

**FACULTY OF COMMERCE**

**DEPARTMENT OF FINANCE**

**BACHELOR OF COMMERCE HONOURS DEGREE IN FINANCE**

**RISK ANALYSIS [CFI 4104]**

**PART IV 1ST SEMESTER FINAL EXAMINATIONS DECEMBER 2015**

**TIME ALLOWED: 3 HOURS**

**Instructions to Candidates**

1. Answer any **FOUR (4)** questions.
2. Show **ALL** calculations.

**Information for candidates**

1. The paper consists of **six (6)** printed pages including the cover page.
2. All **six (6)** questions carry **25 marks** each.
3. Standard normal distribution tables are attached at the back of the question paper.
4. Businesses in this paper are intended to be fictitious.

**QUESTION ONE**

(a) The most recent estimate of daily volatility of the US$/£ exchange rate is 0.6% and the exchange rate at 4pm yesterday was 1.5000. The parameter λ in the exponentially weighted moving average (EWMA) model is 0.9. Suppose that the exchange rate at 4pm today is 1.4950. Update the estimate of daily volatility using the EWMA model. **(3 marks)**

(b) Suppose that the current daily volatilities of asset *X* and asset *Y* are 1.0% and 1.2% respectively. The prices of the assets at the close of trading yesterday were $30 and $50 respectively, and the correlation coefficient between the returns on the two assets made at that time was 0.50. Correlations and volatilities are updated using a GARCH(1,1) model. The estimates of the model’s parameters are and For the correlation , and for the volatilities . If the price of *X* is $31 and that for *Y* is $51 at the close of trading today, update the correlation estimate between the two assets. **(8 marks)**

(c) Suppose that the price of gold at close of trading yesterday was $600 and its volatility was estimated as 1.3% per day. The price at the close of trading today is $596. Update the volatility estimate using:

1. The EWMA model with λ=0.94 **(3 marks)**
2. The GARCH(1,1) model with **(3 marks)**

(d) Considering your calculations in (c) above, which estimate provides a more realistic estimate of volatility? Explain your answer. **(3 marks)**

(e) Suppose that λ=0.95 and that the estimate of the correlation between *X* and *Y* on day *n-1* is 0.6. Further suppose that the estimate of the volatilities for *X* and *Y* on day *n-1* are 1% and 2% respectively. The percentage changes in *X* and *Y* on day *n-1* are 0.5% and 2.5% respectively. Update the correlation coefficient for day *n* using the EWMA model. **(5 marks)** **Total = 25 marks**

**QUESTION TWO**

(a) Calculate the total risk of a two asset portfolio given the following composition of the portfolio:

Share Weight Beta Specific risk

A 40% 0.92 12%

B 60% 1.25 10%

Market risk is 11%. **(5 marks)**

(b) You are given the following information on returns and probabilities of occurrence for three securities *A, B* and *C;*

**Probability RA (%) RB (%) RC (%)**

0.25 24 28 4

0.50 12 12 8

0.25 0 4 28

**Required**

Calculate the following;

1. Standard deviation of *A, B* and *C* (**6 marks)**
2. Covariance between *A* and *B* **(3 marks)**
3. Correlation coefficient between *A* and *B* **(2 marks)**

(c) Show that the variance of an individual asset does not matter where one has a well diversified portfolio. Instead, what matters is the covariance between the asset and the other assets in the portfolio. **(6 marks)**

(d) Briefly explain why semi-variance may be considered a better measure of risk than variance when dealing with risk averse investors. **(3 marks)** **Total = 25 marks**

**QUESTION THREE**

(a) Consider a position consisting of a $100 000 investment in asset A and a $100 000 investment in asset B. Assume that the daily volatilities of both assets are 1% and that the correlation coefficient between their returns is 0.3. Compute the 5-day 99% Value-at-Risk (VaR) of this portfolio. **(4 marks)**

(b) The 1-day 99% confidence level VaR for a portfolio held by GGH Asset Managers is $1 million. Assuming returns follow a Gaussian distribution, there is no autocorrelation and mean reversion on the market, scale this VaR figure to a 10-day 95% confidence level VaR. **(3 marks)**

(c) A company entered into a forward contract to buy £1 million for $1.5 million some time ago. The contract now has 6 months to maturity. The daily volatility of a 6-month zero-coupon sterling bond (when its price is translated to dollars) is 0.06% and the daily volatility of a 6-month zero-coupon dollar bond is 0.05%. The correlation between returns from the two bonds is 0.8. The current exchange rate is $1.53/£.

**Required**

1. Calculate the standard deviation of the change in the dollar value of the forward contract in one day. **(3 marks)**
2. Calculate the 10-day 99% VaR assuming that the 6-month interest rate in both sterling and dollars is 5% per annum with continuous compounding. **(5 marks)**

(d) Describe three ways of handling instruments that are dependent on interest rates when the model-building approach is used to calculate VaR. How would you handle these instruments when historical simulation is used to calculate VaR? **(6; 4 marks) Total = 25 marks**

**QUESTION FOUR**

(a) What does it mean to assert that the delta of a call option is 0.7? How can a short position in 1000 options be made delta neutral when the delta of each option is 0.7? **(2; 2 marks)**

(b) Calculate the delta of an at-the-money six-month European call option on a non-dividend paying stock when the risk-free interest rate is 10% per annum and the stock price volatility is 25% per annum. **(5 marks)**

(c) Explain what is meant by the assertion that theta of an option is -0.431 when time is measured in years. **(3 marks)**

(d) What is meant by the gamma of an option position? What are the risks in the situation where the gamma of a position is highly negative and the delta is zero? **(3: 2 marks)**

(e) Does a forward contract on a stock index have the same delta as the corresponding futures contract? Explain your answer. **(4 marks)**

(f) Explain the implications of both a high and a low vega on the value of a portfolio. **(4 marks)** **Total = 25 marks**

**QUESTION FIVE**

(a) The spread between the yield on a 3-year corporate bond and the yield on a similar risk-free bond is 60 basis points. The recovery rate is 40%. Estimate the average default intensity per year over the 3-year period. **(2 marks)**

(b) Given below are average bond cumulative default rates (as percentages) for different rating categories collected by a rating agency:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | |  | |  | | **Years** | |  | |  | |  | |
| **Rating** | | **1** | | **2** | | **3** | | **4** | | **5** | | **7** | | **10** | |
| **Aaa** | | 0.000 | | 0.000 | | 0.000 | | 0.026 | | 0.099 | | 0.251 | | 0.521 | |
| **Aa** | | 0.008 | | 0.019 | | 0.042 | | 0.106 | | 0.177 | | 0.343 | | 0.522 | |
| **A** | | 0.021 | | 0.095 | | 0.220 | | 0.344 | | 0.472 | | 0.759 | | 1.287 | |
| **Baa** | | 0.181 | | 0.506 | | 0.930 | | 1.434 | | 1.938 | | 2.959 | | 4.637 | |
| **Ba** | | 1.205 | | 3.219 | | 5.568 | | 7.958 | | 10.215 | | 14.005 | | 19.118 | |
| **B** | | 5.236 | | 11.296 | | 17.043 | | 22.054 | | 26.794 | | 34.771 | | 43.343 | |
| **Caa** | | 19.476 | | 30.494 | | 39.717 | | 46.904 | | 52.622 | | 59.938 | | 69.178 | |

The questions below are based on the table above:

1. Calculate the probability of a ***B*** rated bond defaulting during the third year . **(2 marks)**
2. Calculate the probability that a ***Baa*** rated bond will survive until the end of year 4 **(2 marks)**
3. Calculate the probability that a ***Caa*** rated bond will default in the fourth year conditional on no earlier default (hazard rate). **(3 marks)**
4. The table above shows that for investment grade bonds, the probability of default in a year tends to be an increasing function of time. Conversely, for bonds with a poor credit rating, the probability of default is often a decreasing function of time. Explain why this is the case. **(4 marks)**

(c) Calculate the loss given default for a loan granted by Bank XYZ to Robust Enterprises given the following information;

Interest accrued to date = $3 million

Recovery rate = 40%

Amount of loan outstanding = $35 million

No-default loan value = $45 million **(4 marks)**

(d) A portfolio has two assets X and Y worth $10 million each. Over the next year X has a probability of default of 8% while Y’s default probability is 15%. Their joint probability of default is 5%. Calculate the expected loss on this portfolio due to credit defaults over the next year assuming a 35% recovery rate for both assets. **(4 marks)**

(e) In measuring the risk of financial assets, in most cases returns are assumed to be normally distributed. Discuss the appropriateness of assuming a normal distribution in measuring the risk of these assets. **(4 marks)** **Total = 25 marks**

**QUESTION SIX**

(a) Suppose a portfolio manager estimates that one week from now his long position in stocks will have an expected profit of $50 000, with a standard deviation of $100 000. Further assume that the probability distribution of the returns follows a normal distribution.

**Required**

1. Calculate the probability that the manager will incur a loss. **(3 marks)**
2. Calculate the probability of realising a profit greater than $80 000. **(3 marks)**
3. Calculate the probability of obtaining a loss greater than $150 000.  **(3 marks)**

(b) Consider an investment portfolio held by a Zimbabwean asset management company which comprises of equities traded on the Zimbabwe Stock Exchange, foreign currencies, properties and bonds. The firm is concerned about developments in the foreign exchange market, the stock market as well as the general global economic environment’s effect on their investments. They have decided to stress test their portfolio using the factor push method. Explain how they would perform the stress test on this portfolio. **(6 marks)**

(c) Stress testing based on historical events often faces the problem of missing shock factors. Briefly discuss how this problem can be handled. **(4 marks)**

(d) Discuss any two limitations of gap analysis as a measure of risk. **(6 marks)** **Total = 25 marks**

**END OF EXAMINATION PAPER**