

Examiner: Prof. Dr. Peter Reichling

The following aids can be used: non-programmable pocket calculator

This examination comprises 3 problems. All of them are to be solved.

EXAMINATION QUESTIONS:

Problem 1. (10 Points)

- (a) Demonstrate by means of the payoff profiles the put-call parity and briefly discuss it.
- (b) What is the price of a stock, if the call and the put on this stock cost €2 and €0.5, respectively, and both options mature in 6 months and have a strike price of €30. The risk-free interest rate is 5%, compounded continuously.
- (c) Assume now that the call option from (b) sells for €1.75 and the stock price you received in (b) is true. Is there any arbitrage opportunity? If so, show with the help of an arbitrage table how much can you receive *today* by pursuing an appropriate strategy.

Problem 2. (30 Points)

Suppose you have a short put position on one non dividend paying share. This position is not hedged, however, you would like to do this. On the market you can observe the following data: (i) stock price is 78; (ii) volatility of stock returns is 30%; (iii) risk-free interest rate is 10% p.a.; (iv) put option is of the European type with maturity in 3 months and a strike price of 75.

To answer the following questions use a binomial model with one step per month.

- (a) Make a graph of the binomial tree for the stock price development.
- (b) Determine the current value of the put option using the binomial tree.
- (c) What deltas does the option have today and in one month? (*Hint: Use here just the definition of the option delta.*)
- (d) How can you hedge your position in the put option today?
- (e) What adjustments must be carried through in one month to maintain your hedge position? Consider here the two possible developments of the stock price in one month.

Problem 3. (20 Points)

On the market you can observe the following data: (i) the stock price is 101; (ii) risk-free interest rate (with discrete compounding) is 408.2bps p.a.; (iii) volatility of stock returns is 30%.

- (a) What is the price of an European call option with a maturity in 3 months on the above mentioned stock with a strike price of 100 in the Black-Scholes world?
- (b) In order to replicate the option from (a), what position in the stock should you take and how much should you borrow/lend at the risk-free rate?
- (c) Compute delta, gamma, and theta of the call option and show what kind of relationship arises among them.

Standard Normal Distribution - Cumulative Distribution Function

[illegible]