



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**SCHOOL OF MATHEMATICS AND ACTUARIAL SCIENCE**

**UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE**

**ACTUARIAL**

**3<sup>RD</sup> YEAR 1<sup>ST</sup> SEMESTER 2022/2023**

**REGULAR (MAIN)**

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**COURSE CODE: WAB 2306**

**COURSE TITLE: FINANCIAL ECONOMICS 1**

**EXAM VENUE:**

**STREAM: (BSc Actuarial Science)**

**DATE: 9/12/2022**

**EXAM SESSION: 9.00-11.00AM**

**TIME: 2.00 HOURS**

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**Instructions:**

- 1. Answer question 1 (Compulsory) and ANY other 2 questions**
- 2. Candidates are advised not to write on the question paper.**
- 3. Candidates must hand in their answer booklets to the invigilator while in the examination room.**

## QUESTION 1

- a. Define the following terms
- i. Portfolio **(2MARKS)**
  - ii. Non satiation **(2MARKS)**
  - iii. Risk averse investor **(2MARKS)**
  - iv. Utility **(2MARKS)**
- b. Each year, Mr. Wills is offered the opportunity to invest KSH10, 000 in a risk fund. If successful, at the end of the year he will be given back KSH20, 000. If unsuccessful, he will be given back only KSH5, 000. There is a 50% chance of either outcome. Calculate the expected rate of return per annum on the investment. **(2MARKS)**
- c. List five assumptions underlying mean-variance portfolio theory. **(5MARKS)**
- d. Investor A has an initial wealth of \$100, which is currently invested in a non-interest-bearing account, and a utility function of the form:

$$U(w) = \log(w)$$

Where  $w$  is the investor's wealth at any time.

Investment Z offers a return of  $-22\%$  or  $+28\%$  with equal probability.

- I. What is Investor A's expected utility if nothing is invested in Investment Z?  
**(2MARKS)**
  - II. What is Investor A's expected utility if they're entirely invested in Investment Z?  
**(2MARKS)**
- e. What proportion  $\alpha$  of wealth should be invested in Investment Z to maximize expected utility? What is Investor A's expected utility if they invest this proportion in Investment Z?  
**(2MARKS)**
- f. An insurance company will be required to make a payout of £500 on a particular risk event, which is likely to occur with a probability of 0.4. The utility for any level of wealth,  $w$ , is given by:

$$U(w) = 4,000 + 0.5w$$

The insurer's initial level of wealth is £6000. Calculate the minimum premium the insurer will require in order to take on the risk.

**(5MARKS)**

g. Define first-order and second-order stochastic dominance.

**(4MARKS)**

### QUESTION 2

a. Investment returns (% *pa*),  $X$ , on a particular asset are modelled using a probability distribution with density function:

$$f(x) = 0.00085(110 - (x - 10)^2) \text{ where } -5 \leq x \leq 15$$

Calculate the

- i. mean return **(4MARKS)**
- ii. Variance of return. **(4MARKS)**
- iii. downside semi-variance of return **(4MARKS)**
- iv. Value at Risk (VaR) over one year with a 95% confidence limit for a portfolio consisting of KSH10, 000,000 invested in the asset. **(4MARKS)**
- v. shortfall probability where the benchmark return is 0% *pa* **(4MARKS)**

### QUESTION 3

a. Define the following measures of investment risk:

- I. variance of return **(2MARKS)**
- II. downside semi-variance of return **(2MARKS)**
- III. shortfall probability **(2MARKS)**
- IV. Value at Risk. **(2MARKS)**

- b. Investment returns (% *pa*),  $X$ , on a particular asset are modelled using the probability distribution:

$X$	Probability
-7	0.04
5.0	0.90
8.9	0.06

Calculate the mean return and variance of return.

**(4MARKS)**

- c. The returns from an investment in Jubilee holding insurance are assumed to conform to the fixed rate model with the distribution of rates as specified below:

0.06 With probability 0.2

0.08 With probability 0.7

0.10 With probability 0.1

- I. Calculate the expected accumulated value at the end of 5 years of an initial investment of KSH75, 000. **(2MARKS)**
- II. Calculate the accumulated value at the mean rate of return. **(3MARKS)**
- III. Calculate the variance of the accumulated value of the investment**(3MARKS)**

### QUESTION 3

- a. List three capital investment appraisal methods used to test viability of a financial project. **[3 marks]**
- b. An investor has the utility function  $U(w) = - \exp\left(-\frac{w}{100}\right)$  Determine whether the investor exhibits increasing, constant or decreasing absolute and relative risk aversion. **[5 marks]**
- c. £200 is invested for 12 years. In any year the yield on the investment will be 3% with probability 0.25, 5% with probability 0.6 and 6% with probability 0.15, and is independent of the yield in any other year.
  - I. Calculate the mean accumulation at the end of 12 years. **(3MARKS)**

II. Calculate the standard deviation of the accumulation at the end of 12 years.

**(3MARKS)**

- d. A stochastic model of investment returns assumes that the annual rates of return in different Years are independent and identically distributed normal random variables with mean 8% and Standard deviation 2%. Calculate the mean and standard deviation of the accumulated value, at time 2, of an initial Investment of £10,000.

**(6MARKS)**

#### QUESTION 4

- a. An insurer with initial wealth of KSH2, 000,000 and a utility of  $U(x) = \log(x)$  is designing a policy to cover damages of KSH500, 000 that occur with probability 0.5. Calculate the minimum premium that the insurer can charge for the policy. **(6MARKS)**
- b. Suppose Investor A has a *power* utility function with  $\gamma = 0.9$ , whilst Investor B has a power utility function with  $\gamma = 0.75$ .
- Which investor is more risk-averse ? **(3MARKS)**
  - Suppose that Investor B has an initial wealth of 100 and is offered the opportunity to buy Investment X for 100, which offers an equal chance of a payout of 110 or 92. Will the Investor B choose to buy Investment X? **(3MARKS)**
- c. Consider the two risky assets, A and B, with cumulative probability distribution functions:

$$F_A(w) = w$$

$$F_B(w) = w^{1/2}$$

In both cases,  $0 \leq w \leq 1$ .

- Show that A is preferred to B on the basis of first-order stochastic dominance. **(4MARKS)**
- Verify explicitly that A also dominates B on the basis of second-order stochastic dominance. **(4MARKS)**

#### QUESTION 5

- a. State five assumptions of black Scholes model. **(5MARKS)**
- b. A building society issues a one-year bond that entitles the holder to the return on a weighted-average share index (ABC kenya limited) up to a maximum level of 30% growth over the year. The bond has a guaranteed minimum level of return so that investors will receive at least  $x\%$  of their initial investment back. Investors cannot redeem their bonds prior to the end of the year. The volatility of the ABC Kenya limited

index is 30% *pa* and the continuously compounded risk-free rate of return is 4% *pa*. Assuming no dividends, use the Black-Scholes pricing formulae to determine the value of  $x$  (to the nearest 1%) that the building society should choose to make neither a profit nor a loss. **(15MARKS)**