

Written Exam for the M.Sc. in Economics summer 2012

**Pricing Financial Assets**

Final Exam (re-exam)

August 9, 2012

(3-hour closed book exam)

Please note that the language used in your exam paper must correspond to the language of the title for which you registered during exam registration. I.e. if you registered for the English title of the course, you must write your exam paper in English. Likewise, if you registered for the Danish title of the course or if you registered for the English title which was followed by “eksamen på dansk” in brackets, you must write your exam paper in Danish.

If you are in doubt about which title you registered for, please see the print of your exam registration from the students' self-service system.

The Exam consists of 3 problems that will enter the evaluation with equal weights.

### **Problem 1**

In the Black-Scholes-Merton Model the price,  $c$ , at time  $t = 0$  of a European call option with strike  $K$  on a stock with price  $S_0$  at time  $t = 0$  and expiry at  $T > 0$  is given by:

$$c = S_0 N(d_1) - Ke^{-rT} N(d_2)$$

where

$$d_1 = \frac{\ln S_0/K + (r + \sigma^2/2)T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

1. What are the assumptions behind this model?
2. Using the call-put-parity derive a formula for the pricing of a put option on the same stock and with same strike and expiry as the call.
3. How can the call price formula be modified to cover the case of a dividend paying stock?

### **Problem 2**

1. For a general derivative with the value  $V(S, t)$  contingent on the price of a stock  $S$ , which can be assumed to follow an Ito process, and time  $t$  define the following Greeks: Delta, Theta and Gamma.
2. Explain the term "Delta-neutral". What could be the purpose of a Delta-neutral portfolio?
3. Suppose a portfolio of the stock and/or derivatives of that stock is Delta-neutral, and that there are no arbitrage possibilities. What can we say about the relation between the Theta and Gamma of the portfolio?

### **Problem 3**

1. Suppose that the probability that a company is not in default on its obligations at or before time  $t$  is given by  $V(t)$ . How would we define the hazard rate (or default intensity)?
2. How, and under which assumptions, may we estimate the hazard rate from the interest rate spread on bonds issued by the company? Under what probability measure would we say this estimate is derived? Compare this to a hazard rate that is derived from default frequencies and recovery ratios published by a ratings agency.

3. In the Merton-model the value of a claim on a company is modeled taking credit risk into account by using a variation on the Black-Scholes-Merton option model. Describe the characteristics of the Merton-model and discuss it's potential shortcomings.