



JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF MATHEMATICS AND ACTUARIAL SCIENCE

UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE

ACTUARIAL SCIENCE

SPECIAL RESIT 2015/2016 ACADEMIC YEAR

MAIN REGULAR

COURSE CODE: SAC 405

COURSE TITLE: INVESTMENT AND ASSET MANAGEMENT 11

EXAM VENUE: LAB 1

STREAM: (BSc. Actuarial)

DATE: 06/05/2016

EXAM SESSION: 11.30 – 1.30 PM

TIME: 2.00 HOURS

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

1). Three bonds paying annual coupons in arrears of 7% and redeemable at 105 per \$ 100 nominal reach their redemption dates in exactly one, two and three years time respectively. The price of each of the bonds is \$98 per \$ 100 nominal. [7 marks]

(i) Determine the gross redemption yield of the 3 year bond

(ii) Calculate all possible spot rates implied by the information given

2) Explain how expectations theory can be modified by both ‘liquidity preference’ and ‘market segmentation theories. [3 marks]

3). A life insurance firm has the following liabilities: annuity payments of £160,000 per annum to be paid annually in arrears for the next 15 years and a lump sum of £100,000 to be paid in ten years. It wishes to invest in two fixed-interest securities in order to immunize its liabilities. Security A has a coupon rate of 8% per annum and a term to redemption of eight years. Security B has a coupon rate of 3% per annum and a term to redemption of 25 years. Both securities are redeemable at par and pay coupons annually in arrears.

(i) Calculate the present value of the liabilities at a rate of interest of 7% per annum effective. [5 marks]

(ii) Calculate the discounted mean term of the liabilities at a rate of interest of 7% per annum effective. [5 marks]

(iii) Calculate the nominal amount of each security that should be purchased so that both the present value and discounted mean terms of assets and liabilities are equal. [8 marks]

(iv) Without further calculation, comment on whether, if the conditions in (iii) are fulfilled, the pension fund is likely to be immunized against small, uniform changes in the rate of interest. [2 marks]

QUESTION 2

1. An insurance company has liabilities consisting of eleven annual payments of £1 million, with the first payment due to be made in 10 years’ time and the last payment due to be made in 20 years’ time. The rate of interest is 6% per annum effective.

(i) Show that the discounted mean term of these liabilities, to four significant figures, is 14.42 years [5 marks]

The insurance company holds two zero-coupon bonds, one paying £X in 10 years’ time and the other paying £Y in 20 years’ time.

(ii) Find values of X and Y such that Redington’s first two conditions for immunisation from small changes in the rate of interest are satisfied. [5 marks]

(iii) Explain, without making any further calculations, whether you would expect Redington’s third condition for immunisation to be satisfied for the values of X and Y calculated in (ii).

[3 marks]

2. The one year forward rate of interest at time $t=1$ year is 5% pa effective. The gross redemption yield for a two year stock issued at time $t=0$ which pays a coupon of 3% pa annually and is redeemed at 102 is 5.5% pa effective. The issue price at $t=0$ of a three year fixed interest stock bearing coupon of 10% pa payable annually in arrears and is redeemed at par is \$108.9 per 100 nominal

(i) Calculate the one year spot rate per annum effective at time $t=$ [4 marks]

(ii) Calculate the one year forward rate per annum effective at time $t=2$ [3 marks]

QUESTION 3

An economist's model of interest rates indicate that the n year spot rate of interest is $0.1(1 + e^{-0.2n})^{-1}$

(i) Sketch a yield curve based on this formula, indicating clearly the values of the immediate spot rate and the limiting yield on long dated stocks. [4 marks]

(ii) a.) Explain what is meant by the term structures of interest rates. [3 marks]

b) Explain briefly the shape of the yield curve by reference to the liquidity preference theory. [5 marks]

(iii) Assuming that the economist's model is correct, calculate:

(a) The price of a bond, purchased now, paying coupons of 6% annually in arrears and redeemable at par in 3 years time [4 marks]

(b) The par yield for the bond in (a) [4 marks]

QUESTION 4

1. Define the following terms [5 marks]

(i) Arbitrage

(ii) Forward contracts

(iii) Short forward position

(iv) Derivative and give two examples

2. Consider a ten month forward contract on a stock with a price of \$ 50. Assume that the risk free rate of interest (continuously compounded) is 8% pa and the term structure is flat. Also assume that dividends of \$ 0.75 per share are expected after 3 months, 6 months and 9

months. Calculate the present value of the dividends and use it to calculate the forward price
[5 marks]

3. Consider a 6 month long forward contract on a non dividend paying stock. The risk free rate of interest (continuously compounded) is 10% pa, the stock price is \$ 25, and the delivery price is \$ 25. Calculate the forward price (F) and also determine the value of the forward contract. [5 marks]

4. An investor entered into a long forward contract for \$100 nominal of a security eight years ago and the contract is due to mature in four years time. The price per \$100 nominal of the security was \$94.50 eight years ago and is now \$143. The risk free rate of interest can be assumed to be 5% pa effective throughout the contract. Calculate the value of the contract now if it were known from the outset that the security will pay coupons of \$9 two years from now and \$10 three years from now. You may assume no arbitrage. [5 marks]

QUESTION 5

1. An insurance company has liabilities of \$ 87,500 due in 8 years time and \$ 157,500 due in 19 years time. Its assets consist of two zero coupon bonds, one paying \$ 66,850 in four years time and the other paying \$ X in n years time. The current interest rate is 7 % pa effective

(i) Calculate the DMT and convexity of the liabilities. [6 marks]

(ii) Determine whether values of \$ X and n can be found which ensure that the company is immunized against small changes in the interest rate. [5 marks]

2. In a particular bond market, n –year spot rates per annum can be approximated by the function

$0.08 - 0.04^{-0.1n}$ Calculate:

(i) The price per unit nominal of zero coupon bond with term 9 years [3 marks]

(ii) The four year forward rate at time 7 years [3 marks]

(iii) The three-year per yield [3 marks]