Chapter 8: Black and Scholes option pricing - part 1

Exercises

1. It is sometimes said that if the current share price equals the exercise price, then call options on the share have a 50% chance of ending up worthless (if the share price falls) and a 50% chance of ending up "in the money" (if the share price rises). Explain in simple terms or with an example why this statement is or is not correct.

2. A stock has an annual volatility (standard deviation) of 34%. Calculate the standard deviation of the daily return. Assume that a year has 252 trading days and that the returns are independently and identically distributed (iid).

3. On 11 April 2017 there was a bomb attack on the bus of the Borussia Dortmund football team; fortunately only one player was lightly injured. Ten days later, the 28-year-old Sergej W. was arrested on suspicion of planting the bomb. It appeared that greed was his motive. He had taken a position in securities related to shares of Borussia Dortmund, the only club in Germany that issued shares that are listed on the stock exchange. Describe, briefly but precisely, a position in securities that would have given a high payoff if the bomb attack would have been successful.

4. The iid assumption means that the distribution of stock returns is stable over time. Does this stability mean that past stock returns can be used to predict future ones?

5. On a financial market a stock is traded at a price of €240. The stock does not pay dividends and has an annual volatility of 25%. Call options on the stock with an exercise price of €250 and a time to maturity of 1 year are also traded. The risk free interest rate is 6%. Calculate the price of the option.

6. On a financial market shares of ZX co. are traded at a price of €100. The shares have an annual volatility of 25%. Risk free borrowing and lending is available against an annual interest rate of 5%. Put and call options on ZX co.'s shares are also traded; the available exercise prices range from €75 to €125 in steps of €5, the available times to maturity are 3, 6, 9 and 12 months. An investor owns 1000 shares of ZX Co. She bought the shares some time ago for €60, so she is well pleased with her investment in the shares. She needs to sell her shares in six months time to pay for a house she has bought. She hesitates to sell the shares immediately, because she thinks there is a good probability that shares will increase in value over the next six months. On the other hand, she does not want to sell the shares for less than €90 per share because that would jeopardize the financing of her house. Since you followed a course in finance for science and technology students, she asks your advice.

   Design an option position that reflects the investor's expectations and preferences and calculate how much it costs to set up that position. Show calculations to support your answer and make additional assumptions if necessary.

7. You own American put options on shares ZX Co. with an exercise price of €67.50 and a time to maturity of 9 months. When you bought the options they were at-the-money,

but disaster suddenly struck ZX Co. and its shares now trade for €2. The risk free interest rate is 8%. Should you exercise the options today or wait until maturity?