Course Coverage

Question	Unit	Syllabus Performance Outcome	Learning Objective	Total Marks
1 (a)	2, 3	5, 9	5.2, 9.2	8
1 (b)	2, 3	5, 8, 9	5.1, 8.3, 9.2	6
1 (c)	2, 3	5, 7, 9	5.4, 7.1, 9.2	8
1 (d)	2, 3, 5	4, 5, 6, 7, 10, 15	4.1, 4.2, 5.1, 5.2, 5.3, 6.1, 6.2, 7.1	8
2 (a)	3, 4	8, 9, 11, 14	8.1, 8.2, 8.3, 9.2, 9.3, 9.4, 11.7, 14.1, 14.2	12
2 (b)	1, 2, 3, 4	1, 2, 4, 5, 6, 7, 9, 10, 12, 13	1.1, 1.2, 2.3, 2.4, 4.1, 4.2, 5.4, 6.1, 6.2, 6.3, 7.1, 7.2, 7.6, 9.2, 10.3, 12.3, 13.1, 13.4	18
TOTAL				**60**

Answer TWO questions.

QUESTION 1 **(30 Marks)**

You are the pricing actuary for CanDoIt Ltd, a medium sized Australian life insurer that sells a range of risk and savings products.

CanDoIt has an automated system to calculate the reinsurance premiums that are due on its YRT business, under its current obligatory treaty. Every month this system performs the calculation of reinsurance premiums for the month ahead, i.e. premiums are payable monthly in advance.

As part of a regular audit, you are required to independently calculate the reinsurance premium that is due for the month ahead, to check against the amount generated by the automated system. The reinsurance arrangements currently in place for the YRT business, under the obligatory treaty, are as follows:

- A proportional arrangement with 60% of cover ceded to the reinsurer, with reinsurance premium based on the reinsurer's risk rates;
- A selection discount of 100% is payable in the first year of the policy, but no reinsurance commissions are payable.
- Treaty underwriting limits for maximum sum insured of the original policy are:
    - If no underwriting loadings: $7,500,000
    - Underwriting loadings are 100% or less: $4,000,000
    - Underwriting loadings are greater than 100% but less than 600%: $3,000,000
    - Any policy that is outside these limits is 100% facultatively reinsured.

The reinsurer's risk rates and the profile of CanDoIt's in-force YRT policies can be found in the spreadsheet '2A Exam 2014 Sem 2 Q1'.

a) Assuming that the date is 1-10-2014, calculate the reinsurance premium due under the obligatory treaty for the month of October 2014.

(8 marks)

b) The Board of CanDoIt is particularly concerned with the mortality risk posed by an outbreak of pandemic influenza. It considers that current reinsurance arrangements on the YRT business provide insufficient protection against the extra claims that would arise, should a significant pandemic cause many deaths.

As an initial step to investigate their concerns, you have obtained the following information from a consultant, with regards to the mortality risks posed by a pandemic:

- There is a 3% chance that a pandemic can occur in any 12 month period;
- If a pandemic occurs, there is a 20% chance that standard mortality will increase by 500% for that 12 month period

- If a pandemic occurs, there is an 80% chance that standard mortality will increase by 200% for that 12 month period

Based on the consultant's view on pandemic risk and using the mortality tables provided, calculate the additional claims expected to arise as a result of a pandemic, net of current reinsurance arrangements.

Make your calculations based on the 12 month period starting from 1-10-2014, with expected standard mortality on the YRT business given in the sheet 'standard mortality', in the spreadsheet '2A Exam 2014 Sem 2 Q1'. Justify any assumptions that you make.

(6 marks)

c) The Board of CanDoIt has seen your additional claims risk calculation in (b) above and is now considering what additional reinsurance arrangements could be undertaken to mitigate the risk of extra mortality claims arising from a pandemic influenza.

It is considering three options, one of which the Board will ultimately select to proceed with:

(i) The current YRT reinsurer has offered to extend the current arrangements, to now reinsure 80% rather than 60% of the sum insured of each policy under the obligatory treaty. The rates for the additional sum reinsured would be 115% of the existing reinsurance risk rates.

(ii) Pursuing a non-proportional, stop-loss reinsurance cover.

(iii) Pursuing a non-proportional, catastrophe reinsurance cover.

CanDoIt's Board has requested that you provide a recommendation as to which of the three options above provides the most appropriate reinsurance arrangement for protection against pandemic risk. In justifying your recommendation you should explain why the alternatives are less appropriate than your recommended option.

(8 marks)

d) Other than the additional mortality claims risk, describe other risks that CanDoIt faces from a pandemic. Describe the various risk management strategies and practices it can adopt to mitigate these risks.

(8 marks)

Spreadsheet: 2A_Exam_2014_Sem_2_Q1

SOLUTIONS: QUESTION 1

(a)

First need to check for policies that are outside the treaty arrangements.

Policies with sums insured > $7.5m:

Policy number	Age last birthday)	Gender of life insured	Smoker status	underwriting loading (%)	Date of policy commencement	Sum Insured
773880197	66	male	non smoker		1/02/2004	8,991,000
72180367	35	male	non smoker		1/07/2002	8,987,000
253907705	35	male	non smoker		1/07/2002	8,979,000
611066796	28	female	non smoker	100%	1/10/2004	7,990,800
80442280	36	female	non smoker		1/01/2006	7,980,800
610060821	36	female	non smoker		1/01/2006	7,974,800

Policies with underwriting loadings 100% or less, and sum insured > $4m:

Policy number	Age last birthday)	Gender of life insured	Smoker status	underwriting loading (%)	Date of policy commencement	Sum Insured
27275989	49	female	smoker	50%	1/01/2002	5,992,300

Policies with underwriting loadings greater than 100% but less than 600%, and sum insured > $3m:

Policy number	Age last birthday)	Gender of life insured	Smoker status	underwriting loading (%)	Date of policy commencement	Sum Insured
259639590	36	female	non smoker	300%	1/07/2011	5,996,300

Policies with underwriting loadings of 600% or more:

Policy number	Age last birthday)	Gender of life insured	Smoker status	underwriting loading (%)	Date of policy commencement	Sum Insured
293977429	60	female	non smoker	700%	1/11/2013	452,000
960030423	60	female	non smoker	700%	1/11/2013	104,500
712981304	60	female	non smoker	700%	1/11/2013	96,500

The 11 policies above are assumed to be 100% facultatively reinsured and so do not contribute to the analysis which follows.

For the calculation of the monthly reinsurance premium, see the spreadsheet '2A Exam 2014 Sem 2 Q1 – solutions'. The sheet 'In force Term Life policies' contains the details of the required calculation.

The solution is in cell L3:

Premium for month of October
2,555,972

Marks to be awarded along the following lines:

Identifying and removing policies that fall outside treaty terms:	3 marks
Correctly looking up the correct reinsurance risk rate:	1 mark
Correctly incorporating underwriting loadings:	1 mark
Correctly applying the selection discount:	2 marks
Correct reinsurance sum insured, calculation, translation to monthly premium:	1 mark

To a maximum of 8 marks.

(b)

See the spreadsheet '2A Exam 2014 Sem 2 Q1 – solutions'. The sheet 'Modelling pandemic impact' contains the details of one proposed approach.

This approach assumes that the selection discount has no impact on whether a claim occurs in year 1 or not – both for claims expected to arise in the normal (non-pandemic) state of affairs, and for the scenario where a pandemic occurs. This is arguable either way – certainly it is reasonable to assume that the stated operation of the selection discount in

the reinsurance treaty is a pricing mechanism to allow for expected lower claims to arise in the early years of a policy, but it is not reasonable to say that there will never be any claims in the first year. A reasonable assumption could be that there is a selection impact of 50% in year 1, 20-50% in year 2, and 0% thereafter. A candidate adopting reasonable assumptions for either case ('non pandemic' and 'pandemic' scenarios) should be graded appropriately.

The proposed approach also assumes that underwriting loadings directly correlate to an expected claims risk in the normal (non-pandemic) state of affairs, and that they similarly increase the claims risk for the scenario where a pandemic occurs. In terms of the pandemic risk, this too is arguable. It is uncertain whether having an increased mortality risk is itself proportionately increased compared to a 'clean-skin' life in the event of a pandemic, or whether a pandemic generates more of a risk that is level across all health states. Or, whether it is additive or multiplicative of existing loadings

Given that the pandemic information is worded in a way that aligns with increasing 'standard' mortality by a %, the proposed approach is reasonable, but a candidate adopting reasonable assumptions should be graded appropriately. Again, facultatively reinsured policies are excluded from this analysis as candidates are asked about the impact 'net of current reinsurance arrangements'.

Extra claims expected to arise from pandemic	Expected extra claims
43,627,905	1,308,837

Answers will depend on the interpretation of 'calculate the expected additional claims, over and above that expected to arise from standard mortality experience and net of your current reinsurance arrangements, that could arise as a result of the risk of a pandemic' – as to whether the 'expected additional claims' is conditional upon a pandemic occurring, or is based on the scenario that a pandemic does occur. Both approaches are acceptable.

Marks to be awarded along the following lines:

All calculations based on policies and risk exposure falling within treaty terms:	1 mark
Correctly calculate expected claims in 'standard' scenario:	1 mark
Correctly calculate expected claims in 'pandemic' scenario:	1 mark
Reasonable approach taken/justified to u/w loadings and selection discount:	2 marks
Marginal increase in expected claims specified clearly:	1 mark

To a maximum of 6 marks.

(c)

Candidates are expected to determine and recommend that a stop-loss reinsurance cover is the most appropriate arrangement for the Board's purposes: to mitigate the risk of extra mortality claims arising from a pandemic influenza.

Given that the expected net claims in a non-pandemic year are approximately $17m and the extra retained claims expected to arise from a pandemic, given that it occurs, are approximately $43m (to take total expected claims to $60m) in a 12-month period, a

reasonable stop-loss cover might cover total net claims exceeding $20-25m in a 12-month period, up to a maximum of $40-50m of cover.

In this case, the cover being pursued and the premium being charged is covering the extra claims across a portfolio and across time, which is the main concern of the Board.

The other options should not be given too much attention by candidates.

- Extending the current arrangements to 80% rather than 60%, is simply increasing the reinsurance protection by 1/3 of the existing arrangements. Yet from the calculations in part (b), the additional expected claims risk is 8% (the expected net-of-reinsurance claims in a 12-month period is approximately $16.8m, and the additional expected claims arising from a pandemic is $1.3m). So pursuing this option is covering far more than what is the goal of the Board, and an expected forfeiture or passing on of profit occurs as well – which itself is exacerbated by the higher risk rates being quoted. So this is unlikely to be an appropriate solution, and does not require any additional calculations to have it considered inappropriate.

- A non-proportional, catastrophe reinsurance cover is not appropriate because a pandemic influenza is not likely to be covered by a catastrophe reinsurance cover. However, some judgement required to be made by markers here though, depending on the strength of arguments made by a candidate, due to:

    - Page 171 of the textbook says: 'Another potential cause of adverse experience is catastrophes. For life insurance, catastrophe risk can take the form of pandemics (worldwide outbreaks of contagious diseases such as flu), natural disasters such as earthquakes, terrorist attacks or war. Whilst events causing large numbers of claims are very rare, they can have a major impact on a life company'. Some candidates may interpret this as saying that catastrophe reinsurance would cover pandemics, and frame their answer accordingly.

    - Page 178 of the textbook says: 'A catastrophe is usually defined as one event or occurrence claiming more than an agreed number (a common figure is 5) of lives insured within a given period, usually 24 to 72 hours.

    - Appropriate credit to be given for those who at least consider the appropriateness or otherwise of using catastrophe reinsurance and make justifications for their choices. A typical arrangement would specify (1) the number of lives lost to a particular event in order for a catastrophic event to have occurred, (2) the time frame applying for the definition of a catastrophe, and (3) the financial details of the sizes of losses covered (up to some maximum amount)

    - However, higher marks are only due to those who justify stop-loss being more appropriate.

Marks to be awarded along the following lines:

Identification of stop-loss as the most appropriate cover, with justification: 2 marks

Giving appropriate parameters for the stop-loss arrangement: 1 mark
Identifying and describing the inappropriateness of an extended Quota Share: 2 marks
Reasonable discussion about the appropriateness/operation of Catastrophe cover: 2 marks
Making a reasonable recommendation, consistent with arguments made: 1 mark

To a maximum of 8 marks.

(d)

There are many potential answers here. The following table summarises some major points that a good answer would be expected to deliver.

Risk	Mitigation strategies
Operational and reputation issues: - Sickness and absence of key staff, such as underwriting and claims managers - At the time of increased vulnerability to staff absence, there is likely to be a greater call on their resources for claims - But also for underwriting and sales as life insurers may face increased demand for their products - Delays in claim assessment and payments will impact reputation - Delays in processing new business applications will impact reputation - Additional underwriting challenges in dealing with increased risks	A business continuation plan should be realistic, practical, appreciated and known by staff, and in place well before it is needed. It could cover: - ensuring workers can function from offsite locations or from home - making prophylactics such as face masks and handwashes available - ensuring online processing for all key functions, but planning for alternatives if telecommunications service providers fail; - raising awareness and training staff in advance of how the company plans to react across the spectrum of services: claims, underwriting and asset management. - Management and the Board should ensure they have considered how the company might react under a range of different scenarios, allowing for prompt confirmation of decisions and exercise of authority in real time.
Increased morbidity claims risk, from higher levels of poor health.	- As for mortality risk, appropriate reinsurance support that matches the risk appetite of the Board should be in place

Risks arising from economic impacts: - Business activity decreases, leading to lower investment returns in key asset sectors (tourism, retail, etc) - 'Flight to safety' of investors who turn to cash and bonds, increase in demand for liquidity - Values of savings products may therefore fall, but there may be an increased demand to surrender and cash them in by policyholders - Greater overall market volatility	- Having access to lines of credit for liquidity purposes should an influx of surrenders occur; - Ensuring surrender values themselves are appropriate and not detrimental to viability of the insurer; - Advice on hand to reassure savings product policyholders that the economic impacts may be short to medium term, or having alternative and more conservative products on sale for panicked investors to transfer into - (Use of derivatives etc not likely to be an appropriate risk management strategy for this scenario – not appropriate to enter such arrangements after or during the pandemic event).

Marks to be awarded along the following lines:

Operational/reputation issues – reasonable discussion of risks/mitigation:	4 marks
Increased morbidity claims risk – reasonable discussion of risks/mitigation:	2 marks
Economic impacts on saving products - reasonable discussion of risks/mitigation:	2 marks
Other reasonable points / discussion of risks/mitigation:	maximum 2 marks

To a maximum of 8 marks.

QUESTION 2 **(30 Marks)**

You are a recently qualified actuary who works for the Australian life insurer TakeMyMoney Ltd (TMM). TMM has large volumes of YRT, TPD, Disability Income and Trauma risk products in force, and has a small but growing number of single-premium, inflation-linked life annuities.

The annuities pay annual payments at the end of each year as long as the policyholder is alive at that time. The applicable inflation rate is the previous year's Consumer Price Inflation figure or 3%, whichever is the greater.

TMM's Appointed Actuary has asked you to contribute to the re-pricing of the annuity product, to allow for updated mortality assumptions.

The most recent pricing basis is:

- Expenses:
    - Initial: $500
    - At the time of each payment: $85 plus 0.15% of the payment amount
    - Policy termination (i.e. upon death): $300 at end of year of death
- A simplified reserving basis for establishing reserves at the end of each policy year for a policyholder alive at that time, is given by:
    - 0.5 x [amount of annuity payment just made] x [120 – entry age – policy duration in years]

  (You may assume that this reserving basis aligns with relevant regulatory requirements and cannot be modified).
- Interest = 4% per annum
- The relevant risk discount rate is 5% per annum
- Tax may be ignored
- Inflation: 3.1% per annum
- The profit requirement for TMM is that EPV(profits) / EPV(premium) = 3%.

The relevant mortality data is in the sheet 'Tables', within the spreadsheet '2A Exam 2014 Sem 2 Q2'. This includes the current mortality assumptions and the historical population-level female mortality rates for certain ages, dating back over 100 years.

a) Provide a price for the annuity product, assuming that a 60 year old female takes out a policy that will pay her $40,000 in exactly one year's time, with payments increasing in line with inflation thereafter. You should justify any assumptions that you adopt concerning mortality experience, but for the purposes of pricing this particular policy you may adopt other assumptions as per the most recent pricing basis.

(12 marks)

b) The Appointed Actuary has now asked you for a report on the overall risks posed to TMM by selling this annuity product.

She would like you to describe:

- The types of risk you consider to be material;
- Any potential risk mitigation strategies that TMM may already have in place, or could introduce, to manage those risks;
- The effectiveness or otherwise of each of those mitigation strategies;
- Any issues you would like to draw to the AA's attention arising from Section 6 of PS 200, based on the information you have available.

Give your advice in the form of a report to TMM's Appointed Actuary.

(18 marks)

Spreadsheet: 2A_Exam_2014_Sem_2_Q2

SOLUTIONS: QUESTION 2

(a)

There are 2 main categories to apply marks within in this question.

i. The reasonableness of the worked example
ii. Assumptions and approach towards to mortality

i. The reasonableness of the worked example (7 marks)

One approach is given in the sheet 'Annuity pricing' within the spreadsheet '2A Exam 2014 Sem 2 Q2 – solutions'.

A reasonable solution needs to account for:

Payments increasing with inflation	1 mark
Accurate incorporation of expenses	1 mark
Investment earnings accounted for	1 mark
Reserve calculation in line with stated basis	1 mark
Profit emerging in each year correctly calculated	1 mark
Accurate incorporation of an assumed mortality basis	1 mark
All leading to a reasonable single premium based on the given criteria	1 mark

These mark allocations are a guideline only – the overall reasonableness of a good versus poor attempt at this question will depend on the overall effort made.

To a maximum of 7 marks.

ii. Assumptions and approach towards to mortality (5 marks)

A wide variety of approaches are possible here, with one suggested approach given in the sheet 'Tables'.

The key aspects are to:

Make a reasonable judgement and assumption that historical improvements should be accounted for – this should be justified;
Calculate a chosen historic mortality improvement accurately, and relating it to an annual or otherwise useful rate;
Project mortality on this basis, allowing for these improvements to recur year on year, depending on the assumption made;
Check that the resulting projected mortality rates make sense – i.e. no obvious discontinuities, no strange impacts with older ages having mortality rates lower than younger ages, etc.

Again, an overall mark allocation to be made appropriately – the overall reasonableness

of a good versus poor attempt at this question will depend on the overall effort made and the consistency within it.

To a maximum of 5 marks;

To an overall maximum of 12 marks for part (a).

(b)
A good report should include the following main points:

<u>The types of risk you consider to be material</u>

- Inflation risk is a major issue. The assumption at 3.1% accounts for some exposure to inflation higher than the minimum each year of 3%, but only marginally so, and the risk that inflation exceeds this consistently is relatively high. (3 marks)
- Clearly, future mortality is a major risk. Historical improvements are significant, and there is much uncertainty as to what future mortality will be. (2 marks)
- Expense assumptions are likely to be sensitive to business volumes, which may be very small and/or volatile (1 mark)
- Other risks include: anti-selection in non-compulsory market and claims management (survival checking) (0.5 marks for each valid point)
-

<u>Any potential risk mitigation strategies that TMM may already have in place, or could introduce, to manage those risks</u>

- Introduce a cap on the upper limit of inflation increases per year, say 4-5% (1 mark)
- Reinsurance or securitisation of the longevity risk is possible (1 mark)
- Pricing in the risk of lower mortality, or higher inflation (1 mark)
- There is the potential of a natural mortality hedge with the 'large volumes of YRT policies' currently in force. This means that if mortality rates decrease, which increases the payouts on the annuity, there may be an associated decrease in claims in the YRT business, and vice versa. (1 mark)
- Some projections of various bases can be given to illustrate the differences in the required price should mortality/volumes differ substantially to that anticipated. (2 marks)
- Survival checking process (0.5 marks)

<u>The effectiveness or otherwise of each of those mitigation strategies</u>

- Introduce a cap on the upper limit of the inflation increases per year is reasonable and likely to be in line with market practice, so unlikely to be a risk in itself of lower marketability (1 mark)

- Reinsurance or securitisation of the longevity risk is possible, but will come at a cost and requires a willing risk exchange with another party (2 marks)

- Pricing in the risk of lower mortality, or higher inflation means a higher price than otherwise, which may make it unmarketable, leading to excessive unit expenses and an unviable product (1 mark)

- The potential of a natural mortality hedge with the 'large volumes of YRT policies' currently in force may be limited by the age profiles of each business – YRT business are likely to be sold to younger lives in general, whereas annuities will be sold to older lives. To the extent that mortality impacts (improvements or increases) differ across age, this means the hedge may not be as effective as it otherwise would be (2 marks)

- The robustness of the mortality hedge will also be impacted by the differences in volumes sold – volumes of annuities are low, but volumes of YRT are high, which is a good situation in terms of covering longevity risk on annuity products. (1 mark)

Any issues you would like to draw to the AA's attention arising from Section 6 of PS 200, based on the information you have available

- There is no commission assumption in the current pricing basis. Is this an oversight of a key expense or deliberate due to annuity market operating on some other remuneration model? (for example, fee for advice) (1 mark)

- Required capital is not explicitly accounted for, but annuities are a capital-intensive product. This should be accounted for within cashflow projections, or more explicitly in the risk discount rate adopted. (1 mark)

Marks provided in brackets provide a suggested guideline to overall allocation of the 18 available marks.

Other reasonable points and discussion to be awarded marks as appropriate.

To an overall maximum of 18 marks.

END OF PAPER