# INSTITUTE AND FACULTY OF ACTUARIES

# April 2017

# CA3: Communications
# Paper 2

Time allowed: 2 hours

**INSTRUCTIONS TO THE CANDIDATE**

1. You have 2 hours to complete the paper.

2. You must write your submission from the beginning and not use an imported e-template.

Your file names must include your ARN and each file should also contain your ARN as a header or footer.

Please note that the content of this paper is confidential and students are not to discuss or reveal the contents under any circumstances nor are they to be used in a further attempt at the exam.

If you encounter any issues during the examination please contact the Online Education team at online_exams@actuaries.org.uk  T. 0044(0) 1865 268 255

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You work for ABC Reinsurance, which reinsures life insurance, critical illness insurance and longevity risks from insurance companies. You have received the following email from your manager, Kate:

Dear Rob,

We have been asked by the finance director, Reena, of XYZ insurance to give her an introduction to longevity swaps. As you know, we work with XYZ Insurance closely on the life insurance side, reinsuring their main life insurance product. XYZ Insurance also writes annuity business and the present value of their annuity portfolio is around $1.2 billion. They have never reinsured any aspect of their annuity business, instead treating it internally as a natural hedge against their life insurance business. However, now that they have bought reinsurance to back the majority of their life insurance business it makes sense to consider reinsurance possibilities on their annuity business.

Reena has not considered longevity swaps before and therefore just wants an overview of how they work at this stage. This is a good opportunity to help an important client, and be the first reinsurer to discuss this topic with them. I am unable to make the meeting, so I would like you to give this presentation. Note that Reena is not an actuary, though obviously will be familiar with the insurance sector.

Your presentation should be no longer than ten minutes and should include:

1. A brief explanation of longevity risk – I think you could also show how life expectancy has increased in the past possibly with a chart, and make it clear that future developments are uncertain.

2. An outline of how a longevity swap works – the payments made by the insurance company and those made by the reinsurer.

3. A brief explanation of how the swap would protect the insurance company from longevity risk – perhaps best to illustrate the cashflows on a chart comparing current expectations with an alternative scenario.

I have asked Amit to pull together some background information on longevity swaps and some illustrative figures for you to use. Your presentation should just be an introduction to longevity swaps, – there is no need to discuss what this means specifically for XYZ Insurance. Please ask Reena to contact me if she wants any more information on this topic or to discuss how we could provide her with a tailored quotation.

Kind regards,

Kate

Amit has provided the following information:

**Longevity swaps**

A longevity swap is a mechanism to pass longevity risk (here specifically the risk that annuitants live longer than the insurance company expects them to) from one party to another.

An annuity contract works in the following way:

- The policyholder pays a single premium to the insurance company at the start of the contract (usually when the policyholder retires).

- In return the insurance company commits to paying the policyholder a regular income (usually with monthly payments) until that policyholder's death. Where the policyholder has bought a joint life annuity, an income will be paid to a second life (usually a spouse or partner) should they live longer than the original policyholder.

To determine the income which can be paid on an annuity, the insurance company will make an assumption about how long its policyholders will live for, allowing for the fact that life expectancy is generally expected to increase each year. However, the insurer is exposed to the risk that policyholders live longer than implied by these assumptions. Any increase in actual life expectancy in excess of that assumed by the insurance company, will mean the insurance company pays the income for longer than expected, therefore paying more than expected.

The insurance company may wish to pass this risk on to another party, usually a reinsurer. One way to do this is to enter into a longevity swap with the reinsurer where both parties agree to pay the following cashflows:

1. The insurer will pay the reinsurer a fixed set of cashflows, known as the fixed leg of the swap. This is based on the annuity payments that are expected to be paid to policyholders, as determined at the point when the swap is written, plus a risk fee. The risk fee is usually expressed as a percentage of the expected annuity payment.

2. The reinsurer pays a set of cashflows which will vary with the underlying longevity experience, known as the floating leg of the swap. This payment will equal the actual annuity payments the insurer is required to pay to policyholders. If life expectancy increases faster than expected then over time this amount will become materially higher than expected at outset.

The following example illustrates how this works:

Consider an insurance company that is due to make payments of $50m in 2018 on a closed book of annuities (i.e. no new annuitants will be admitted). This figure will fall over time as annuitants die, and might be expected to be $20m in 2028. However, the $20m figure is uncertain, and could be higher or lower depending on the number of annuitants who die before 2028. By entering into a longevity swap the insurer fixes the future cashflows on the book of annuities for a fee. If the fee is 6%, the insurer will pay known amounts of $53m in 2018, and $21.2m in 2028. The reinsurer will pay the insurer the actual annuity amounts paid out which are likely to be close to $50m in 2018, but could be considerably higher or lower than $20m in 2028.

The insurer will continue to pay the annuities to its policyholders and the transaction between the insurer and reinsurer will consist of the net cashflow arising from the swap agreement. Initially this net cashflow is likely to be a payment from the insurer to the reinsurer in respect of the risk fee.

**Example cashflows**

The indicative figures below illustrate a fixed leg, together with two possible floating legs. The fixed leg assumes a risk fee of 10%, which is probably higher than a typical price, but helps us to illustrate the effect. The two floating legs each show an example of longevity experience as follows:

- expected floating leg – experience in line with expectations

- alternative floating leg – longevity experience at first heavier (more annuitants die than expected), and then lighter (fewer annuitants die than expected)

Figures are in millions of dollars.

| Year | Fixed leg | Expected floating leg | Alternative floating leg |
|------|-----------|-----------------------|--------------------------|
| 0 | 110.0 | 100.0 | 100.0 |
| 3 | 100.0 | 90.9 | 88.8 |
| 6 | 88.8 | 80.7 | 74.7 |
| 9 | 76.6 | 69.6 | 58.7 |
| 12 | 63.7 | 57.9 | 46.9 |
| 15 | 50.6 | 46.0 | 39.1 |
| 18 | 38.2 | 34.8 | 33.7 |
| 21 | 27.4 | 24.9 | 31.7 |
| 24 | 18.5 | 16.8 | 23.8 |
| 27 | 11.7 | 10.7 | 21.1 |
| 30 | 6.9 | 6.2 | 14.8 |

Where the fixed leg is higher than the floating leg, the insurer pays the reinsurer the net amount. Where the floating leg is higher than the fixed leg, the reinsurer pays the insurer the net amount.

**Recent longevity experience**

Life expectancy has increased in recent years. The figures below show the progression of life expectancy for a 60-year-old (averaged over males and females) over the last twenty five years. The figures shown in the table represent the expected age of death for a 60-year-old:

| Year | Cohort life expectancy |
|------|------------------------|
| 1990 | 80.6 |
| 1995 | 81.3 |
| 2000 | 82.5 |
| 2005 | 83.7 |
| 2010 | 84.3 |
| 2015 | 85.6 |

Note this shows the cohort life expectancy, and so represents the life expectancy of a 60 year old in each year, taking account of the future improvements in mortality. For example, cohort life expectancy at age 60 in 2010 would be worked out using the mortality rate for age 60 in 2010, for age 61 in 2011, for age 62 in 2012 and so on. This uses observed mortality rates for past years, but must project mortality rates from the most recently published projections for future years.

**Future improvements in life expectancy**

The following list shows the key factors that are expected to drive changes in life expectancy over the next thirty to fifty years.

Positive factors:

- Improvements in cancer treatments leading to prevention or cure of some cancers. Most particularly immunotherapy which uses the body's own immune system to target cancerous cells.

- Improvements in surgery, such as transplant surgery and implants.

- Breakthroughs in the understanding of the bio-medical ageing process that lead to effective anti-ageing strategies.

- Continued decrease in the prevalence of smoking.

- Increasing mental and physical activities in old age.

Negative factors:

- Increasing drug resistance to known infectious diseases.

- Changes in population health as a result of poor diet.

- Increasing stress levels in the general population.

**All of the figures and information provided is correct for the purposes of the question. There is no need to calculate any further figures for the presentation.**

# END OF PAPER