Actuarial Society of South Africa

WRITTEN EXAMINATION

5 OCTOBER 2021

Subject A213 — Contingencies

Time allowed:
Two hours and fifteen minutes – examination time
20 minutes (at the end of the examination) – scan and upload time

INSTRUCTIONS TO THE CANDIDATE

1. *Once you have entered the ASSA Exam Platform, ensure that you have accessed the* ***Video Room*** *Invigilation link with both your camera and microphone on,* ***before you attempt the examination.***
2. *Your PC must be placed, and camera angled, so that your writing area on your desk is visible to the invigilator.*
3. *Ensure that you have your candidate number handy to input* ***as part of the 2 hours 15 minutes examination****. Write your candidate number at the top of each page. (DO NOT WRITE YOUR NAME OR MEMBER NUMBER.)*
4. *Your cell phone that will be used to scan your final answer script must be switched* ***OFF*** *during the 2 hours and 15 minutes examination time. Place your cell phone at the top of your examination pad / writing pages in view of the invigilator.*
5. *You are strongly encouraged to use the first 15 minutes as reading time only, however, you may commence answering the paper whenever you are ready. You then have two hours to complete the paper.*
6. *Questions are only available in the ASSA Exam Platform and may not be printed or copied outside of the ASSA Exam Platform.*
7. *You are required to write your answers on a clean A4 examination pad. Write only on one side of the paper and number your pages.*
8. *Attempt all questions, beginning your answer to each question on a new page and numbering your answers clearly.*
9. *Write in black or dark blue pen.*
10. *You should show calculations where this is appropriate.*
11. *You may not use any other computer program (e.g. Email, MS Word or Excel) or files, nor open any other browser during the examination.*

12. *You MAY NOT make use of a Formulae and Tables book during the examination. Any such information that may be required will be provided to you within the examination.*
13. *Mark allocations are shown in brackets.*
14. *You may use additional scrap paper to make notes where this is appropriate. This paper MUST NOT BE SCANNED as part of your answer script.*
15. *Assume that months are all of equal length, unless otherwise stated.*
16. *At the end of the 2 hours and 15 minutes examination time, you must stop writing and may start scanning and uploading your script.* ***Do not continue writing into upload time****.*
17. *Access to your PC will be opened-up after the examination time so you can access your scanned file. You may now also switch on your cell phone to scan.*
18. *Scan ALL your answer pages to .pdf so that your candidate number at the top of the page is clear.*
19. *Save your .pdf scanned file using your candidate number as file name. (DO NOT USE YOUR NAME OR MEMBER NUMBER AS FILE NAME.)*
20. *Transfer your .pdf script to your PC and click on the UPLOAD ANSWERS link below the examination paper link.*
21. *Upload your answer file into the ASSA Exam Platform and ensure you click on FINISH below the upload box and again on FINISH all and SUBMIT,* ***before*** *the 20 minute upload time is up. (If the status on the summary page indicates "Answer saved" your file was uploaded. You can click on Review attempt to see the file you have uploaded.)*
22. *An option to opt out of the examination will become available one hour after the official examination start time. If you select the Opt-Out option, you agree and understand that your entire script/answers will be deleted and cannot be retrieved at a later stage and that your script or part thereof will not be put forward for marking.*

Note: The Actuarial Society of South Africa will not be held responsible for any late submissions or loss of data where candidates have not followed instructions as set out above.

END OF INSTRUCTIONS

QUESTION 1

Consider an *n*-year term assurance deferred for *m*-years, where a benefit of R1 is payable at the end of the year of death of a life currently aged *x* exactly.

Clearly define a random variable for the present value of this benefit. Define all notation used.

[Total 4]

QUESTION 2

Show that the following approximation holds: $\bar{a}_{x:\overline{n}|} \approx \ddot{a}_{x:\overline{n}|} - \frac{1}{2}\left(1 - v^n {}_n p_x\right)$

Hint: Start by expressing $\bar{a}_{x:\overline{n}|}$ as two continuous whole life annuities.

[Total 4]

QUESTION 3

A medium-sized South African life insurance company sells endowment assurance policies to their clients with death benefits payable at the end of the year of death.

Calculate the expected present value and the standard deviation of the present value of an average policy.

Basis:

Average sum assured	R100 000
Average term	10 years
Average age of a policyholder	35 years
Mortality	AM92 Select
Interest rate	4% per annum effective

[Total 10]

QUESTION 4

A large manufacturing company would like to offer special joint life annuities to its senior employees as a reward for long service.

The annuity of R200 000 per annum is payable continuously in respect of a male and female life, respectively aged 50 and 55 exactly. Payments commence on the first death and continue for three years after the second death.

Calculate the expected present value of this special annuity.

Basis:

Mortality	PMA92C20 for the male life
	PFA92C20 for the female life
Interest Rate	4% per annum effective

[Total 9]

PLEASE TURN OVER

QUESTION 5

An African life insurance company sells increasing term assurance policies to lives aged 45 exactly. The death benefit on the policy is given by the formula:

$(8+t)$ x R50 000 $\quad t = 0, 1, 2, ... n-1$

where t denotes the curtate duration in years since the inception of the policy and n denotes the term of the policy.

Assume that the benefit is payable immediately on death.

Level premiums on the policy are payable monthly in advance for the term of the policy, ceasing on death if earlier.

Due to budget restrictions, the company has embarked on a massive cost cutting exercise in recent months and expects the policy costs to decrease year on year.

Basis:		
Mortality		AM92 Ultimate
Interest rate		4% per annum effective
Expenses:	Initial	R1 000
	Renewal	R120 per annum at the start of the second and subsequent policy years deflating at 1.92308% p.a. effective
	Claim	R300 on death deflating at 1.92308% p.a. effective
Commission:	Initial	25% of the total premium in the first policy year
	Renewal	5% of the second and subsequent monthly premium
Profit loading:		None

i. Express the expected present value of the premiums of a 20-year policy in terms of the monthly premium. Use the expression "P" to denote the monthly premium.

[3]

ii. Calculate the expected present value of the benefits of a 20-year policy.

[6]

iii. Express the expected present value of the expenses and commission of a 20-year policy in terms of the monthly premium.

[6]

iv. Calculate the monthly premium for a 20-year policy.

[2]

[Total 17]

PLEASE TURN OVER

QUESTION 6

i. A company only sells whole of life insurance policies. In general terms, give an expression for the expected profit the company earns over a policy year, for a policy in-force at duration t.

Clearly define all terms used.

[4]

A life insurance company is busy investigating the impact that the Covid-19 pandemic had on its operating profits during 2020.

The company sells 10-year endowment assurance contracts to its clients. Premiums are payable annually in advance. The sum assured payable is structured so that if the policyholder survives to maturity then it is double the sum assured payable at the end of year of death during the policy term.

The company's administration system reflects the following for policies sold to lives aged 55 exactly on 1 January 2020:

Total sum assured payable on maturity for all policies	R20 000 000
Total annual premiums for all policies	R600 000

The company's accounts reflect the following relating to claims in 2020 for the policies listed above:

Total death claims paid during the year	R1 000 000
Total annual premiums for policies claiming	R55 000

The company calculates reserves using the gross premium prospective method.

Calculate the following:

ii. The expected death strain for this portfolio [7]

iii. The actual death strain for this portfolio [4]

iv. The mortality profit or loss during 2020 for this portfolio
Clearly state whether the company made a profit or a loss. [2]

Basis:

Mortality	AM92 Ultimate
Interest rate	6% per annum effective
Expenses	None

[Total 17]

PLEASE TURN OVER

QUESTION 7

An insurer is considering opening a new line of unitised accumulating with-profits contracts.

i. Discussed what is meant by a 'unitised accumulating with-profits contract'.

[2]

ii. Discuss two examples of how the unit price of a unitised with-profits contract could be calculated differently to that of a normal unit linked policy.

[4]

[Total 6]

QUESTION 8

i. Explain clearly what a retrospective gross premium reserve is. [2]

A life insurance company selling whole life insurance policies is considering adding surrender values to their policies to make them more competitive in the market. The company will calculate surrender values on a retrospective gross premium basis.

The company sells policies to clients aged 30 exactly. The sum assured of R500 000 is payable at the end of the year of death. Level premiums are payable monthly in advance for the duration of the contract.

ii. Calculate the surrender value after 20 years for a policy with a monthly premium of R500, using the premium basis below, but using 6% per annum interest rate.

[9]

Premium basis:

Interest rate		4% per annum effective
Mortality		AM92 Ultimate
Expenses:	Advertising	R1 200 at outset of the policy
	Renewal	3% of the second and subsequent monthly premiums
	Claim	R500 on death of policyholder
Commission:	Initial	20% of the first monthly premium

An actuarial student suggests calculating the surrender value using a prospective gross premium reserve (instead of a retrospective gross premium reserve) and using the premium basis, except that an interest rate of 6% per annum effective should be used.

iii. Explain clearly whether this surrender value would be smaller, the same or greater than the surrender value calculated in (ii). No calculations are required.

[4]

[Total 15]

PLEASE TURN OVER

QUESTION 9

i. Define in words the meaning of the following expression: $20\,000\bar{A}^{\,2}_{x:y}$.

[4]

ii. Calculate:

a) $20\,000\bar{A}^{\,2}_{50:40}$

b) the annual premium payable continuously until the 2nd death for the benefit in a).

Basis:
$\mu = 0.05$ for a life aged 40 exactly at entry, level throughout their life.
$\mu = 0.06$ for a life aged 50 exactly at entry, level throughout their life.
$i = 8.3287\%$ p.a. effective
Ignore all expenses. [10]

iii. Outline the main disadvantage of the above premium paying structure to the insurance company and suggest an alternative.

[4]

[Total 18]

[GRAND TOTAL 100]

END OF EXAMINATION

