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**University Examinations 2014/2015**

THIRD YEAR, FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR IN ACTUARIAL SCIENCE.

**STA 2390: ACTURIAL MATHEMATICS II**

**DATE: APRIL 2015 TIME:** $2$ **HOURS**

**INSTRUCTIONS:** *Answer question* ***one*** *and any other* ***two*** *questions*

**QUESTION ONE (30 MARKS)**

1. Define $\left.\ddot{a}^{(12)}60!50!20\right⌉$ fully in words and calculate its value using PMA92c20 and PFA92c20 tables for the two lives respectively at 40% interest rate.
2. The future life time of two individuals x and y are independent and subject to constant force of mortality 0.05, 0.06 respectively. Calculate probability that their second death occurs after 3 years but before 8 years (4 marks)
3. Define the following and give their integral expressions;

(i)  (2 marks)

(ii)  (2 marks)

(iii)  (2 marks)

1. Tx and Ty are the computed future lifetimes of two lives aged x and y respectively. Let the random variable g(T) take the following values

$$g\left(T\right)=\left\{\begin{array}{c}\overbar{a}\_{\left.T\_{x}\right⌉} if T\_{x}\leq T\_{y}\\\overbar{a}\_{\left.T\_{y}\right⌉} if T\_{x}>T\_{y}\end{array}\right.$$

1. Determine the benefit which has the present value equal to g(T) (2 marks)
2. Express E as an integral (2 marks)
3. Write down an expression for the variance of $g(t)$ using assurance functions (2 marks)
4. Calculate
5. 
6. p[50];[60] for two independent lives basis. Mortality: AM92 select (3 marks)
7. A policy provides a benefit of 500,000 payable immediately at the death of (y) if she dies after (x)
8. Write down an expression in terms of Tx and Ty (random variables denoting the complete future lifetime of $(x)$ and $(y)$ respectively) for the present value of the benefit order the policy (2 marks)
9. Write down an expression for the expect4ed present value of the benefit in terms of integral (2 marks)
10. Suggest, with a reason, the most appropriate term for regular premiums to be payable over this policy (2 marks)

**QUESTION TWO (20 MARKS)**

1. A life insurance company issues an annuity policy to two lives each aged 60 exact in returns for a single premium. Under the policy, an annuity of Ksh. 10,000 per annum is payable annually in advance while at least one of the lives is alive
2. Write down an expression for the net future loss random variable at the outset of this policy (2 marks)
3. Calculate the single premium, using the equivalence principle.

Basis,

Mortality PMA92C20 for the first life, PFA92C20 for the second life

Interest 40% per annum

Expenses Ignored (3 marks)

1. Calculate the standard deviation of the net future loss random variable at the outset of this policy using the basis in part (ii). You are given that  at a rate of interest of 8.16% per annum (5 marks)
2. A life insurance company issues at annuity contract of a man aged 65 exact and his wife aged 62 exact. Under the contract, an annuity of$ £ 20,000$ per annum is guaranteed payable for a period of 5 years and thereafter during the lifetime of the man. On the man’s death, an annuity of $ £ 10,000$ per annum is payable to his wife, if she is then alive. This annuity commences on the monthly payment date next following, or coincident with, the date of his death or from the 5th policy anniversary, if later and is payable for the lifetime to his wife. Annuities are payable monthly in advance. Calculate the single premium required for this contract.

Basis

Mortality: PMA92C20 for the male and PFA92C20 for the female

Interest: 4% per annum

Expenses: None (10 marks)

**QUESTION THREE (20 MARKS)**

On 1st December 2010, a life insurance company issued 10,000 whole life joint life assurance policies to couples. Each couple was made of 1 male at an age of 60 and 1 female aged 55, when the policy commenced. Under the policy, cum assured of 100,000 is payable immediately on death to the second life to die. Premiums under each policy are payable annually in advance, while at least one of the lives is alive.

Basis: pma92C20 for males and PFA92C20 for females at 40% p.a.

1. Calculate annual premium under each policy (10 marks)
2. Calculate reserves in the calendar year 2010, when
3. Both lives are alive (4 marks)
4. When y dies and x survives (3 marks)
5. When x dies and y survives (3 marks)

**QUESTION FOUR (20 MARKS)**

Two lives, a female aged 60 exact and a male aged 65 exact, purchased a policy with the following benefits;

1. An annuity deferred then years, with 20,000 payable annually in advance for as long as either of them is alive
2. A lump sum of 100,000 payable at the end of the policy year of the first death, should it occur during the deferred period

Level premiums are payable in advance throughout the deferred period or until earlier payment of the death benefit
Calculate the monthly premium

Basis

Mortality Female PFA92C20

 Male PMA92C20

Interest 4% per annum

Expenses Initial 350

 Renewal 2.5% each monthly

 Premium excluding the first

**QUESTION FIVE (20 M ARKS)**

1. (i) Define in words  (3 marks)

(ii) Calculate

1. 

1. The annual premiums payable continuously until the 2nd death for the above assurance in (a) with sum assured of 1,000.

Basis

 for a life aged exact 30 at entry level throughout their life

 for a life aged exact 40 at entry level throughout their life.

 =0.05 throughout

Expenses = Nil (7 marks)

1. Outline the main deficiency of the above premium paying scheme and suggest an alternative (3 marks)
2. A man life aged 52 and a female life aged 50 exact take out a whole life assurance policy. the policy pays a sum assured of 100,000 immediately on first death. Premiums are payable for a period of five years, monthly in advance

Calculate the monthly premium payable

Basis:

Mortality: PMA92C20 (male life) and PFA92C20 (female life)

Rate of interest: 4% p.a

Expenses: Nil (7 marks)