



JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF MATHEMATICS AND ACTUARIAL SCIENCE

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

4TH YEAR 1ST SEMESTER 2017/2018 ACADEMIC YEAR

MAIN REGULAR

COURSE CODE: SAC 403

COURSE TITLE: ACTUARIAL LIFE CONTINGENCIES II

EXAM VENUE:

STREAM: (BSc. Actuarial)

DATE:

EXAM SESSION:

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 [COMPULSORY] [30 Marks]

(a) List 4 uses of reserves in a life insurance business. [4 Marks]

(b) Consider an year of death n -year endowment assurance for a sum assured of 1 without profits, payable at the end of the year of death (if this occurs within the term of the policy). There are level premiums of P'' , payable annually in advance for n years until earlier death of the policyholder, who was aged x at the issue date. The premium and reserving basis includes the following allowances for expenses: expenses of e on the payment of each premium, with additional initial expenses of I (so the total initial expense is $I + e$).

Show that the “Zillmerised reserve” required at duration t , just before payment of the premium then due is given by

$${}_tV^Z = (1 + I){}_tV - I$$

where ${}_tV$ denotes the corresponding net premium reserve, i.e

$$\begin{aligned} {}_tV &= {}_tV_{x:\overline{n}|} \\ &= 1 - \frac{\ddot{a}_{x=t:\overline{n-t}|}}{a_{x:\overline{n}|}} \end{aligned}$$

[8 Marks]

(c) In a combined sickness and mortality table

$$K_{x+1} = 554,405, z_x = 1.129, D_x = 24,510, D_{x+1} = 23,425$$

Estimate K_x .

[8 Marks]

(d) A life insurance company has a portfolio of 10,000 one-year term assurances. For each policy, there is a sum assured of Kshs.500,000 payable at the end of the year if the policyholder dies during that year. The company assumes that mortality will be 1%p.a.

(i) Calculate the expected death strain for this policy [4 Marks]

(ii) Given that 89 people die during the year, calculate the actual death strain and hence the mortality profit or loss for this policy. [6 Marks]

QUESTION 2 [20 MARKS]

(a) Show that (i)

$${}_tV_{x:\overline{n}|} = 1 - \frac{\ddot{a}_{x+t:\overline{n-t}|}}{\ddot{a}_{x:\overline{n}|}}$$

[6 Marks]

(ii)

$${}_t\bar{V}_{x:\overline{n}|} = 1 - \frac{\bar{a}_{x+t:\overline{n-t}|}}{\bar{a}_{x:\overline{n}|}}$$

[6 Marks]

b) Consider a whole life policy with sum assured 1 without profits, payable immediately on the death of (x). The policy was issued t years ago by level annual premiums payable continuously throughout life. Derive the formula for the net premium reserve ${}_tV$ (on a given mortality and interest basis)

[8 Marks]

QUESTION 3[20 MARKS]

A life office issues a 3-year without profits endowment assurance policy to a life aged 62. The sum assured of 1,500 is payable on maturity or at the end of the year of death, if within 3 years, and there are level annual premiums of 472.50 payable in advance.

The office uses the following “experience” basis:

mortality: A1967-70 ultimate

interest: 6% per annum

initial expense: 20

renewal expense: 5 at the beginning of the second and third policy years.

The office reserve basis is as follows

net premium method using A1967-70 ultimate mortality and 3% p.a interest.

Determine $(PRO)_t$ and hence calculate the profit signature of this policy.

[20 Marks]

QUESTION 4[20 MARKS]

A life office issues a three year non-profit endowment assurance policy to a man aged 30. The sum assured is 60,000 on maturity or at the end of the year of earlier death. Level premiums of 19,000 are payable annually in advance.

the main office reserves is as follows:

Policy year	Reserve at the end of policy year
1	19,000
2	38,000

The office expects that its life funds will earn interest at 7% p.a over the next 3 years. the office expenses are to be as follows:

initial expenses: 10% of the first year's premium

renewal expenses: 2% of later premiums

Mortality is expected to follow A1967-70 ultimate.

Calculate

(a)the profit signature **[14 Marks]**

(b)the net present value at the issue date of the profit to the office, using a risk discount rate of 10%p.a. **[6 Marks]**

QUESTION 5[20 MARKS]

(a) Ten years ago, a man then aged exactly 30 effected an insurance policy providing sickness benefits of 100 per week for the first six months of sickness, 50 per week for the remainder of the first year and 30 per week thereafter, with benefit ceasing at age 60. Calculate the weekly premium payable to age 50 on the following basis:

Mortality: English Life Table No.12-Males

Sickness: Manchester Unity 1893-97, Occupational Group AHJ

Interest: 4% per annum

Expenses:10% of each premium

[12 Marks]

(b)The man now wishes to alter his policy so that premiums will in future be waived during all periods of sickness. Calculate the revised premium payable assuming that alteration basis follows the premium basis above.

Note that expenses are incurred even when premiums are waived. [8 Marks]