



# MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

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## UNIVERSITY EXAMINATIONS 2023/2024

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR DEGREE OF BACHELOR  
OF SCIENCE IN ACTUARIAL SCIENCE

### SMS 3464: FINANCIAL RISK MANAGEMENT

**DATE: APRIL 2023**

**TIME: 2 HOURS**

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**INSTRUCTIONS: Answer Question ONE and any other TWO questions.**

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#### QUESTION ONE (30 MARKS)

- A bank charges a 3% per annum all-in-spread (all income in percentage over the funding cost) on a loan. According to the historical data, 50% of borrowers with similar characteristics defaulted when there was an adverse credit scenario, and typically the lenders were able to recover only 40% of loan amount on average once borrowers defaulted in those adverse credit scenarios. What is the Risk- Adjusted-Return-on-Capital (RAROC) of this loan if we use loan loss under 1 percentile value as the estimate of loan risk? (5 marks)
- State the motives and objectives for Basel II (5 marks)
- State how to estimate top — down scenarios with high severity in Stress Testing and Scenario Analysis (5marks)
- Your company's CFO has budgeted \$18 million for capital expenditures during 2000 by your division. Unfortunately, the division has good opportunities to invest much more than \$18 million. The cost of capital is 12%.

| Project | Investment in 2020 | NPV | IRR |
|---------|--------------------|-----|-----|
| Q       | 10.5               | 5.5 | 15  |
| R       | 2.0                | 0.5 | 18  |



|   |     |     |    |
|---|-----|-----|----|
| S | 6.0 | 2.5 | 25 |
| T | 7.5 | 2.0 | 30 |
| U | 1.5 | 1.0 | 26 |
| V | 3.0 | 1.0 | 20 |

Assume the \$18 million budget cannot be increased. Which projects should be undertaken?

(5 marks)

e. State VaR as a measure of risk and highlight its shortcomings.

(5 marks)

f. Define the following risks in relation to financial risk management.

(5 marks)

- i. Operational risk
- ii. Credit risk
- iii. Market risk
- iv. Liquidity risk
- v. Underwriting risk

### QUESTION TWO (20 MARKS)

a. Discuss how are risk weights are to be determined when external ratings assigned by credit ratings agencies and how it differs with when there are no external ratings available.

(10 marks)

b. Should inflation and cross-currency bases be included as a risk factor in the General Interest Rate Risk (GIRR) charge?

(5marks)

c. Should the risk weight for the curvature risk charge be the highest prescribed delta risk weight for each risk class, or should it be the highest prescribed delta risk weight for each of the delta risk factors which are shocked together in order to determine the curvature risk charge?

(5 marks)

### QUESTION THREE (20 MARKS)

a. i. List the key elements of Own Risk and Solvency Assessment (ORSA).

(2 marks)

ii. Critique the following statements:



Under the finite risk horizon approach, the Economic Capital represents the current market value of assets required to ensure that the value of liabilities can be covered at a finite point in the future, at the chosen security level, less the current value of liabilities. Under this approach, a run off projection is still required. (4 marks)

- b. Instruments with optionality are subject to vega and curvature risk charges. Are vega and curvature risk charges also applicable to instruments with no optionality that are hedged by instruments with optionality? For example, convexity adjustments on constant maturity swaps (CMS) and other products can generate significant vega risks, which are hedged using plain vanilla interest rate swaptions which are subject to vega and curvature. (5 marks)
- c. Investment returns ( $\% \text{ pa}$ ),  $X$ , on a particular asset are modelled using a probability distribution with density function:  $f(x) = 0.00075 (100 - (x - 5)^2) - 5K \text{ } x < 15$   
Calculate the 97.5% VaR over one year for a portfolio consisting of £200m invested in shares. You should assume that the return on the portfolio of shares is normally distributed with mean 8% pa and standard deviation 8% pa. (11 marks)

#### QUESTION FOUR (20 MARKS)

- a. Discuss the THREE pillars of the Basel II (15 marks)
- b. There are two pure-discount bonds (i.e., zero-coupon bonds) issued by the same firm, one with one year to maturity, and the other one with two years to maturity. Two bonds have the same seniority in terms of payments (i.e., they have same levels of credit risk). If the issuer defaults, both bonds are expected to lose all the claims on principal and interests. The yield to maturity for the 2-year bond is 10% per annum. The 1-year risk free spot rate is 4%, and the risk-free forward rate in the 2nd year is 4.7% according to the current term structure of interest rates. What is the expected probability of default of the 2-year bond over its 2-year life according to term structure model of credit risk? (5 marks)

#### QUESTION FIVE (20 MARKS)

- a. Table A gives investments, NPVs, IRRs and the first three years cash flow for several capital investment projects. Each project's cash flows continue for several more years, longer for some projects than others. The cost of capital is 12% for all projects.



Table A (figures is in millions).

| Project | Invest in 2018 | $C_1$ | $C_2$ | $C_3$ | NPV | IRR  |
|---------|----------------|-------|-------|-------|-----|------|
| A       | 100            | 20    | 20    | 20    | 57  | 17.8 |
| B       | 200            | 0     | 20    | 40    | 64  | 14.5 |
| Cc      | 50             | 20    | 20    | 20    | 41  | 37.8 |
| D       | 75             | -10   | 10    | 30    | 0   | 12   |
| E       | 30             | -10   | 5     | 7     | -3  | 11   |
| f       | 10             | 3     | 4     | 5     | 5.5 | 30.2 |

Projects A and B are mutually exclusive - your firm can take only one. The projects are discrete you cannot make partial investments in any project.

- i. Suppose the firm rejects all projects with payback periods greater than 3 years. What is the NPV from following this policy? (3 marks)
  - ii. A manager defends the decisions in part (i) as a way to avoid taking on risky projects. Does this defense make sense? (4 marks)
  - iii. Which project would you choose, A or B? (2 marks)
  - iv. Suppose that the firm now identifies a new project AA with exactly the same cash flows, NPV and IRR as project A. Does the opportunity to invest in AA change your answer to part iii? (2 marks)
  - v. Suppose the firm has only \$200 million to invest- a fixed capital constraint. Which projects would you undertake? (Ignore project AA.) (2 marks)
  - vi. Now the firm negotiates a line of credit that allows it to borrow up to \$100 million at 8%. Would access to additional debt capital at a cost of 8% change your answers to questions iii, iv or v? Explain each answer briefly. (2 marks)
- b. You own three oil wells in Vidalia, Texas. They are expected to produce 7,000 barrels next year in total, but production is declining by 6 percent every year after that. Fortunately, you have a contract fixing the selling price at \$15 per barrel for the next 12 years. What is the present value of the revenues from the well during the remaining life of the contract? Assume a discount rate of 8 percent (5 marks)