BUS 761 - Global Financial Risk Management – Sample Exam II

Professor Koch Covers: Hull, Chapters 9, 11, 12, 15, 18.

Answer all questions. Points assigned to each problem appear in parentheses. 90 points possible.

1. Is each statement is True, False, or Uncertain? Explain your answer in each case.

True False

(6) A. European puts & calls cannot be more valuable than the present value of **K**.

$P \le K$; $p \le Ke^{-rT}$ $c \le C \le S$ but S may be $> Ke^{-rT}$

(6) B. European calls and puts can be accurately valued using the Black/Scholes model, although American calls and puts cannot. False – American calls can if no dividend.

European calls & puts can. (American puts cannot)

(6) C. The risk-neutral valuation principle implies that we can value American put options using implied volatility. Say what risk neutral valuation is, & what implied volatility is; say we can value American puts with Binomial model.

False – nonsense

2. A. Suppose that the current stock price is S = $45;

(6) a one-year European put option with a strike price of **K** = $50 costs p = $9; and the riskfree rate is 10% (thus, $\mathbf{K}e^{-rT}$ = $45.24). What is the equilibrium value of a one-year European call on this stock (c) with the same exercise price, implied by Put-Call Parity?

$S + P = Ke^{-rT} + C$; $C = S + P - Ke^{-rT} = 45 + 9 - 45.24 = \boxed{\$8.76}$

(6) B. If, in addition to the information in A. above, you observe that the call is currently selling for c = $9.50, discuss possible arbitrage opportunities. ← (buy stock, put, borrow)

sell call for 9.50; buy synthetic call for 8.76; keep diff – TC

3. Assume that the one-period Binomial Option Pricing model holds, where the time period is one year (Δt = 1 year), the initial stock price is S_0 = $50, and the final stock price, S_1, either increases to uS_0 = $60 (u=1.2) or decreases to dS_0 = $40 (d=.8).

(6) A. If the exercise price of a call option on this stock is **K** = $45, what is the value of this call option at expiration:

(i) if S_0 increases; $\boxed{\$15}$ (ii) if S_0 decreases? $\boxed{\$0}$

(6) B. What is the hedge ratio for this stock (the number of shares of stock purchased per call written that makes the outcome riskfree)?

$\Delta = (C_u - C_d)/(S_u - S_d) = (15 - 0)/(60 - 40) = \boxed{.75}$

(6) C. If the riskfree rate is r = 9.54% ($e^{r\Delta t}$=1.10), what is the value of this call option at the beginning of the period?

$p = (e^{r\Delta t} - d)/(u - d) = (1.10 - .8)/(1.2 - .8) = .75$; $C = [\$15(.75) + \$0(.25)]/1.10 = \boxed{\$10.23}$

(6) D. Now assume that the two-period Binomial Option Pricing model holds (n=2), with all other information identical to that above (Δt = 1 year, S = $50, u = 1.2, d = .8, **K** = $45, and r = 9.54%). What is the value of this call option at expiration (after 2 periods):

(i) if S_0 increases twice; $C_{uu} = \max\{Su^2 - K, 0\} = 72 - 45 = \$27$

(ii) if S_0 increases once and decreases once; $C_{ud} = \max\{Sud - K, 0\} = 48 - 45 = \$3$

(iii) if S_0 decreases twice? $C_{dd} = \max\{Sd^2 - K, 0\} = 32 - 45 \Rightarrow \$0$

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4.(6) A. Discuss what happens to delta when expiration approaches, for:

(i) an in-the-money call option; $\delta \to 1$

(ii) an out-of-the-money put option. $\delta \to 0$

probability (itm)

(6) B. Suppose the delta of a call option is (.20), and the delta of a put option on the same underlying asset is (-.68). Explain in detail how to construct a delta-neutral hedge for a long position in one unit of the underlying asset:

(i) using call options; sell $1/\delta = 1/.2 = \boxed{5 \text{ calls}}$

(ii) using put options. buy $1/\delta = 1/.68 = \boxed{1.47 \text{ puts}}$

5. Consider a $300,000 investment in gold, and another $500,000 investment in silver. Suppose the daily volatilities of gold and silver returns are .018 and .012, respectively. [This means that the standard deviation of the daily change in the gold investment, for example, is $300,000*(.018) = $5,400.] Silver → $\$500{,}000 \times (.012) = \$6{,}000$

(6) A. What is the 95% 1-day VaR for the gold investment? $1.65 \times \$5{,}400 = \boxed{\$8{,}910}$

What is the 95% 1-day VaR for the silver investment? $1.65 \times \$6{,}000 = \boxed{\$9{,}900}$

(6) B. What is the 95% 10-day VaR for the gold investment? $1.65 \times \$5{,}400 \times \sqrt{10} = \boxed{\$28{,}176}$

What is the 95% 10-day VaR for the silver investment? $1.65 \times \$6{,}000 \times \sqrt{10} = \boxed{\$31{,}307}$

(6) C. Consider a portfolio consisting of both the gold and silver investments above. Suppose the correlation between daily returns in gold and siver is ρ=.6.

(i) → What is the 95% 1-day VaR of this joint investment?

(ii) → What are the benefits of diversification?

That is, by how much does diversification reduce the 95% 1-day VaR of this joint investment below the VaR's of the two investments separately?

6. (6) Briefly explain why the linear model can provide only approximate estimates of VaR for a portfolio containing options.

Options have nonlinear payoffs; linear model ignores curvature (or gamma) — only gives approximation.

C. $\sigma(u+v) = \left[\sigma_u^2 + \sigma_v^2 + 2\rho\sigma_u\sigma_v\right]^{1/2}$

$= \left[5400^2 + 6000^2 + 2(.6)(5400)(6000)\right]^{1/2} = \boxed{\$10{,}200}$

Thus 95% 1-day VaR $= 1.65 \times \$10{,}200 = \boxed{\$16{,}830}$

Benefits = Var(u) + Var(v) − Var(u+v)

$= \$8{,}910 + \$9{,}900 - \$16{,}830 = \boxed{\$1{,}980}$