EC3070 Financial Derivatives: Dummy Exam Paper

Answer ONE Question from Section A and ONE from Section B (The answers carry equal weight)

Section A

1. **(a)** Explain how to create the following trading strategies:

(i) A *Bear spread* using puts.

(ii) A *Butterfly spread.*

(iii) A *Strangle.*

(b) For each of the above trading strategies, draw diagrams to reveal the potential profits and losses associated with each of these portfolios as a function of the spot price of the underlying asset at maturity.

(c) Explain under which circumstances would you advise an investor to acquire each of the above trading strategies.

(d) Establish and justify the formula for the put–call parity.

2. Annual payments of $\$M$ must be made over a period of n years to redeem a mortgage. Derive the formula for the present value of this stream of payments.

If the loan was for \$150,000 and the rate of interest was fixed a 5% for the entire period, what should be the size of the annual payment in order to redeem the loan in 20 year's time?

3. Let the annual rate of interest be r and let the price of a share at the present time of $t = 0$ be $S_0 = 100$. Suppose that, after one year, when $t = 1$, the price will be either $S_1^u = 200$ or $S_1^d = 50$. A call option to buy the share at time $t = 1$ at a price of $K_{1|0} = 150$ can be purchased at time $t = 0$ for $c_{1|0}$.

Show that, unless $c_{1|0} = \{100 - 50(1 + r^{-1})\}/3$, there will always exist a combination of x shares and y options that will yield a profit.

Section B

4. Describe and analyse the dangers of financial disaster that can accompany any two of the following activities:

(a) The securitisation of mortgages,

(b) Buying stock on margin,

(c) Trading in options,

(d) Short selling a financial asset,

(e) An attempt to corner the market in a commodity or a financial asset.

5. How does a futures market operates and how might it facilitate the trade in industrial and agricultural commodities?

What are the consequences of the replacement of futures contracts by options. Should options trading be encouraged or discouraged in commodity markets?

6. Explain what is meant by a standardised first-order random walk and itemise its essential mathematical properties.

Show how a Wiener process can be derived as a limiting case of a random walk. Why is such a process not appropriate for describing of the trajectory of a asset price?

How is the model of a geometric Brownian motion derived from that of a Wiener process, and what are its properties?

7. Explain how the following Black–Scholes formula for determining the price of a call option can be derived:

$$c_{\tau|0} = S_0\Phi(d_1) - K_{\tau|0}e^{-r\tau}\Phi(d_2),$$

where $\Phi(d) = P(z \leq d)$ denotes a value from the cumulative Normal distribution function, and where

$$d_1 = \frac{\ln(S_0/K_{\tau|0}) + (r + \sigma^2/2)\tau}{\sigma\sqrt{\tau}} \qquad \text{and} \qquad d_2 = d_1 - \sigma\sqrt{\tau}.$$

Describe the properties of the formula and comment on the realism of the model that underlies it. What are the hazards of using the formula in a uncritical manner.