

**Subject CA1 — Actuarial Risk Management  
Paper Two**

**September 2009 Examinations**

**EXAMINERS REPORT**

**Introduction**

The attached subject report has been written by the Principal Examiner with the aim of helping candidates. The questions and comments are based around Core Reading as the interpretation of the syllabus to which the examiners are working. They have however given credit for any alternative approach or interpretation which they consider to be reasonable.

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Chairman of the Board of Examiners

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**Comments for individual questions are given with the statistics that follow**

General comments

*This subject examines applications in practical situations 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 main weakness that candidates continue to show is an inability to answer the question that the examiners asked, having read the question carefully. Too many candidates write around the subject matter of the question in more general fashion, and gain few marks. Good candidates demonstrate that they have used the planning time well - an attempt to get a logical flow is a big advantage in making points clearly and without repetition.*

*The notes that follow are not to be interpreted as model solutions. Although they contain the majority of the points that the examiners were looking for, they also contain more than even the best prepared candidate could be expected to write in the time allowed in the examination room.*

1

- a change in their liabilities
- a change in the regulatory or tax regimes
- uncertainty in the political climate
- fashion or sentiment altering
- sometimes for no discernible reason
- marketing
- investor education undertaken by the suppliers of a particular asset class
- a change in the asset valuations
- a change in their risk appetite
- change in wealth/personal status
- availability of new investment products

*Answered well in general. Many focused solely on individual investors. Others gave more description than needed for a list question, or repeated the same points in different words.*

2

Loans between commercial organisations will require higher returns than those involving the government because there is a greater risk of default. The risk margin is generally low in short term money markets because the borrowers are regarded as very secure and the short term reduces the level of uncertainty. Hence the gap between base and commercial rates may widen when the risk of a commercial loan rises relative to “risk free” loans involving the government.

The government may change the base rate for political reasons e.g. to stimulate growth. A commercial lender may choose not to pass this on for commercial reasons.

In times of economic downturn or uncertainty risks relating to even the highest quality borrowers can rise.

Commercial banks are the most active players in the money markets. If the banking sector in general starts to make losses or has to write down a significant portion of their assets (e.g. bad debts), then loans to banks become more risky and interest rates on such loans will rise.

Some banks have a track record of inappropriate investing and lending that has led to the destruction of capital. Essentially they tend to lend too much to borrowers who can't repay or buy assets that are overpriced and/or they don't understand. This will lead to relatively high money market rates.

Often, it is the fear that things will go wrong that causes rates to rise rather than actual losses or write downs. In particular, uncertainty over asset values shown in banks' balance sheets can lead to a perception of greater risk.

Credit crunch. Returns are set by supply and demand. In difficult times for banks, they may be unable or unwilling to lend money. Funds are needed to shore up their own capital positions. This lack of supply or liquidity means that loans become more expensive.

Governments or central banks may not be able to provide the liquidity needed. Even if they could, banks may choose not to make such funds available for commercial loans.

In times when banks have been unwise, it is possible that tighter regulations would be introduced, which implicitly or explicitly constrain banks' ability to lend so pushing up rates.

*We were looking for application of basic principles to a topical scenario. Weaker candidates commented that rates may go up or down without addressing the widening of the gap.*

3

- (i) Credit risk is the risk of failure of third parties to repay debts.  
A credit rating is given to a company's debt by a credit rating agency as an indication of the likelihood of default/credit loss
- (ii) Credit risk can be reduced by ensuring lending is of a high quality and that the nature of the bonds is appropriate to the fund and the level of available expertise.  
Need to consider continuing monitoring  
Does the company have a good reputation — is it a known, competent company with high quality personnel?  
  
Are there any concerns about the sector?  
Will need to ensure that the investment fund does not have too much exposure to any single bond or counterparty or to a particular sector?  
Are there any risks due to the country, currency, environment, resource or technology?  
Are there any moral or ethical issues? Either of concern to the investment fund or others in the market as this may affect marketability.  
Will also need to consider the amount of debt finance (the issue being considered and any prior ranking debt). Is this amount reasonable in the circumstances?  
Can the debt be serviced and repaid? How safe is the source of repayment? Income and capital cover can be considered.  
Any security will enhance the lenders position. This must be realisable in a cost effective manner.  
The credit rating of the company can also be considered.  
Also need to consider term of investment  
Can the risk be reduced by some form of insurance? Such as credit default swaps
- (iii) A published rating is the rating considered appropriate by the agency at a particular point in time. The conditions of the company may change and this may lead to a change in the rating. The rating may not be adjusted quickly enough.  
There could, therefore, be a period of time when the rating is incorrect and so it is important to consider the circumstances of a company along with the credit rating.  
Other information could also be useful, eg relating to the probability of default or greater granularity than the published rating "buckets".

The rating agency may be too close to the company management and this may affect the rating given.

The credit rating agency could make an error of judgement or may not have complete information.

*This question was generally well answered, though many did not make sufficient points in (ii) for the marks available.*

4

Essentially there are three groups of reasons to look at: change in basis, inter-valuation experience and actions taken as a consequence of the previous surplus.

### **Basis**

Had the most recent valuation been carried out using the previous methods and assumptions, the result would presumably have been different.

Hence, by comparing valuations run on each basis, it will be possible to see how the current deficit would have been different on the previous basis.

Changes in the Supervisory Basis could take a variety of forms.

The basis may have changed to reflect expected future experience. That is, the underlying principles are unchanged but “realistic” assumptions are now different. Those assumptions with the most negative impact would be lower real (versus inflation or salary growth) investment returns or lower mortality rates post retirement.

Alternatively, there may have been a more fundamental change in approach. Previously there could have been scope for a degree of discretion in the choice of assumptions. Now the assumptions may be more tightly proscribed. Hence, the Actuary’s view at the previous valuation may have been at the more optimistic end of the range allowed.

The previous basis may have used a long-term stable assumed rate of return (and associated assumptions). The new basis may be market related. Or vice-versa.

The new basis may require assumed future investment returns to be linked to the underlying assets held or those that the regulator determines should be held given the liability profile. Hence any assumed extra returns that could be warranted by holding a relatively high proportion of equities may no longer be valid. The regulator may take the view that bonds are the most suitable match for the bulk of the liabilities.

The methods that are allowed may be more conservative. Alternatively, the treatment of discretionary benefits could have been tightened up - perhaps the current basis requires past practice to be allowed for in the valuation

### **Experience**

The experience over the inter-valuation period may have been financially detrimental relative to that assumed on the previous basis. In particular:

Asset values may have fallen (or returns been lower).

Linked to this, taxation privileges on certain asset classes may have been reduced leading to lower actual and expected returns. This could also be a basis issue.

Inflation or salary growth could have been higher than anticipated.

The pattern of mortality could have been adverse e.g. a lot of high death in service benefits paid or not enough pensioners dying.

The withdrawal experience could have been adverse. Either fewer than expected if withdrawal benefits are relatively low or leavers with more generous benefits than were funded for e.g. on a bulk transfer using a share of fund method.

There could have been a redundancy or early retirement exercise that led to augmentations of benefits e.g. a more generous approach to eligibility for ill-health benefits.

There may have been transfers in with insufficient assets.

Options or guarantees may have bitten.

The expenses of running the scheme could have increased. Either ongoing expense due to for example more onerous legislation to be complied with (requiring more professional advice) such as levies to a compensation fund. Or, one-off measures such as a new computer system.

## **Events**

The surplus disclosed at the previous valuation could have been spent so naturally reducing future surpluses.

The benefits for members could have been improved either with a one-off cost e.g. a special increase to pensions in payment or with ongoing implications e.g. an improvement in the accrual rate. Clearly there may be other reasons for benefit improvements (competitor pressure or legislation say) but a surplus makes such improvements more feasible.

There may have been a suspension of contributions (employer or, less likely, employee) to the scheme.

Some of the surplus may have been refunded to the employer.

Legislation may stipulate that tax must be paid on any surpluses arising on the Supervisory Basis (or on refunds to employers).

May have been unanticipated expenditures – possibly fraud, or (for example) charitable donations e.g. to associations set up for the benefit of current and former employees — sports clubs etc.

There may have been legislative changes. For example leaving service benefits may have been improved or guaranteed increases to pensions in payment introduced.

There may have been data errors in the previous valuation that have now been corrected.

*The better answers followed the approach set out above (as pointed to in the question) and broke it down into distinct sections, so reducing the risk of becoming confused and repetitious. Weaker candidates did not clearly distinguish between changes in the assumptions for the future and experience not equalling the assumptions in the past.*

5

- (i) At a fundamental level, risk relates to the chances and consequences of an institution failing to meet its objectives.

These objectives are generally expressed in relation to stakeholders in the institution.

Primarily these stakeholders consist of investors (owners and creditors) and customers. Other significant stakeholders could include employees, the government and regulators. In many cases, the interests of stakeholders could conflict. Or, stakeholders could wear more than one hat e.g. in mutual organisations, customers are also owners.

Objectives are generally expressed in terms of targets.

Such targets can be general for example to meet liabilities as and when they fall due, or can be specific and quantifiable e.g. to achieve a particular return on capital.

Targets can be measured in absolute terms for example with reference to earnings per share growth. More commonly, as financial markets tend to be competitive, targets are expressed relatively. This can be in relation to the liabilities of the institution or to the performance of competitors. Such relative targets could cover relative returns on assets or funds under management or market share.

Identification, assessment, mitigation and monitoring of risks are fundamental aspects of the management of any financial institution. This is because failure to control risks can have major consequences for the interests of all stakeholders.

Risk can be measured in terms of the probability of occurrence and the financial impact should it arise.

However, such measurement can be an extremely subjective exercise as risk events are difficult to quantify and the impact can vary considerably depending on a wide range of other unpredictable influences.

Risks can be assessed as events or circumstances that could lead to the institution failing to meet its targets. Ultimately, these risks could threaten the continued viability of the institution. Hence risk could be expressed in terms of the possibility of a given course of action leading to ruin.

Risks can be classified into broad categories. The most general split would be between financial and non-financial risks. Though risks that have non-financial sources do have financial consequences.

Below this level, risks can be grouped into, either, Market, Credit, Business, Liquidity, Operational or External.

Clearly such grouping can be arbitrary or subjective. But it can be a useful tool.

Risk mitigation focuses on reducing the likelihood of the risk occurring and/or the cost if the risk should occur.

The aim of mitigation could be to improve stability and predictability in the operations of the business.

To this end, insurance or other ways of sharing or transferring risks are core risk management tools.

The institution should consider risk over its whole portfolio, taking account of the diversification/concentration from different risk sources.

Risks will need to be monitored and the situation reviewed.

Risk does not necessarily have to be viewed in a negative light. Institutions can actively take calculated risks with the aim of improving their performance so meeting or exceeding their objectives.

The institution should therefore understand its appetite for risk, and the constraints such as the extent of its capital.

(ii)

- Use economic analyses to form judgements about future inflation and interest rates
- Use data relating to future liabilities to estimate payments that need to be met
- Build, parameterise, test and implement models
- Handle assumptions in a critical manner
- Build appropriate margins into assumptions and appreciate the impact of such margins
- Project and discount future cashflows using assumptions
- Calculate the contributions/premiums/charges required to build up a fund over time to meet future liabilities
- Monitor the progress of the accumulation of a fund and its liabilities
- Analyse the variation between the actual and expected experience
- Manage the variation in the progress of the fund to ensure that future liabilities are met
- Handle data in a critical manner
- Manage the build up of assets to meet future liabilities
- Contribute to decisions on investment policies aimed at meeting future liabilities
- Arrange suitable reinsurance

*Higher scoring candidates covered broad risk management issues in part (i), rather than going into too much detail on actuarial analysis in both parts.*

6

(i) An insurance company holds capital for a variety of reasons including:

- Required by regulators
- Ensure solvency
- Finance new business(as new business costs may exceed revenue)

i.e. to meet acquisition expenses and pay commission

- Meet future growth aspirations
- For example, launching new subsidiaries, sales channels or products requires capital to pay for initial expenses until sufficient volumes of policies are built up
- Can help if company wants to grow through mergers/acquisitions or launch new ventures (e.g. in new markets such as India)
- Meet claims as they fall due
- Particularly since the timing of claim payments is highly uncertain
- Where guarantees and options are provided additional capital may be needed
- Meet the financial consequences of unexpected events e.g. credit crunch or stock market volatility
- Meet mismatching costs
- These may arise due to the investment strategy that the company adopts
- Demonstrate financial strength
  - both to potential customers
  - and also to providers of finance e.g. capital markets, rating agencies, equity analysts, regulator etc.
- To smooth results

(ii) Significantly above means still above if something adverse occurs

This level of capital may be considered appropriate for the company's needs eg due to a large concentration risk

Regulatory capital levels are set to ensure that a minimum level of capital is held to secure policyholder benefits

If the capital levels held by the company fall below the minimum levels there are a variety of consequences

Including the potential for the company to be put under judicial management or be closed to new business

The insurance company will thus hold a capital buffer to ensure it can maintain the minimum capital levels at all times

Including the ability to withstand adverse events that may reduce capital levels in the short term

The company will also want to hold a capital buffer to demonstrate the strength of the company to other parties e.g. investors, customers, ratings agencies etc

- (iii) Answer will depend on Co X's own capital buffer policy
- As the combined company will be much larger than the individual companies, the overall capital requirements would naturally be expected to reduce, as there is likely to be significant diversification benefits
  - Further, operational risk capital may be reduced over time if the company combines its operations (synergy benefit)
  - The extent to which the capital policy can be changed is dependent on the structure of the company and its ability to merge existing funds, and on any conditions imposed by the regulator in authorising the transaction
  - The company may also be able to improve the matching of assets and liabilities which should reduce both reserving requirements and the resulting capital requirements
  - The company may also revise its reinsurance arrangements in order to make efficient use of capital
  - This depends on the existing reinsurance arrangements, and may increase capital requirements if exposures to individual reinsurers increase significantly
  - Liquidity may be a constraint, e.g. more liquid capital less capital overall
  - New business policy strategy will influence capital required
- (iv) (a)
- Borrowing costs have increased and yields have risen
  - Reserves for insurance business have reduced
  - But this reduction may be more than offset by the fall in asset values and so may be mismatched
  - Hence free surplus is likely to have been reduced for many companies. It will have fallen in cash terms even if not in percentage terms
  - And capital requirements may thus have increased
  - Counterparty risk and uncertainty will have increased
- (b)
- One could utilise the existing economic capital methodology for both credit risk and liquidity risk

- The parameters used would be updated in line with current market conditions and the actual capital could be recalculated
- The internal capital target would also have to be recalculated
- The difference between actual and target would represent the additional capital required

*Parts (i) and (ii) were generally well answered, though too repetitive in many cases. In (iv)(a) very few candidates demonstrated understanding of why the capital requirements might have changed.*

7

(i) Loss of the entire building would mean that a catastrophe had occurred. Examples of such catastrophe risks include the following:

- Terrorism — potential for 9/11 style attacks on prominent buildings or other large scale terrorist acts
- Fire — potential for building to be burnt down
- Earthquake, flood, natural disasters, acts of God etc
- Staff action
- Acts of war
- Loss of ability to continue in business if building is used as main office space for company eg structural damage
- Operational risks

(ii)

As these risks all have low probability but a very high impact:

- Insurance would be the best option
- Although this may not be cost effective
- Some risks could be mitigated through disaster recovery planning and other management controls
- Would be advisable to attempt to diversify although unlikely to be able to unless the firm is large enough
- Company needs to consider if such events are within their risk tolerance limits; if so they can be ignored
- Could model the potential cost in order to assess insurance requirements or set aside capital
- Further research could be undertaken

(iii)

- The model needs to allow for all cashflows that may arise in future and should be able to model the scenarios noted above
  - ...allowing for the probability of an adverse event occurring, and for the loss that might arise if it does
  - Covering both direct costs (Compensation to those affected and repair) and indirect costs (restoring systems and records, and opportunity costs)
  - The model should also allow for cashflows arising from any supervisory or commercial capital/solvency requirements (e.g. requirements of insurance companies etc.)
  - The model needs to allow for interactions between the different cashflows
  - The model needs to strike a balance between realism (which will make it more complex) and simplicity (which will mean that the model is easy to use and the results are easier to understand and check). This will also affect cost
  - In particular, it is likely that there is very little data available to derive assumptions for the model and hence over-complicating it may not add any value
  - The model should be built to evaluate the risk and could be based on stochastic techniques, scenario analysis or stress testing as these methods can be used to allow for unlikely events i.e. incorporate probabilities
    - This will also provide a guide to the likely distribution of the capital requirements and the potential spread
  - The projection period chosen will reflect a balance between:
    - The time it takes to run the model (e.g. more frequent cashflows or longer projection period means longer run time)
    - The required accuracy of the results (e.g. more frequent cashflows or longer projection period means more accurate but risk spurious results)
  - Sensitivity analysis should be used to analyse the sensitivity of the results of the model to the assumptions used, particularly since there is likely to be very little data on which to base the assumptions
  - Output of the model should be in an appropriate format that can be easily communicated
  - The model should be easy to interpret
  - The model should be capable of development and refinement
  - The model should be appropriately documented
- (iv) Specify model structure and inputs required (including assumptions and data) — should be based on requirements above
- Derive data and assumptions for each risk

- Likely to require input from a wide range of senior individuals within the company to derive assumptions etc.
  - And may need external expert input on this
  - Build model and software platform to be used
    - consider whether to use custom model (existing or new) or commercial package)
  - Test model e.g. against past experience or expected results
  - Produce and interpret results of model including sensitivity analysis
  - Assess versus the risk objectives
  - If necessary, revise the risk management objectives and repeat the modelling process
- (v) (a) Stochastic modelling
- Advantages:
    - Good model can provide good assessment of risks as it provides distribution of results i.e. average, spread, tails etc.
    - Can be used to determine capital required to avoid ruin at any specified probability level
    - Explicit about assumptions made in modelling
  - Disadvantages:
    - Extremely complex to build and run
    - Difficult to derive assumptions
    - Run times require significant levels of computer power which may not be available
    - Hence need to limit ideal scope of the model
- (v) (b) Stress testing
- Advantages:
    - Simpler so less computer power required than stochastic
    - Cost effective and transparent
    - Easy to communicate
    - Easier to see the effect of changes in assumptions
  - Disadvantages:

- Need to derive appropriate parameters
  - Need careful interpretation of the results
  - Can't allow for all possible interactions
- (v) (c) Scenario analysis
- Advantages:
    - Can be used where full mathematical model is inappropriate e.g. where parameters are very subjective
    - Less computer power required than stochastic
    - Frequently used when evaluating operational risks such as those noted above
  - Disadvantages:
    - Need to derive appropriate scenarios and this may be time consuming
    - Subjective
    - Not quantifiable

*Many candidates scored well on this question, though only the better candidates applied the bookwork to the specific scenario. Some candidates who didn't suggest six distinct risks in part (i) seemed to struggle to generate a good range of application points in later parts.*

**END OF EXAMINERS REPORT**