

# **INSTITUTE AND FACULTY OF ACTUARIES**

## **EXAMINERS' REPORT**

April 2014 examinations

### **Subject CA1 – Actuarial Risk Management**

#### **Paper One**

##### **Introduction**

The Examiners' Report is written by the Principal Examiner with the aim of helping candidates, both those who are sitting the examination for the first time and using past papers as a revision aid and also those who have previously failed the subject.

The Examiners are charged by Council with examining the published syllabus. The Examiners have access to the Core Reading, which is designed to interpret the syllabus, and will generally base questions around it but are not required to examine the content of Core Reading specifically or exclusively.

For numerical questions the Examiners' preferred approach to the solution is reproduced in this report; other valid approaches are given appropriate credit. For essay-style questions, particularly the open-ended questions in the later subjects, the report may contain more points than the Examiners will expect from a solution that scores full marks.

The report is written based on the legislative and regulatory context pertaining to the date that the examination was set. Candidates should take into account the possibility that circumstances may have changed if using these reports for revision.

D C Bowie  
Chairman of the Board of Examiners

July 2014

## **General comments on Subject CA1**

This subject examines applications in practical situation of the core actuarial techniques and concepts. To perform well in this subject requires good general business awareness and the ability to use common sense in the situations posed, as much as learning the content of the core reading. The candidates who perform best learn, understand and apply the principles rather than memorising the core reading.

The examiners set questions that look for candidates to apply the principles specific to the situation set out in the questions, having read the question carefully. Many candidates gain few marks by writing around the subject matter of the question in a more general fashion. Detailed specialist knowledge is not required and nor is very detailed development of particular points.

Good candidates demonstrate that they have used the planning time well to understand the breadth of the question and to structure their answer – this is a big advantage in making points clearly and without repetition. This also enables candidates to use the later parts of questions to generate ideas for answers to the earlier parts.

Time management is important so that candidates give answers to all questions that are roughly proportionate to the number of marks available.

## **Comments on the April 2014 paper**

The general performance was slightly higher than in April 2013. Question 4 was on average less well answered.

The comments that follow the questions concentrate on areas where candidates could have improved their performance. Candidates approaching the subject for the first time are advised to use these points to aid their revision.

**1** *Specify the problem*

The problem is to determine appropriate premium rates that would be suitable for each of the events, all of which are likely to have slightly different risks.

The rates will need to ensure that they deliver an acceptable profit to the company; and are competitive in the market place otherwise little business will be written.

The company will need to bear in mind that it is new in the market and as such has little or no experience of the product.

*Developing the solution*

The company will need a pricing model that can project the future development of this line of business in various circumstances. The model needs to be developed or acquired, or an existing model modified.

The first stage is to determine the assumptions around possible claims.

The actuary will need to consider the possible claims costs that might arise if the festival claimed – this will be considering all the possible risks that could occur and then applying an expected claim amount and also the probability of these occurring.

Risks relating to the music festival could include injury if stage collapses, falls caused by badly maintained grounds (e.g. if very wet).

Will need to consider the additional risks that a firework display could create along with the probability of these occurring. These risks could relate to fire damage or injury caused by the fireworks.

Will also need to understand what exclusions might be included in the policy wording; and the safety controls the individual events would have – this would probably mean that some elements of the festivals would be individually priced.

Judgement will need to be applied as to the extent of any margin for prudence included in the reserving basis. The assumed reserving basis will also be an input to the profit testing of the product.

As this is a new development, the model will be run several times to test the sensitivity of premium rates and profit emergence to changes in assumptions (differing probabilities and costs).

The resultant rates will be compared with those available elsewhere in the market.

*Monitoring the experience*

After each of the festivals the company will want to monitor the experience and whether any claims have been made; and how they compared to the assumptions initially made.

It will then feed this back into the model.

All parts of the cycle will need to be considered in the context of the relevant economic and commercial environment. In addition the requirements of professionalism must be recognised at all stages of the cycle.

If the company is not winning any business it may want to consider revising the assumptions.

If the festivals are claiming significantly more than expected then the company will want to review the assessment of the probability and claim amounts and adjust the assumptions accordingly.

Changes to premium rates offered by competitors will also need to be monitored to ensure the rates do not become uncompetitive – especially if each festival is being priced on an individual basis.

The company may find that it cannot offer a price in the market that is both competitive and makes the required return, and hence might withdraw from the market; equally if the company has not priced the risks sufficiently the company could have issues of claims being way too high.

*Overall, candidates scored well on this question. The better candidates got close to full marks by bringing out a few scenario related points (e.g. new line, festivals, fireworks, etc) in addition to being precise with the basic bookwork. Disappointingly few candidates completed the cycle with feedback from the monitoring stage.*

- 2**
- (i) Inflation  
Short term interest rates  
Fiscal deficit  
Exchange rate  
Institutional cash flow
- (ii) The required return on a conventional bond includes:
- Risk free real yield
  - Expected future inflation
  - Inflation risk premium
  - Credit risk premium and liquidity risk premium

The actual investment return on a conventional bond includes:

- Initial yield
- Capital value change

The required return on equities includes:

- Risk free rate of return
- Expected future inflation
- Equity risk premium

The actual investment return on equities includes:

- income yield (dividends)
- capital growth/(falls)

For any foreign investments, any currency changes will also need to be included.

- (iii) If the stocks in the two portfolios relate to similar underlying entities, then the expectation is for portfolio B to outperform in the long term. Because a given entity's bonds are more secure than its equity so the equity risk premium exceeds the credit risk premium.

But this won't hold if the inflation risk premium is very high.

Also, the underlying entities in A may be less risky than B. Especially as B includes foreign companies' equity so may be broader based.

Or there may be a particularly high liquidity premium in A.

Regardless of expectations, portfolio A will outperform over the next twelve months if bonds perform strongly and/or equities underperform.

This could be due to random market fluctuations.

A fall in bond yields would increase the price of bonds which would increase the return on the bond portfolio.

Lower growth expectations would reduce the value of the equities.

This could happen in a period of economic instability, or falling expectation of inflation.

Changing investor demand (e.g. regulator insist bond better for statutory valuation).

If over the year the expected credit risk reduced there would be an improvement in the return on bonds.

Increased supply of equity, or a decrease in supply of bonds would also affect returns.

Returns could also be affected by the availability of alternative asset classes.

Exchange rates, a strengthening of domestic currency would reduce the return on overseas equity.

Failure of an overseas market could reduce return on portfolio B.

May be different expenses / charges.

*Generally well answered for parts (i) and (ii). However, few candidates gave good answers for part (iii). Better candidates generated valid points by using the formula from part (ii), but then there seemed to be little understanding about how it might be impacted by changes in market expectations.*

- 3** (i) A government can influence exchange rates in a number of ways that will affect both the short term and long term level of the exchange rate.

A government can set the official exchange rate, or set a narrow range within which trades are permitted. This approach is often combined with penalties for trading outside of this range.

Exchange controls to limit the flow of money into and out of a country. This will reduce the volatility of the exchange rate by restricting the flow, and may be backed up with physical inspections and penalties for parties trying to avoid the restrictions.

Other methods used to influence exchange rates include:

- Changing the level of the central bank short-term interest rate. Increasing the rate of return relative to other economies will increase demand for the currency due to the higher interest paid on deposits, or vice versa.
- Increasing the supply of government bonds will increase demand for the currency. A higher yield may be needed to attract international investment flows.
- Quantitative easing – the central bank buying national government bonds. The reduction in supply of government bonds/increase in demand will lower yields; which will lower the exchange rate by reducing demand for the currency, i.e. funds will invest in assets in other currencies offering a higher return.
- Printing money will also lower the exchange rate by reducing demand.
- Central bank buying or selling holdings of other currencies. The central bank can use reserves to buy or sell holding of other currencies to increase or reduce the exchange rate.

Indirect ways to influence exchange rates include:

- Providing trade financing to national companies for exports. This will increase the exchange rate by stimulating economic activity and increasing demand for the currency to settle the bills for goods.
  - Stimulating the economic activity, particularly purchases of goods and services in the national economy. Increased imports will increase demand for other currencies (paying for the cost of imports).
  - Encouraging mining of raw materials. This will increase demand for the national currency either directly if the raw material is priced in the national currency, or indirectly if priced in another currency and the earnings used to buy the national currency.
  - Encouraging investment from overseas companies. The overseas investment in the national economy will increase demand for the local currency.
- (ii) A reduction in the exchange rate relative to other currencies will have the following effects on the local economy:

Domestically produced goods and services will reduce in price relative to overseas produced goods and services. This will increase the relative demand for locally produced goods and services stimulating economic activity within the local economy. Imports will reduce as their price will increase relative to domestically produced goods.

Exports will increase as their price will reduce relative to goods/services produced in overseas countries, increasing economic activity. This could lead to reduced unemployment.

Goods produced using raw materials either imported or priced in another currency will increase in cost. This offsets the benefit of a lower exchange rate.

Inflation will also increase due to overseas produced goods and services being more expensive.

If short-term interest rates have been reduced to cause the reduction in the exchange rate then this will stimulate the local economy by reducing the cost of borrowing.

Investment from overseas is likely to increase, local companies cheaper to takeover, goods and services produced in local economy are more competitive.

If further depreciation of the local currency is expected, then countries dependent on funding from international capital markets may have to increase yields to attract investment flows putting upward pressure on exchange rate.

Profits remitted from overseas investments will increase (when converted into domestic currency).

*It was surprising that candidates did not score higher on part (i) given that it was a straightforward economic question – many simply didn't suggest enough points for the marks available. On part (ii) most did quite well; a minority got the question the wrong way round but we gave some credit for valid discussion.*

**4** (i) The first step is to consider the cashflows for the project.

Inflow will be the contract fee if paid at twelve months if the project is completed, which depends on external factors such as weather conditions.

Outflows are capital outlay and expenditure such as wages, the cost of materials and transport costs for goods and equipment.

Some of these will be certain with a known value and timing. Where others will be uncertain or subject to variation.

Cashflows would be adjusted for tax.

These cashflows can be built into a model, either statistically distributed or of different scenarios each with a probability of occurrence. And actuarial techniques can be used to assess the probability of delays, cost overruns, etc.

Actuarial risk management techniques can be used in the project assessment e.g. use of risk register.

- Monitoring progress and establishing back-up plans in the event of adverse experience.
- Identifying and analysing key risks and use of mitigation such as insurance.

The model will allow for the impact of such techniques.

The Net Present Value could be used to price the project. This would determine the expected present value of the project.

The contract fee could be set to a level which ensures a positive value on a suitable discount rate. This is equivalent to setting the contract fee to achieve an appropriate internal rate of return.

Payback period and discounted payback period are not applicable for this project as the payment date is known.

In assessing the project the key assessment will be whether the project can be completed within twelve months.

Need to allow for scenarios where it takes longer – effectively the risk of this happening will push up the contract fee to quote. Although in these scenarios the firm can stop work at the point the deadline becomes unachievable so restricting costs.

The project / contract fee would also need to be assessed relative to the possible contract fee that may be offered by competitors. And also the alternative uses for the capital and construction resources, the opportunity cost.

May also consider if it is possible to build a relationship with the government based on this contract. Particularly if there may be more projects available which the firm may wish to tender for.

More fundamental checks would also be needed, which may determine if the firm is able to consider taking on the work. For example, if there is sufficient expertise and resource to take on the project with a reasonable probability of success.

The firm must also consider if this is compatible with any other projects currently being undertaken.

- (ii) The existence of an early completion fee increases the potential value of the project.

This is because while it may increase the potential pay-out there are no circumstances where it would decrease the contract fee.

For the existing analysis the increase in value would be for any scenario where the project is completed in less than twelve months.

However, there may also be other implications of this early completion fee for the pricing of the project.

For example, if a firm was basing projections on completing work two weeks early, they could (potentially) quote a contract fee which is 10% lower. This would mean that when they complete early they would get the contract fee required.

Alternatively the structure of the project could be changed.

For example, considerable additional resource could be sourced to aim for a six month completion date. This would considerably increase the fee from the project which may compensate for the cost of additional resource.

Any setbacks, e.g. delays due to weather, would have a materially greater downside if the project was structured this way.

This may also reward a firm if it was willing to commission overtime, weekend working, or more advanced working practices.

There may be additional competition due to the increased compensation.

*Quite a wide range of marks on this question. Good candidates scored highly on part (i) by tailoring their answers to the question (i.e. payback period and discounted payback period not being relevant and the discount rate not being a huge issue due to the short project). Part (ii) was generally less well answered, especially by candidates who had struggled with part (i).*

**5** A defined benefit (DB) scheme is a scheme where the rules define the benefits independently of the contributions payable, and the benefits are not directly related to the investments of the scheme. The scheme may be funded or unfunded.

A defined contribution (DC) scheme is a scheme providing benefits where the amount of an individual member's benefits depends on the contributions paid into the scheme in respect of that member increased by the investment return earned on those contributions.

### **Benefits available**

For the DB scheme, the individual will need to know the full details of the benefits promised. For example, how the benefit is linked to salary, how it relates to period of employment; whether the benefit will increase with some form of inflation.

There will, however, still be a risk that there may be insufficient funds available to provide this promised benefit and the individual may wish to investigate this. This may be as a result of:

- insufficient funds having been set aside, i.e. underfunding
- the insolvency of a sponsor or provider of the benefits
- the holding of investments which are not matched to the liabilities

If the scheme belongs to a protection fund, the individual may receive benefits even in the above circumstances. There is, however, the risk that the benefits will now be much lower than those promised.

There is a risk that the sponsor is taken over by a third party unwilling to continue to sponsor the benefits.

There is the further risk that the benefit promise is changed. Legislation will usually prevent a worsening of benefits that relate to past periods, unless the beneficiary agrees to the change. Changes can, however, be made to future promised benefits; these could vary from a change to salary definition to the withdrawal of the defined benefit promise.

For the DC scheme, the individual should consider what choices are available – in relation to the investment funds available; and as to the types of annuity or other forms of drawing benefits after retirement (e.g. relating to index linking, dependants covered, etc.).

The individual will want to compare the projected benefits. There is a risk that the level of the benefits will be lower than expected if the investment return is lower than had been anticipated, or if any expense charges deducted are higher than was expected. The individual may wish to investigate the likely range of net investment returns. It is also possible that the investment return will be higher than expected.

The level of benefits will also depend on the level of annuity that could be purchased. This will depend on the time of retirement and choices made. If the terms are worse than had been anticipated, this will reduce the benefit. Again, it is possible that the terms are better than anticipated leading to a higher benefit.

For both DB and DC, the individual will also want to know details of any death in service benefits and ill health retirement arrangements.

### **Contributions**

For both schemes, the individual will need to know how much they are expected to contribute; and whether this is likely to change in the future; and if there is flexibility to increase (or reduce) contributions.

For the DC scheme, they will want to know how much the employer will contribute and whether this depends on their own contributions.

### **Individual circumstances**

Will need to consider:

- the number of years until the expected retirement of the individual,
- the number of years they expect to be with the employer
- any dependants they have (now or may have in the future)
- their health status
- the individual's other pension and financial arrangements
- how much they can afford to contribute
- their capacity to bear the risks of either arrangement
- their wish to have control over the investment

The individual will also want to know whether the decision can be reversed.

The individual will also need to consider the arrangements of each fund for transferring in any benefits from their previous employment.

Will also need to know the arrangements for each fund if the individual leaves the company.

*A wide variation of marks on this question. Many candidates generated a reasonable number of points from standard bookwork issues. Better candidates went on to develop the comparison with specific examples, e.g. what risks the individual would face in either arrangement.*

- 6 (i) Different levels of cover e.g. overseas cover, illness as well as death.  
Geographical location is not the same.  
Business mix is different e.g. policy size.  
Markets targeted are not the same e.g. higher/lower socioeconomic groups, niche market.  
Different distribution channels.  
Varying underwriting levels and rating factors.  
Different claims control procedures.  
Different levels of monitoring experience and hence revising bases.  
May be random fluctuations for competitors if they are smaller companies.  
Reinsurance program differences.  
Claims reporting.

- (ii) Limit the sum assured.  
Limit the term.  
Limit age at entry.  
Limit to specific distributors.  
Target certain markets and only offer the product to them.  
Ensure the appropriate questions are asked on the proposal form.  
Suitable policy conditions e.g. claim not valid if die within a few months.

- (iii) The life insurance company has no experience in this reduced underwriting and so may benefit from reinsurance by using the reinsurers technical assistance.

There will be very few questions for the new product so it is essential that they pick up the required information. The reinsurer may have helped design similar question sets for other insurers.

On top of this the reinsurer may comment on the target market and the level of premium to charge.

Mortality risk will also need to be protected against i.e. more deaths than expected.

Amount of reinsurance will depend on the life insurance company's attitude to risk.

This is a new product and the company will have not had experience in pricing such a product nor will they have experience data.

Until experience and data has built up it may be that the life insurance company will want to share a large amount of this new business. Quota share would match this need.

There is also the risk of one off large claims.

Surplus reinsurance would be suitable for this, with claims over a maximum amount being passed to the reinsurer.

This also allows the life insurance company to offer larger policies, which they may want to do e.g. IFA channel sell larger policies, to those in higher socio economic groups who have lower mortality.

Another reason for reinsurance is to facultatively accept policies i.e. those in very large sum assured bands (although this would be unlikely for this product).

Catastrophe reinsurance will protect against a large number of deaths e.g. due to a bad strain of norovirus.

If there is a risk of accumulations then the life insurance company may want aggregate excess of loss reinsurance.

In writing the new product, the life insurance company will need to tie up large amounts of capital.

For example in research and development, processing the policies and setting up reserves.

Reinsurance can help to alleviate this strain by allowing lower reserves to be held. This will depend on the existing level of free assets. This should allow the insurance company to write more business.

Financial reinsurance may be able to be used to increase assets.

Reinsurers will also help with staff training and if necessary may spend time with the insurer over the launch period.

The board and shareholders will want stability of profits; excess of loss would be suitable. And will also allow stable dividends.

- (iv) (a) Initially a cost benefit model will be needed. Projecting cashflows over the next say 10 years.

Vary retention levels and/or proportion reinsured, depending on product to see the effectiveness of each product.

Realistic assumptions will be needed: expected future claims, based on past experience.

- (b) Existing relations.

Technical ability – from actuaries to claims specialists.

Size of team. Is the team sufficiently large enough that they can deal with unexpected developments?

Ability to “loan” staff. For instance during launch the life insurance company may need extra underwriting help for a couple of weeks.

Costs – from commission to direct expenses.

Company credit rating. Would want to give the business to a reinsurer with a higher credit rating thus reducing the risk of default.

Ability to offer financial reinsurance and on good terms. Some reinsurers may not have sufficient reserves to offer financing deals.

Product most likely to protect solvency and profit stability against large claims (QS not so effective).

Capacity and willingness to accept the business. If a reinsurer already has high exposure to a particular market they may not offer such good terms, if at all.

*Part (i) was answered well by most candidates. Part (ii) was often not so well-answered. On part (iii) most candidates used the bookwork on reinsurance to pick up a reasonable number of marks but many didn't answer at sufficient length to score very highly. Part (iv) was often poorly answered with candidates not discussing how to model the costs and benefits of reinsurance.*

- 7**
- (i) Potential good profit  
Diversification  
Lack of competition  
May have links with this country  
Ethical reasons
  - (ii) For example:
    - Term life insurance or funeral products
    - Health insurance
    - Disability insurance
    - Property insurance
    - Livestock or crop insurance
  - (iii) The company will monitor its experience as part of the actuarial control cycle to check whether the method and assumptions adopted for financing the benefits are appropriate; both for premium setting and reserving.

This is new business in a new country so there will have been limited data to base the assumptions on at the outset.

Information for management will be needed. The company will need to know whether the claims and expenses have been as expected. It will also need to know if the volume and mix of business has been as expected.

This information will be needed as soon as possible. If the assumptions were not appropriate, the company will need to consider what changes could be made in order to achieve the desired objectives.

- (iv) For statistical factors, such as claims frequency/severity and lapses, the company will need a reasonable volume of stable, consistent data. The data available may be limited and may not be reliable. The company will need to ensure that the data it is using in the analysis is valid. The company will also need to analyse new business e.g. volumes and levels of premiums.

The data ideally needs to be divided into sufficiently homogeneous risk groups, according to the relevant risk factors. However, this ideal has to be balanced against the danger of creating data cells that have too little data in them to be credible. As the business is new and policies will have been in force for a maximum of one year; then there may have been relatively few claims, and not all claims will have been finally settled; so a credible full analysis of the claims experience will not be possible.

In practice the level of detail in the classification of the data depends upon the volumes of data available. The volume of data will not only indicate whether or not an analysis will produce meaningful results, but it will also indicate the extent to which data can be subdivided without leading to problems. For example with life insurance, it may be necessary to group data on deaths into, say; five-year age bands rather than single year bands.

As well as data on the feature being assessed, it is necessary to have data on the exposed to risk; divided into the same cell structure as the experience data. An analysis of experience is not valid unless experience and exposed to risk are matched.

Once the data have been grouped in an appropriate manner, the analysis can be performed.

The analysis will involve the calculation for each data group of the number of claims divided by the number exposed to risk; and also of the average claim amount per claim. The results can then be compared with the assumptions adopted; to determine whether there is a significant difference; and also compared with other relevant standard tables to determine if they appear to be more appropriate for this business.

Economic factors should also be analysed but are also in general outside the management's control. The main economic factors for an insurance company are interest rates and the investment returns of various sectors. For these the analysis is simply a comparison between the actual returns and those assumed. The effect of the difference between actual and expected can be calculated by re-running the expected experience model using the actual economic experience items.

- (v) The results of the analysis of experience should not be used blindly.

Consideration should be given to whether the period under investigation was typical and whether the experience is likely to be representative of future experience.

Given that this is new business in a country without a developed insurance market this is unlikely to be the case. As the company has only been writing business for one year, the period under investigation is unlikely to be typical of the future. There is unlikely to be sufficient data to give an indication of future trends. This year may have been affected by abnormal events or by significant random fluctuations.

The volume/mix of business may not represent likely future experience – either unusually low because of lack of customer awareness/confidence in insurance; or unusually high because of significant demand previously unsatisfied.

The withdrawal experience may not be typical. There may have been a poor understanding of the products initially which may have led to a high withdrawal rate.

It may have been difficult to access the data needed for monitoring. The data that has been obtained may not be accurate.

It may not have been possible to split the analysis into sufficiently homogeneous groups.

The individuals to whom the investigation related may not be typical of the individuals whose benefits will be affected by future experience.

*Parts (i) and (ii) were both generally well answered. On part (iii) better candidates tied the bookwork back to the question. On part (iv) many candidates wasted time by answering why you would do an experience analysis instead of how. Part (v) was generally reasonably well answered.*

## **END OF EXAMINERS' REPORT**