

Assignment (100 marks)

Due by 12 pm on June 16

This assignment is individual. The option data used in the analysis has to be download individually. The assignment is based on the Black-Scholes-Merton (BSM) formula. Use Excel to solve the assignment and show all steps and inputs used in the calculations for the full credit. You have to submit one excel file which includes raw data, tables and calculations (all calculations should be verifiable by the marker), results, and answers to questions. Use a new page for each question. The excel file should be sent to the email address:

shawn.choupani@mail.concordia.ca

Please write “project412: your last name” in the subject area.

Part I.

1. **(10 MARKS)** Consider American call options written on S&P 500 etf (SPY). This etf pays dividends on June 19th. Therefore, we will use BSM formula to price call options maturing on June 17th. Go to finance.yahoo, copy and paste the table with current prices on these options maturing on June 17th to the excel spreadsheet. Consider 10 call options which differ by their strike prices: 5 options in-the-money and 5 options out-of-the-money. The difference between two adjacent strike prices should be \$2. Make a table showing the stock (SPY) price, 10 strike prices and corresponding option prices, where option prices must be equal to the mean between the bid and the ask price. Find the expiration time, T , of the options
2. **(10 MARKS)** Find the historical standard deviation, σ , of SPY returns based on the previous three months. (Use daily prices of SPY from finance.yahoo)
3. **(30 MARKS)** Assume that the continuously compounded risk-free rate is 1.25%. Use BSM formula to find the prices of the call options with the time to maturity, stock price, and strike prices from Q.1 and σ from Q.2. Make a table with the following columns: Stock price, σ , Strike Price, d_1 , d_2 , $N(d_1)$, $N(d_2)$, Price of Call option. The table should have 10 rows corresponding to 10 different strike prices used in Q.1
4. **(30 MARKS)** Find the implied volatilities for 10 strike prices from Q.1. Make a table showing the moneyness of the option (K/S), price of the option, and the implied volatility. Plot the implied volatility versus moneyness. How do you explain the shape of the curve? How it is related to the standard deviation, σ , found in Q.2? Based on your calculations, how accurate the BSM formula is?

(Hint for finding implied volatility in Excel. Use table from Q.3. Have the option price in this table calculated based on the BSM formula with the inputs from the table. Now follow the steps: Go to Data->What If Analysis>Goal Seek. Then enter the cell # where the option price is calculated based on the BSM formula into “Set cell”, enter the cell # with volatility into “By changing cell”, enter the

call option market price in “To value”, hit “OK”. The implied volatility will show up in the cell with volatility)

Part II (not related to part I)

(20 MARKS) Assume that the assumptions of BSM model hold. Consider European call option with strike price $K=50$, $T=.25$ written on the stock with $S_0=50$, $\mu=0.10$, $\sigma = 0.25$. The risk-free rate r is 1.5%. Find the expected return (under real probabilities) of the call option between today and time to maturity. Repeat this exercise for $S_0=40, 45, 55$, and 60. What do you conclude about the expected return of the option versus its moneyness?

(Hint: Take into account that the expected payoff, $E(c_T)$, where the expectation is taken under real probabilities, could be found from the result for $E^Q(c_T)$, where the expectation is taken under risk-neutral probability, since the only difference between the two probability distributions is in their means, μ and r , respectively.)