacher and examiner:** Christer Borell, e-mail: [borell@math.chalmers.se](mailto: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, from week 11)

## **CONTENTS**

### **Week 11**

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

### **Week 12**

The Binomial model. Arbitrage portfolio. Replicating and self-financing strategies.

### **Week 13**

Basic concepts in probability: Gaussian random variables, independence, random walk.

### **Week 14**

Brownian motion. The geometric Brownian motion model of a stock price. Some remarks on portfolio theory. Heat conduction and Brownian motion.

Probabilistic representations of solutions to the heat equation and some other parabolic differential equations.

### **Week 17**

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

### **Week 18**

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

### **Week 19**

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

### **Week 20**

Calls and puts written on dividend-paying underlying assets.

## **EXAMINATION**

### **Written examination (4 hours):**

May 20, 2006, v  
 September 2, 2006, v  
 January 20, 2007, v  
 Aid not permitted.

The test comprises 15 points; to pass requires at least 6 points (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).

#### *Assignments*

A number of exercises solved and handed in by the student at the latest Thursday, April 27 at 10<sup>45</sup> will result in a maximum of 1 point at the final examination.

The written examination thus comprises 15 points, where at least 6 points are of a theoretic nature. At least 3 points from the theoretic part are collected 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 August 23, 2006

Christer Borell