

Michigan State University
 STT 455 - Actuarial Models I
 Final Examination
 Tuesday, 10 December 2013 5:45 - 7:45 PM
 Total Score: 100 points

Name: _____

Section 2

- There are ten (10) multiple choice questions here and you are to answer all questions asked. Each question is worth 10 points.
- Please double check your work as **no partial points** will be granted.
- Please write legibly.
- The Illustrative Life Table (ILT) is attached in the last two pages of this paper.
- Anyone caught writing after time has expired will be given a mark of zero.
- Good luck.
- Have a Happy and Healthy Christmas and New Year!

Question	Worth	Score
1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
7	10	
8	10	
9	10	
10	10	
Total	100	

Question No. 1: (10 points)

For a fully continuous whole life insurance of \$1 issued to (40), you are given:

- Mortality follows De Moivre's (or Uniform distribution) law with $\omega = 100$.
- $\delta = 0.05$
- Premium, based on the Equivalence Principle, is paid continuously at the annual rate of P .

Calculate P .

- (a) 0.015
- (b) 0.021
- (c) 0.023
- (d) 0.025
- (e) 0.031

Question No. 2: (10 points)

A fully discrete whole life insurance of \$100 is issued to (46) . You are given:

- Expenses consist of 10% of annual gross premium in the first year and 4% in subsequent years.
- $A_{45} = 0.15$
- $p_{45} = 0.99$
- $i = 0.04$

Calculate the annual gross premium for this policy.

- (a) 0.67
- (b) 0.70
- (c) 0.73
- (d) 0.77
- (e) 0.80

Question No. 3: (10 points)

For a special fully discrete whole life insurance issued to (50) , you are given:

- The death benefit is \$1,000 plus the return of all premiums paid without interest.
- $i = 0.05$
- $(IA)_{50} = 9.268$
- Based on the Equivalence Principle, the level annual premium for this insurance is equal to \$38.491.

Calculate \ddot{a}_{50} .

- (a) 6.6
- (b) 8.6
- (c) 11.2
- (d) 13.8
- (e) 15.8

Question No. 4: (10 points)

For a special type of whole life insurance issued to (30), you are given:

- Death benefits are 5,000 for the first 10 years and 1,000 thereafter.
- Death benefits are payable at the moment of death.
- Deaths are uniformly distributed over each year of age interval.
- $i = 5\%$
- The following table of actuarial present values:

x	$1000A_x$	$1000{}_5E_x$
30	112.31	779.79
35	138.72	779.20
40	171.93	777.14

Calculate the Actuarial Present Value (APV) of the benefits for this policy.

- (a) 25.90
- (b) 147.25
- (c) 399.28
- (d) 438.08
- (e) 468.42

Question No. 5: (10 points)

You are given:

- $p_x = 0.99$
- $p_{x+1} = 0.98$
- $p_{x+2} = 0.96$
- ${}_4p_x = 0.89$
- ${}_3p_{x+1} = 0.92$

Calculate ${}_2p_{x+1}$.

- (a) 0.960
- (b) 0.963
- (c) 0.966
- (d) 0.969
- (e) 0.972

Question No. 6: (10 points)

You are given:

- $A_{x+20} = 0.40$
- ${}_{20}E_x = 0.50$
- $A_{\overline{x:20}|} = 0.55$
- $i = 0.03$

Calculate A_x .

- (a) 0.05
- (b) 0.15
- (c) 0.25
- (d) 0.40
- (e) 0.50

Question No. 7: (10 points)

Get-a-Life Insurance Company sells 10,000 fully discrete whole life insurance policies of \$1, each with the same age 50. You are given:

- All policies have independent future lifetime.
- $A_{50} = 0.300$
- ${}^2A_{50} = 0.125$
- $i = 0.05$
- Premium is determined according to the portfolio percentile principle, with the probability that the total future loss on the portfolio is negative is at least 95%.
- The 95th percentile of a standard Normal distribution is 1.645.

Calculate the annual premium for each policy.

- (a) 0.0204
- (b) 0.0207
- (c) 0.0210
- (d) 0.0213
- (e) 0.0216

Question No. 8: (10 points)

Consider a life (x) with curtate future lifetime denoted by K . A fully discrete whole life insurance is issued to (x) where:

- The death benefit is \$100.
- Expenses, to be paid at the beginning of each year, consist of 4% of each premium.
- The annual premium is G .
- Denote the discount rate by $d = \frac{i}{1+i}$.

Which of the following is the loss-at-issue random variable?

(a) $\left(100 + \frac{1.04G}{d}\right) v^{K+1} - \frac{1.04G}{d}$

(b) $\left(100 - \frac{1.04G}{d}\right) v^{K+1} + \frac{1.04G}{d}$

(c) $100 v^{K+1} - 1.04 G \ddot{a}_{\overline{K+1}|}$

(d) $\left(100 - \frac{0.96G}{d}\right) v^{K+1} + \frac{0.96G}{d}$

(e) $\left(100 + \frac{0.96G}{d}\right) v^{K+1} - \frac{0.96G}{d}$

Question No. 9: (10 points)

You are given:

- $\ddot{a}_x = 3.65$
- $\ddot{a}_{x+1} = 3.55$
- $p_x = 0.80$

Calculate i .

- (a) 2%
- (b) 4%
- (c) 7%
- (d) 15%
- (e) 20%

Question No. 10: (10 points)

A fully discrete whole life policy of \$100 is issued to (50). Level annual premium is determined with the following expense assumptions:

	% of Premium	Per 100	Per Policy
First year	20%	0.12	2.0
Renewal years	5%	0.07	1.0

Mortality follows the *Illustrative Life Table* with interest rate $i = 6\%$.

Calculate the gross annual premium for this policy.

- (a) 2.0
- (b) 2.6
- (c) 3.2
- (d) 3.8
- (e) 4.4

EXTRA PAGE FOR ADDITIONAL OR SCRATCH WORK