

**FINANCIAL DERIVATIVES AND STOCHASTIC  
ANALYSIS (7.5 hp)**  
(CTH[*tma285*], GU[*MMA710*])

**Period 2, autumn 2007**

**Lectures during weeks 44-50 (56 hours):** MVH11: Monday 10<sup>00</sup>-11<sup>45</sup>;  
Wednesday 13<sup>15</sup>-15; Friday 13<sup>15</sup>-15; MVH12: Tuesday 8<sup>00</sup>-9<sup>45</sup>

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

**Textbook:** S. Shreve, Stochastic Calculus for Finance II. Continuous-Time  
Models, Springer 2004.

## CONTENTS

### Week 44

**Chapters 1 and 2, Probability Theory:** Random variable; Expectation;  
Change of Measure;  $\sigma$ -algebra; Conditional Expectation.

**Exercises:** 1.5, 1.6, 1.7, 1.8, 1.10, 1.11, 1.14

### Week 45

**Chapter 3, Brownian Motion:** Symmetric random walk; Brownian Mo-  
tion; Martingale; Quadratic Variation; Markov Property; First Passage Time  
Distribution.

**Exercises:** 2.3, 2.4, 2.7, 2.9

### Week 46

**Chapter 4, Stochastic Calculus:** Itô integral; Itô-Doeblin formula; Black-  
Scholes-Merton equation; Option Value; Greeks; Put-Call Parity.

**Exercises:** 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 4.4

### Week 47

**Chapter 4, Stochastic Calculus:** Multivariable Stochastic Calculus; Gaussian Processes.

**Exercises:** 4.2, 4.5, 4.6, 4.7, 4.11

**Chapter 5, Risk-Neutral Pricing:** Risk-Neutral Measure; Girsanov's Theorem.

#### Week 48

**Chapter 5, Risk-Neutral Pricing:** Martingale Representation. Fundamental Theorems of Asset Pricing; Forward and Futures contracts.

**Exercises:** 4.13, 4.15, 4.16, 4.19, 5.2, 5.3, 5.4, 5.9, 5.10

#### Week 49

**Chapter 6, Connections with Partial Differential Equations:** Feynman-Kac Theorem; Interest Rate Models.

**Chapter 7, Exotic Options:** Barrier Options. Asian Options.

**Exercises:** 6.1, 6.2, 6.3, 6.4, 6.6

#### Week 50

**Chapter 9, Change of Numéraire:** Foreign and Domestic Risk-Neutral Measure. Forward Measure.

**Exercises:** 6.7, 6.8, 6.9, 9.5

### EXAMINATION

**Written examinations (4 hours):**

December 15, 2007, morning, v

April 28, 2008, morning, v

August ?, 2008

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, November 30 at 9<sup>45</sup> will result in a maximum of 1 point at the final examination in December 2007.

The written examination thus comprises 15 points, where at least 6 points are of theoretic nature. At least 3 points from the theoretic part are collected from the following list:

(a) Theorem 3.3.4 (b) Theorem 3.4.3 (c) Theorem 3.5.1

(d) Theorem 3.6.1 (e) Theorem 3.6.2 (f) Theorem 3.7.1

(g) Theorem 3.7.3. (h) Theorem 4.2.1 (i) Theorem 4.2.2

(j) Theorem 4.2.3 (k) Theorem 4.4.1 (l) Lemma 4.4.4

(m) Theorem 4.4.9 (n) Lemma 5.2.1 (o) Lemma 5.2.2

(p) Theorem 5.2.3 (q) Theorem 5.4.7 (r) Theorem 6.4.1

(s) Theorem 6.4.3 (t) Theorem 7.2.1 (u) Corollary 7.2.2

(v) Theorem 9.2.1 (w) Theorem 9.2.2

Göteborg October 28, 2007

Christer Borell