

FE-620 – Assignment 5

Problem 1.

Consider an option on a non-dividend-paying stock when the stock price is \$30, the exercise price is \$29, the risk-free interest rate is 3% per annum, the volatility is 25% per annum, and the time to maturity is four months.

- a. What is the price of the option if it is a European call?
- b. What is the price of the option if it is an American call?
- c. What is the price of the option if it is a European put?
- d. Verify that put–call parity holds.

Problem 2.

A stock index currently stands at 300 and has a volatility of 20%. The risk-free interest rate is 5% and the dividend yield on the index is 1%. Use a three-step binomial tree to value a six-month put option on the index with a strike price of 300 if it is (a) European and (b) American?

Problem 3.

The futures price of an asset is currently 78 and the risk-free rate is 2%. A six-month put on the futures with a strike price of 80 is currently worth 6.5. What is the value of a six-month call on the futures with a strike price of 80 if both the put and call are European? What is the range of possible values of the six-month call with a strike price of 80 if both put and call are American?

Problem 4.

A financial institution has the following portfolio of over-the-counter options on sterling:

Type	Position	Delta of Option	Gamma of Option	Vega of Option
Call	–1,000	0.5	2.2	1.8
Call	–500	0.8	0.6	0.2
Put	–2,000	–0.40	1.3	0.7
Call	–500	0.70	1.8	1.4

A traded option is available with a delta of 0.6, a gamma of 1.5, and a vega of 0.8.

- (a) What position in the traded option and in sterling would make the portfolio both gamma neutral and delta neutral?
- (b) What position in the traded option and in sterling would make the portfolio both vega neutral and delta neutral? Assume that all implied volatilities change by the same amount so that vegas can be aggregated.

Problem 5

Data for a number of stock indices is provided in the file *ForEx&IndexData.xls*. Choose an index and test whether a three standard deviation down movement happens more often than a three standard deviation up movement.

Problem 6

Consider a position consisting of a \$300,000 investment in gold and a \$500,000 investment in silver. Suppose that the daily volatilities of these two assets are 1.8% and 1.2% respectively, and that the coefficient of correlation between their returns is 0.6. What is the 10-day 97.5% VaR and ES for the portfolio? By how much does diversification reduce the VaR?