

SIMON FRASER UNIVERSITY
Beedie School of Business Administration
Take home Final Examination

BUS 419
Advanced Derivative Securities

23-2

Academic Honesty: This assignment is individual work. Students are required to follow S10.01 requirements (see class web page).

Rules for Submitting Final Exam: Answers are to be typed (except for equations), single spaced, of length 1 page *each* for questions (1.) and (2.), 8"x11" standard paper, with 1" margin and type point not less than 12. (This assignment is typed in 12 point). For these questions answer both parts of the question in one page total. Violations will be subject to deductions. There is no page constraint for the other three questions.

Assignment is due in my email (poitras9@sfu.ca) no later than 12:00 PM on Wed., Aug. 16, 2023. Substantial late penalties (2% per hour or part thereof) will be assessed for assignments not in by the due date time.

DO ALL FIVE QUESTIONS (20 points each; Do all parts of each question; for questions with two parts, each part is 10 points)

1. Compare and contrast the risk management practices for *two* of the following three sectors from the in-class presentations: i) financial firm -- RBC; ii) Canadian Oil and Gas (CPG, MX) OR Cruise Lines (RCL, NCLH, LIND); iii) Global Airlines (LUV, DAL, SAVE). Be sure to identify and contrast the risk management governance; risk reporting techniques; accounting methods; and the amount and type of derivative security usage.

2. CHOICE QUESTION: DO EITHER

a) A long stock position can be "protected" by buying a put. How can the payoff on this portfolio of a stock and option be replicated using "dynamic hedging" strategies involving portfolios which combine only stock and bond positions? (Hint: Be sure to identify the difference between path dependent and path independent strategies and explain the meaning of time invariant.) Why did such strategies become widely used by institutional investors prior to the market break in Oct. 1987? What changes relevant to such trading strategies were introduced following this market break?

b) Derive a "closed-form" expression (i.e., a formula) for the risk-minimizing hedge ratio. In what sense is this ratio an optimal hedge ratio? How is your answer affected if the commodity being hedged is undetermined at the time the hedge is "put on", e.g., a wheat farmer hedging the expected income to be generated by a crop which has just been planted.

OR

a) Describe the various forms of portfolio insurance. How would these various forms of portfolio

insurance perform in the face of discontinuous movements in equity prices during: i) the October 1987 market break; ii) the equity market collapse of Sept. 2008- March 2009? Identify important institutional differences impacting these two market events.

b) Are forward prices unbiased predictors of future spot prices? [Hint: Assuming mean-variance agents, derive an expression for the optimal speculative position size.] What happens to this position as the sensitivity of the agent to risk diminishes? Based on this, what can you conclude about the equilibrium in a market dominated by risk-neutral speculators?

3. a) Outline the continuous time derivation of the **fundamental partial differential equation** (PDE) of the Black-Scholes option pricing model. Prove that the Black-Scholes option pricing model satisfies the PDE and terminal condition.

b) What are the implications of applying the Black-Scholes option pricing model to options prices: i) for currencies; ii) where the state variable is generated by arithmetic Brownian motion; iii) for commodity futures contracts? [Hint: Provide formulas and explanation.] How can Black-Scholes be adapted to pricing American call options?

4. Assuming European options on non-dividend paying stocks, **state the exact formulas** for the delta, gamma and theta for a **written** (short) position in: i) a strangle spread (X for put less than for X call, same T); ii) a butterfly using calls (3 different X and same T); iii) a vertical spread using puts (different X and same T); iv) a horizontal spread using puts (same X , different T); and; v) a strip spread (two puts and one call, same X and T).

5. For the five trades in question #4: using the parameters: $S = 85$; $r = 0.045$; $\sigma = 0.42$; $T = 0.58$ if each spread is constructed to have (negative) delta = -0.1 and have the same initial value (the value of the positions, V^* , is the same), then calculate the number of spreads in each position, the relative gamma and theta of the spread positions and explain the reasons for the differences in the Greeks? [Hint: Provide copies of programs used to calculate results]

BONUS: (5 points)

Under what conditions will an American currency call option be exercised early? When will an American put for non-dividend paying stock be exercised early?