

Johns Hopkins University
Carey Business School

Financial Risk Management

Fall 2009

Homework 1

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ASSIGNMENT – DUE ON Thursday 15 OCTOBER 2009

I will collect the assignment at the beginning of the class. Please, bring two copies of the assignment. One should be submitted to me and will be graded. The second is for you. At the beginning of the class I will solve the homework. I believe it may be useful for you to check your solutions while I am solving the homework in class.

Late submissions will not be graded.

Do not submit your homework via email.

The plagiarizing, in any form, of the work of another is a form of academic dishonesty and will result in an automatic failing grade. By the act of submitting written work to satisfy the homework assignment, you make the claim that the work is your own.

PART I : Essay (50 points)

Based on your reading of Stulz—“Risk Management Failures: What Are They and When Do they Happen?”, please answer the following questions:

1. What is the role of risk management?
2. Explain the idea of deadweight costs within the context of risk management.
3. What are the five types of risk management failure?
4. Stulz says that “...correlations increase in a period of crisis.” (p. 43) What does he mean and how does that matter to risk management?
5. How can one manage risk that are truly unknown (e.g., the attack of September 11)?
6. What are some of the conceptual problems with VaR and such similar methods of risk management?
7. What kind of techniques does Stulz recommend for dealing with entirely unanticipated risks?

In light of your reading of Stulz, discuss Ludwig B. Chincarini 's (2007) paper on Amaranth. Specifically address whether Amaranth collapse can be regarded as risk management failure or failure of risk measures based on Stulz's five types of risk management failure.

PART 2: Analytical Questions (50 points)

Question 1 (10 points)

Please comment the following statements. (Correct or Wrong). Write down your reason.

- (1) The convexity of bonds is always positive? (For example: Treasury Notes, Treasury Bonds, MBS, and callable bonds.)
- (2) Other things being equal, you will choose bonds with lower convexity rather than bonds with higher convexity.
- (3) VaR can be extended from a one-day horizon to T days by multiplication by the square root of time. This adjustment is valid with i.i.d. returns that have a lognormal distribution.
- (4) We still like VaR method although VaR doesn't describe the worst loss. However, VaR could describe the distribution of losses in its left tail.
- (5) Sub-additivity implies that the sum of risks of the portfolio component must be less than the risk of a portfolio.
- (6) A drop in the stock price will decrease the leverage of the firm and therefore the risk.
- (7) In practice, both the rate of return and stock price follow normal distribution.

- (8) We prefer higher confidence levels because they can help us to generate precise VaR measures.
- (9) The generalized Wiener process is geometric because the trend and volatility terms are proportional to the current value of stock price.
- (10) The modified duration of 10-year zero coupon bond is equal to 10.

Question 2 (5 points)

Consider a bond with the following characteristics: Maturity 5 years, 5% semiannual coupon-paying period. Yield 5 % per year.

- What does duration mean? Please compute Macaulay duration, Modified duration, and Dollar duration of this bond.
- What does duration mean? Please compute convexity and Dollar convexity of this bond.
- Using the Taylor expansion, compute the new bond price if the yield moves from 6% to 8%.

Question 3 (5points)

A bond portfolio has the following composition:

- Portfolio A: price \$90,000, modified duration 2.5, long position in 8 bonds
- Portfolio B: price \$110,000, modified duration 3, short position in 6 bonds
- Portfolio C: price \$120,000, modified duration 3.3, long position in 12 bonds

All interest rates are 10%. If the rates rise by 25 basis points, how does the bond portfolio value change?

Question 4 (20 points)

From Yahoo! Finance download daily data for the JOYG, GOOG, GS, and DJ30 index (symbol ^DJI) from September 1, 2004 to September 21, 2009. Compute daily, weekly and monthly returns on the stock prices and index: $R_t = \ln(P_t / P_{t-1}) \times 100$. (Hint: please use hypothesis testing in statistics to test your result)

- For the return processes (daily, weekly, monthly) compute mean, standard deviation, skewness and kurtosis. Are your results in line with the *stylized facts* of real market data? Explain.

- b) Graph the distribution of returns(daily, weekly, monthly).
- c) Compute the autocorrelation of daily, weekly and monthly returns up till lag 10. Comment on your results.
- d) Assume squared returns are a proxy of volatility: $\sigma_t^2 = R_t^2$. Compute the autocorrelation of daily, weekly and monthly volatilities up till lag 10. Comment on your results. (2 points)
- e) Assume you invest \$100 M in the each of stock and index. Using the historical one-year (from September 1, 2008 to September 22, 2009) distribution of the stocks and invest, compute the daily, weekly and monthly VaR for a confidence level of 90%, 95%, and 99%. Compute conditional VaR for the same confidence interval
- f) Assume now that you invest total of \$100 M in four assets. Assume you invested %20, %20,%20 and %40 percent your money in JOYG, GOOG,GS and DJ30, respectively. Compute daily, weekly and monthly VaR and CVaR for a confidence level of 90%, %95 and 99%.
- g) Now assume stock prices and index price has log-normal distributions. Using one year mean and volatility measure from the historical data, simulate stock and index prices and find VaR and CVaR for a confidence level of 90%, %95 and 99%.

Question 5 (5 points)

- a) Consider a stock that pays no dividends, has an expected return of 15% per annum, and volatility of 40% per annum. The process for the stock price change is a geometric Brownian motion. If the current price is \$80, what is the process for the change in the stock price over the next business day and next week? What is the assumption implied in your answer, please comment your result.(3 points)
- b) Assume the price in one week is given by $S = \$80e^R$, where R has annual expected value of 20% and volatility of 30%. Construct a 90%, 95%, and 99% confidence interval for S. (2 points)

Question 6 (5 points)

Assume that the following one-factor model describes the term structure of interest rates

$$\Delta r_t = \kappa(\theta - r_t)\Delta t + \sigma r_t^\gamma \Delta z_t,$$

where:

Δz_t is the usual Wiener process, $0 \leq \kappa < 1$, $\theta \geq 0$, $\sigma \geq 0$.

This model becomes the Vasicek model when $\gamma = 0$, while when $\gamma = 0.5$ this is the Cox, Ingersoll, and Ross model.

- a) Simulate both the Vasicek and the Cox, Ingersoll, and Ross models assuming that $r_0 = 5\%$, $\theta = 7\%$, $\kappa = 0.6$, $\sigma = 1$, $T = 126$ (21×6 ; 6 trading months)
Produce your results in a graph.

- b) Simulate both the Vasicek and the Cox, Ingersoll, and Ross models assuming that $r_0 = 5\%$, $\theta = 7\%$, $\kappa = 0.3$, $\sigma = 1$, $T = 126$ (21×6 ; 6 trading months)
Produce your results in a graph.

- c) Comment and compare your results in a) and b).