

# EXAMINATION

4 April 2005 (pm)

## Subject CA1 — Core Applications Concepts

### Paper 2 (Liabilities and Asset Liability Management)

*Time allowed: Three hours*

#### **INSTRUCTIONS TO THE CANDIDATE**

1. *Enter all the candidate and examination details as requested on the front of your answer booklet.*
2. *You have 15 minutes at the start of the examination in which to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have three hours to complete the paper.*
3. *You must not start writing your answers in the booklet until instructed to do so by the supervisor.*
4. *Mark allocations are shown in brackets.*
5. *Attempt all 7 questions, beginning your answer to each question on a separate sheet.*
6. *Candidates should show calculations where this is appropriate.*

#### **AT THE END OF THE EXAMINATION**

*Hand in BOTH your answer booklet, with any additional sheets firmly attached, and this question paper.*

*In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator.*

- 1** (i) Describe the main features of the two types of proportional reinsurance. [5]
- (ii) Explain, by means of numerical examples, how the claim payment is divided between the reinsured and the reinsurer, in the event of a claim under each of the two types of proportional reinsurance. [3]
- [Total 8]
- 2** (i) State the reasons why the surplus/deficit arising between successive valuations of a benefit scheme would be analysed. [4]
- (ii) Describe the steps that would be followed to perform such an analysis. [5]
- [Total 9]
- 3** A general insurance company sells household contents insurance that covers domestic residential property against fire, theft, storm, flood and accidental damage. Instead of setting the premium based on the value of the contents chosen by the applicant, it proposes to base the premium on the number of bedrooms in the property, and to give unlimited cover. Other factors used in assessing the premium to be charged (such as the location of the property, type of construction and security systems) will be unchanged.
- (i) Discuss the advantages and disadvantages of the new approach from the point of view of the applicant and the company. [8]
- (ii) Describe the controls that could be included in the product design or the underwriting process to mitigate any disadvantages to the company. [3]
- [Total 11]
- 4** A general insurance company is constructing an asset-liability model to determine the likely future relationship between its assets and liabilities.
- (i) Describe the features of the business that the model will need to take into account if it is to be used to assess future solvency. [5]
- (ii) Discuss the issues that should be considered when deciding whether it would be more effective to use a deterministic or a stochastic model for this purpose. [4]
- (iii) List the parties who may be interested in the level of the solvency of the company, and state a reason for the interest of each. [4]
- [Total 13]

**5** A life insurance company sells level term assurance contracts through insurance intermediaries. The application form includes questions on the applicant's current and previous medical conditions and treatments. The company requests a doctor's report on, or a medical examination of, the applicant if:

- the proposed sum insured exceeds a certain limit; or
- the information from the application form suggests a need for further information

It is now proposed to cease obtaining this additional medical information, and instead to determine the terms to be offered on the basis of information in the application form alone.

(i) Discuss the implications the proposed change may have for the company. [7]

Two years after the change has been implemented, the company is reviewing the impact of the change.

(ii) Describe the investigations the company would carry out to do this. [10]  
[Total 17]

**6** A company operates a benefit scheme. The benefit is a lump sum at the fixed retirement age, determined from salary and service in accordance with a set formula. At retirement, employees can choose either to take the lump sum as cash or to use it to purchase a pension from the insurance market.

(i) State the information that would be useful for employees to receive every year about the plan and their benefit entitlement. [8]

The government is introducing legislation that requires retirement lump sums to be used to purchase a lifetime pension, rather than being taken as cash. Employee representatives have told the company that they are concerned that employees will be dependent on the insurance market. They suggest that the company offers an option for employees to convert their lump sum into an annual pension at an annuity rate of 35 for every 1000 lump sum, as an alternative to purchasing a pension from the insurance market. They comment that this will probably not cost anything as typical annuity rates in this country are currently 40 per 1,000 lump sum.

(ii) Discuss the issues the company should consider in these circumstances. [11]  
[Total 19]

**7** A small company is negotiating a remuneration package with an individual aged 50 who it wishes to appoint as its new chief executive officer. The individual has asked the company to guarantee him a pension of \$200,000 a year from age 60. The company is considering how it might finance this benefit.

- (i) List four approaches to the timing of the company's payments to meet this benefit, and outline how any surpluses or deficits could be removed under each approach. [5]

The company decides to provide the benefit without contributing to a specific fund in advance.

- (ii) Discuss the effect of this on the amount of capital that the company requires in order to operate its business. [7]

The company then decides that it cannot accept the risk of the guaranteed pension. Instead it is agreed that the individual will receive a higher salary and will make his own pension arrangements. The individual asks for advice on the amount of contributions he should pay to meet the target pension of \$200,000 a year.

- (iii) Describe the additional information required from the individual in order to enable an advisor to give suitable advice. [7]

- (iv) Outline the points that would be made when presenting the advice (without carrying out any calculations). [4]

[Total 23]

**END OF PAPER**

# **EXAMINATION**

April 2005

**Subject CA1 — Core Applications Concepts**

**Paper 2  
(Liabilities and Asset Liability Management)**

## **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.**

**M Flaherty  
Chairman of the Board of Examiners**

**28 June 2005**

*The division of the syllabus and core reading for CA1 into two parts for the 2005 and 2006 examinations in order to cope with the transition arrangements between the old and new examination strategies leads to an unbalanced split in the examination papers. The paper 2 syllabus and reading is considerably longer and less straightforward than that for paper 1. As expected the standard of candidates' solutions was less good in this paper than in paper 1.*

*As the title of the course suggests, this subject examines applications of the core techniques and considers broad actuarial concepts in practical situations. 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. These features are particularly tested in Paper 2.*

*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** (i) For both types, the arrangement determines a proportion of each and every risk to be covered by the reinsurer. The proportion, or a rule for calculating it, is determined at the inception of each risk.

There will normally be an obligatory treaty in place. This requires the writer to reinsure and the reinsurer to accept all the risks taken on at standard rates.

The experience, apart from differences in expenses and commission of the reinsured and the reinsurer, will be similar.

For Quota Share reinsurance a fixed percentage of each and every risk is reinsured.

For Surplus reinsurance the reinsured establishes a retention limit, which is specified in the treaty, and the reinsured retains all risk up to the retention limit.

The reinsurer takes all risk above the retention limit, up to its own maximum level of cover, also defined in the treaty. Risks in excess of the reinsurers maximum level of cover fall back on the reinsured, but would normally be reinsured elsewhere by a "second surplus" treaty.

If a claim is less than the full sum insured, it is settled in proportion to the share of the sum insured covered by the reinsured and reinsurer.

- (ii) Quota share. Assume 35% of the risk is retained.

Then for sum insured £100,000, direct writer pays £35,000, reinsurer £65,000.

If the claim is only £60,000, direct writer pays £21,000, reinsurer £39,000

Surplus. Assume retention limit £100,000 and reinsurer's maximum cover £400,000

For sum insured £65,000, reinsured pays £65,000, reinsurer pays nothing.

For sum insured £120,000 reinsured pays £100,000, reinsurer pays £20,000

If the claim is only £60,000, reinsured pays £50,000, reinsurer pays £10,000

For sum insured £550,000 reinsured pays £150,000, reinsurer pays £400,000

*Most candidates answered well on Quota Share, but relatively few understood Surplus reinsurance, particularly failing to mention the concept of a retention limit, which is fundamental to this type of cover. Many candidates discussed the advantages of proportional reinsurance as opposed to describing how it operates.*

- 2** (i) The main reasons for analysing the surplus or deficit arising between successive valuations of a benefit scheme are:

To identify the most significant sources of profit/loss and so review the risk of operating the scheme.

To review the assessed cost of new benefit accrual.

To check both the valuation assumptions and the method.

As an independent check on the valuation results and data.

To help formulate decisions about how to deal with any surplus or deficits that has arisen.

To assess the performance of trustees and managers.

To provide detailed information for disclosure to shareholders of the sponsoring employer.

To monitor trends in experience to assist in corrective action (actuarial control cycle).

A requirement of legislation or professional guidance.

- (ii) The aim is to establish a model that compares the actual experience since the last valuation with what was expected if all assumptions had been borne out.

The starting point is the results of the last valuation, therefore need full details of the assumptions made last time.

Obtain data on what has happened since then

... cashflows — contributions/premiums, benefits paid, expenses  
... investment returns — capital movements and investment income  
... membership movements  
... salary/benefit increases

Consider changes in benefits provided by scheme, contribution rates, etc.

Compare actual against expected for each item separately.

Consider whether the experience has been typical. Is there sufficient data for it to be statistically significant?

Analyse the effect of any change of basis.

*This question was generally well answered, although many candidates' answers related to insurance companies instead of benefit schemes. In part (ii), several candidates wasted effort by discussing how to value assets and liabilities as opposed to how to analyse surplus and deficit. Other candidates seemed to confuse the model with a general asset / liability model and did not relate their solution to the particular question.*

### **3 (i) For the applicant**

The advantage is that there is no need to estimate the value at risk, and to keep it up to date with inflation. This would be difficult for a non-professional estimator to do.

The householder is sure that he is fully covered.

Individuals with overly valuable goods in a small house are likely to see a reduction in premium.

The disadvantages are for those with small households of one or two people living in a large property (perhaps because their children have left home). They may be over-insured and pay a higher premium.

#### **For the company**

The advantage is that there will be no need to assess the sum at risk to ensure that cover is adequate. This will reduce claims management expenses and will also limit potential adverse publicity if claims are reduced through under-insurance.

The company may find it easier to offer telephone or on-line applications, thereby reducing costs. This is because the applicant will not have to think about the sum insured required.

The company is introducing increased pooling of risks by averaging the sums insured for different property types. Whether this is an advantage or not depends on whether it gets the premiums right.

Many properties have rooms that could equally be used as bedrooms or for other purposes. Classification could be difficult if this is left to the applicant. This could result in identical properties being charged different premiums.

This approach may lead to anti-selection because individuals with high value goods (e.g. much jewellery) living in a smaller property would be attracted to the new contract. Conversely those with few possessions in a large property would go elsewhere for insurance.

This might lead to a change in the mix of risk taken on, which is not present in the portfolio used to set the premium rates.

On the new approach, the company may not have adequate data to set the premium rates.

If the premiums are wrong, losses may result.

Unlimited cover may create moral hazard if customers exaggerate claims.

(ii) To mitigate the company's risks it could:

Impose a maximum single article limit or a limit of the total of jewellery and other valuables. Additional premiums would be required for any excess risks. This would limit the risk of high value items in a small property.

Make the rating factor the total number of rooms (excluding kitchens and bathrooms). This might still leave distortions where houses have had two rooms converted into one.

Allow for a change in the mix of business in setting the new premium rates, and obtain maximum amount of data on similar policies.

Raise excess levels.

*In part (i), most candidates picked up the main points relating to anti-selection and the reduction in costs and time at the application stage. Better candidates commented on the practical issues of using a bedroom classification. Part (ii) was less well answered, with few candidates doing more than listing a couple of suggested controls.*

**4** (i) The model design will need to consider and allow for:

Any statutory requirements relating to the valuation of both assets and liabilities.

The likelihood of catastrophes and accumulations of risk, and the vulnerability of capital to major shocks such as these.

The effects of non-proportional reinsurance coverages.

The spread of different risk groups within the portfolio.

Insurer's experience of writing different classes of business.

Liquidity risk — will the assets be able to be realised to pay unexpected claims.

The current position in the insurance cycle.

The expected level of profitability and level of investment return generated.

The level of free assets.

Volume of new business.

Levels of potential cashflows - premiums, claims, investment income, expenses, tax.

- (ii) The company could test stresses using variations in assumptions and a deterministic model. It is easier to test effects of particular defined scenarios using a deterministic model.

A stochastic model is more complex, and harder to get right and explain — greater model risk.

Stochastic models are harder to parameterise — greater parameter risk..

For some products, asset risk is not important enough to justify the effort/cost of a detailed model. However there are well defined and well tested stochastic asset models available.

Stochastic models are more objective in incorporating allowance for volatility in asset values and uncertainty in claims experience than deterministic.

Stochastic models may take into account correlations between and within assets and liabilities.

Stochastic modelling allows construction of probability distribution for outcomes and assessment of a risk of ruin, or alternatively the capital required to avoid ruin at all but a small number of outcomes.

- (iii) Statutory authorities — to protect policyholders.

Company management — duty to company / shareholders / policyholders.

Analysts / rating agencies — provide accurate information to investors.

Insurance brokers / IFAs — to place business with solvent companies.

Shareholders/bondholders — to monitor their investments.

Policyholders — to check the solvency of their insurers.

Competitors — to try to discover competitively useful facts.

Potential purchasers of the company — to assess its value.

Employees — to assess security of jobs/pensions.

Creditors – to control their business risks

Auditors – to decide if going concern basis appropriate.

*Better candidates scored well on part (i) by describing features of the business relevant to solvency (i.e. most features); some candidates discussed some particular features in unnecessary depth. In part (ii) most candidates commented on the relative complexity of stochastic methods but the weaker candidates did not relate their answers to the issue of solvency, for example the desirability of assessing extreme scenarios or outcomes. Part (iii) was well answered with candidates suggesting some inventive reasons for the interest of each party.*

- 5** (i) The company will no longer incur the costs of obtaining the additional medical information.

The savings will give the opportunity for premiums to be reduced, or alternatively profits increased. The company would normally wish to reduce premiums if it can. This will make the contract more competitive, and thus should increase sales.

The underwriting process should be faster. This will be popular with prospective policyholders and with insurance intermediaries. It should lead to increased sales.

Reinsurers may wish to re-price reinsurance cover, or become more involved in the underwriting process for large cases. This might increase costs or introduce delays, offsetting the benefits above.

The underwriters will have to base decisions on more limited information and so more experienced underwriting staff may be needed, increasing staff costs and reducing the expense savings.

The company could increase the number and depth of questions on the application form. This may be a deterrent to prospective policyholders, and offset the benefit of the faster underwriting process.

With less information, it may be necessary to decline more lives. This may lead to complaints, or intermediaries not recommending the company.

The risk of underwriting incorrectly will be increased. This may cause mortality experience to worsen. Alternatively unnecessarily harsh terms might be imposed, to ensure experience is no worse. This may have the same consequences as increased declinations.

There is a risk of anti-selection if the company attracts lives where the additional information from a medical report would cause other companies to impose special terms.

There is a risk of moral hazard if customers believe they can give incorrect information and not be found out by a medical exam.

(ii) The company would wish to investigate experience against assumptions in:

- mortality
- expenses
- new business volumes
- market share
- the proportion of cases where special terms were offered
- the rate of acceptance of special terms
- the proportion of cases declined
- intermediaries perception of the advantages/disadvantages of the new arrangements
- the number of, and volume of business from, supporting intermediaries.

With only two years data, any changes in mortality experience are very unlikely to be statistically significant unless the company is very large, and most mortality tables have a select period of at least two years.

Nevertheless the mortality rate within the first and second years of the policy could be calculated both before and after the change.

The number of deaths and the exposed to risk would be counted, taking care that they match. If there is sufficient data to generate credible results, analysis by cause of death would be a useful guide to the underwriters.

Analysis by age and sex might be possible, but for deaths at short duration this would be less useful than the cause of death analysis.

Underwriting expenses should emerge from the company's expense analysis.

Before the change these would include costs paid for medical reports and examinations.

The costs of the underwriting department would be determined. The direct costs would be grossed up for management costs and other overheads. The

costs could be expressed both as a charge per new policy written and as a charge per case proposed.

For comparison with the costs two years ago, it is important to inflation adjust the results.

It will be important to look at new business both in terms of the number of cases and the average size.

Changes in the way industry statistics are collected for market share results will have to be allowed for.

The company could also investigate whether any competitors have adopted similar underwriting approaches.

Most of the other statistics are a simple analysis of the data from the company's systems. Consistency of approach is important.

A questionnaire could be prepared for intermediaries that have supported the company both before and after the change, and for those intermediaries who either started or stopped supporting the company as a result of the change.

*This question was generally poorly answered, with few candidates writing sufficient points to score highly. Many candidates seemed to miss the obvious points on this question - for example, the fact that the company would save on the costs of obtaining the additional information. Disappointingly, few candidates discussed in part (ii) how to investigate all the issues that they had raised in part (i), instead discussing analysis of experience in general and so missing out on many available marks.*

**6** (i) It would be useful for scheme members to receive:

Estimate of the benefit entitlement in detail  
... accrued and projected at retirement  
... what pension might the lump sum purchase  
... including options (for purchasing dependants' benefits, increases, early/late retirement etc.)  
... specifying any assumptions used in these estimates

Statement of any risks to the benefit entitlement  
... what happens if the employer becomes insolvent  
... and if the scheme does not have sufficient funds

Statement of how well-funded the scheme currently is  
... and the implications if the scheme was wound up now

Confirmation of any contributions the employee has paid  
... and how much he will have to pay in future  
... and what the employer is contributing

Statement of the fund's investment strategy  
... and recent investment performance  
... net of expenses

Details of how the scheme is operated  
... and how the employee can get more information

- (ii) All guarantees have a cost (otherwise why is one requested?)

Market annuity rates do vary, depending on bond yields, etc., and it is quite conceivable that they will fall sufficiently that the guarantee will bite.

Indeed, rates would be expected to fall over the medium term because of improvements in longevity.

Employees could choose whether to take the guarantee, so there is risk of anti-selection.

The expected cost of paying the pension may be less than insurers charge, as insurers will have a margin for profit/expenses. However insurers' margins also reflect the cost of putting up the risk capital.

If the company underwrites the pensions, it is bearing the risk of adverse future experience and should reflect this in its pricing. The company would also need to establish and cost admin systems for pension payroll.

Market rates now may be low because of selection by those with good life expectancy but the company would face the same issue.

Annuity rates would normally be dependent on sex, and possibly also state of health. Guaranteeing a flat rate involves taking on a business mix risk.

Does the company have the capacity to operate rates that differ by state of health, and would it be perceived as unfair if it did so?

If the company offers this, it should model the risks it would be running, building in possible longevity changes as well as financial conditions.

It will need to consider safeguards to restrict its commitment and/or exposure:  
... review the "guarantee" rate periodically  
... (making it clear up front how this would happen)  
... and consider how to invest to contain the risks  
... or whether to lay off the risks through hedging or insurance.

Consider the competitive position – what are other employers doing?

*In part (i), candidates generally picked up points about the individual's benefit entitlement but missed many points about the plan in general – few listed sufficient points to have a chance of scoring very highly. Part (ii) was poorly answered, with only the better candidates*

*noting that guarantees might bite and that the company should model the likely costs of this risk. Very few candidates actually discussed the issues that affect the cost if the company offers this guarantee or discussed how to mitigate the risks.*

**7** (i) A ... Lump sum in advance when individual commences employment.

B ... Regular contributions throughout the period that the individual is employed.

C ... Lump sum at the time the individual retires.

D ... Pay-as-you-go as benefit payments are due.

Surplus/deficit does not arise under D.

Generally, surplus might be dealt with by reducing future contributions, but there is no scope for this under A, and only limited scope under B and C — surplus may arise after retirement.

An alternative is to take a refund of surplus.

Generally deficits are dealt with by the employer paying additional contributions. This may happen after the employer thinks he has finished paying, and a significant unexpected contribution requirement may create problems for the employer, especially if the individual is no longer employed.

Another option is to adjust benefits, but that defeats the objective.

There may be legislative constraints and/or tax implications.

(ii) Capital requirements can be considered in terms of economic capital or regulatory capital.

Regulatory capital will depend on what legislation applies (if any) and on what accounting rules apply.

In economic terms, the company is taking on an obligation which reduces its available capital; the obligation is the value of the benefits and expenses that will arise. There are a variety of ways to value this but it is important to allow for the uncertainty: the risk that the actual obligation exceeds the expected cost.

The company could aim to secure this with an insurance contract at retirement - consider the expected premium - or even look at the cost of securing the benefit now.

Even if it is not intended to secure the benefit with insurance, the cost of doing so is a good measure of the cost of the capital required to provide it.

The company needs to ascertain whether the obligation accrues immediately or over the course of the individual's career. The latter is preferable so that the capital cost can be met from profits over the period, which is the period that the company benefits from the individual's work.

Also consider the benefits payable if the individual dies or leaves before age 60.

There may be currency risk — consider if that could be hedged.

- (iii) Establish exactly the target benefits  
... dependant's benefits, pension increases in payment  
... is the target pension really a fixed amount at age 60, or indexed

Establish the contribution pattern  
... regular level contributions or increasing with salary.  
... how much is affordable

If he died, or retired early or late, how much would be required in the fund.

Does he intend to purchase an annuity at retirement with some or all of the fund.

Establish attitude to risk, given the uncertainty of outcomes. Are there particular risks to be avoided or that the individual is prepared to accept.  
... does the individual prefer to aim high or low?  
... is there scope to adjust contributions in response to changing circumstances?

Establish how he intends to invest his fund and whether that would change over the period to retirement.

Obtain information on his health and life expectancy.

Establish his tax position — on pension and contributions

- (iv) Remind the individual of the inputs he gav.

State that the answer will depend on actual experience so you need to make assumptions, and set out the key assumptions made.

Illustrate the variation by using a range of scenarios or stochastic analysis.

Point out that the uncertainty will be affected by his investment choice, and possible changes to tax, legislation, etc.

Suggest that there is regular review to see whether the contribution plan continues to meet his objectives.

*In part (i) most candidates correctly listed the four timing approaches but only better candidates outlined all the methods of removing surpluses and deficits. Part (ii) was very poorly answered, with few candidates appreciating that making a benefit promise would affect the company's capital immediately (as opposed to its liquidity) and of those who did, few went on to discuss how to measure the effect.*

*Many candidates appeared under the false impression that the company was an insurance company, although this did at least lead them to comment on regulatory capital. In parts (iii) and (iv), several candidates appeared to be under time pressure whereas other candidates scored well on what was largely bookwork.*

# EXAMINATION

5 September 2005 (pm)

## Subject CA1 — Core Applications Concepts

### Paper 2 (Liabilities and Asset Liability Management)

*Time allowed: Three hours*

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- 1** A large employer is setting up a benefit scheme for its employees. It is intended that the scheme will be administered in-house.

Discuss ways in which the costs of setting up and administering the scheme can be minimised. [10]

- 2**
- (i) State the reasons why an insurance company might wish to purchase reinsurance. [6]
  - (ii) Discuss the issues which an insurer should consider when assessing the security of a reinsurer. [5]
- [Total 11]

- 3** A general insurance company has been asked to quote premium rates by a large country-wide motor dealer for residual value insurance on loans arranged by the motor dealer for car purchase. The loans would typically have a term of 5 years. The insurance is offered at point of sale of a car to the car buyer. The cover provided is the difference between the amount required to pay off the loan and the amount recoverable under the policyholder's motor insurance policy if a car is written off as a total loss through accident or theft.

- (i) In order for the insurance company to determine the premium rates to be quoted:
    - (a) List the information required.
    - (b) Describe an approach to determining and expressing the premium rates that could be used. [12]
  - (ii) State the risks involved for the insurance company in providing this benefit and suggest how these could be mitigated. [6]
- [Total 18]

- 4** The government of a certain country has just passed legislation creating a Fund for Protecting Pensions (FPP). When a sponsor of a defined benefit scheme becomes insolvent and the scheme is unable to provide the benefits that have been promised to members, the FPP will take over the scheme in order to guarantee benefits. The FPP will be financed by levies on the sponsors of defined benefit schemes and by the assets of schemes that it takes over.

- (i) List the parties which will be affected by the imposition of levies, and state how each is affected. [6]
- (ii) Discuss the potential conflicts of interest that an actuary might face in advising the FPP on the levies it should charge, and comment on how these potential conflicts could be managed. [5]

A few years after the FPP has come into effect, all defined benefit schemes in the country have been terminated. Schemes have either been wound up after securing all their liabilities, or their assets and liabilities have been transferred to the FPP. The FPP has assets of around \$10 billion to meet the benefits of schemes it has taken over. The government has made it clear that it will not provide any funds if the FPP were unable to meet all the benefits promised.

- (iii) Discuss the factors the FPP should consider at this point in setting its investment strategy and managing its liabilities. [16]  
[Total 27]

- 5** (i) State the requirements and basic features of an actuarial model to be used to determine the premium rates for a new life insurance product. [7]

- (ii) Discuss the relative importance of the assumptions for:

- investment return
- mortality experience
- expenses
- withdrawal rates

when setting the pricing basis for the following products:

- (a) a without profits term assurance  
(b) a without profits level immediate annuity [12]

For each product in part (ii), it has been decided that the pricing model should involve stochastic simulation of some of the four items listed above.

- (iii) For each product, state with reasons which of the four items would be modelled stochastically. [6]

- (iv) Give reasons why the prices charged for the products might be different from the prices determined by the modelling process, and discuss the implications for the company of such differences. [9]  
[Total 34]

**END OF PAPER**

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September 2005

**Subject CA1 — Core Applications Concepts**

**Paper 2**

**(Liabilities and Asset Liability Management)**

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Chairman of the Board of Examiners

29 November 2005

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*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** Minimise set-up costs by using standard legal structures and documentation based on similar schemes run by other employers.

No member options:

- Reduces calculations required; and
- Simplifies member communications.

Require that benefits of small value be wholly commuted for cash:

- Reduces benefit payment costs; and
- Shortens period over which records have to be held.

Simple benefit structures:

- Less actuarial costs;
- Less management time.

If retirement benefits are provided offer a lump sum not a pension.

Require member contributions to be made by deduction from pay:

- Saves processing payments by other means.

Keep tight control on expenses of running the scheme:

- Prepare a budget;
- Monitor expenses against budget;
- Take action on overruns quickly;
- Adequate staff training;

- Purchase/design efficient and cost effective administration systems;
- Cost effective communication methods;
- Choice of professional advisers.

Consider outsourcing some functions to reduce the costs of administration, but remember only the function not the responsibility is outsourced:

- Investments;
- Paying pension benefits.

*This was the least well answered question on the paper. Few candidates thought widely enough to gain many marks. Although many candidates mentioned simple benefit and contribution structures, few suggested why these would reduce costs. There were also a significant number of candidates who failed to read the question and indicated how the overall cost of the scheme, i.e. the contribution rates, could be minimised.*

**2** (i) Reasons for purchasing reinsurance:

To limit the effect of a catastrophe or aggregate loss  
Commission paid by the reinsurer for the business/ financial assistance  
Reduce exposure when new market or area  
Stabilise results  
Spread risks/ diversification  
Reciprocity  
Supervisory requirement  
Technical assistance  
Write large risks  
Improve solvency position  
Take advantage of low priced reinsurance  
Investment freedom  
Financial reinsurance to manage balance sheet  
Not to be out of line with market practice  
To write more business for same capital

(ii) Features of reinsurer that would be reviewed:

Reinsurer's solvency position.

Assets of reinsurer adequate to meet liabilities and suitable re term, marketability, admissibility, cash flow, liquidity etc.

Liabilities spread by class and geographically, technical reserve adequacy, exposure to catastrophes.

Spread of risk: to ensure random fluctuations covered.

Reinsurer's own reinsurance arrangements: no appreciable gaps and reinsurers' security.

Quality of management.

Ownership of reinsurer and quality/size of backing.

Market views on security and pricing adequacy.

Business being reinsured, i.e. will reinsurer still be around when claims come to be paid.

Credit rating.

Legislative regime of reinsurer/ where incorporated.

Size of reinsurer.

Reputation.

*Part (i) was a straightforward piece of bookwork that has been asked regularly over recent years, in both subjects 302 and 303. As expected candidates performed well. Part (ii) was also generally well answered by most candidates.*

**3** (i) More information is required from the motor dealer on the loans:

Terms of loans: are these all, say, 5 year loans or of varied length? What are the interest rates on loans? What are the repayment conditions on early repayment of loans?

Is there just one lender involved or more than one with different arrangements?

Is the insurance on new cars, second-hand cars, or both?

What is the range of prices of cars sold with loans?

What are the loans expressed as a percentage of the price?

What is the likely volume of business (split by new/second-hand; term of loan; price of car; etc. if at all possible)?

Other information required would be:

Statistics on frequency of total losses of motor vehicles from own company's motor insurance experience.

Residual value decay information, i.e. what the value of a car would be for the purposes of insurance throughout the period of the loan from own company statistics or from the motor trade, e.g. motor pricing guide books.

It is presumed, although confirmation would be required, that cover under the policy would cease on resale of the car (or death of the car-owner).

The amount of cover depends on:

The loan repayment value: a value slowly decreasing to zero (starting at more than the amount borrowed depending on early repayment conditions) over the term of the loan; and

the residual value of the car, depending on whether it is second hand or new when purchased.

The value of a second hand car may only decline slowly and the “gap” may be extinguished within two or three years. A new car may lose a large part of its value immediately on purchase (because it is no longer new), so the “gap” will be bigger and persist for longer.

In view of the cash flow characteristics of the exposure, it is probably necessary to perform a stochastic exercise when testing premium rates allowing, for example, for various changes in the assumptions for residual value decay, total loss rates and for early loan repayment.

Premium might be expressed as a fixed percentage of the loan with different rates for different loan percentages/terms of loans, or a fixed amount within bands of loan amount varying by loan percentages/terms of loans, in each case possibly varying by whether new or old car.

Loading for expenses and profit.

- (ii) The risks for the insurer are that the assumptions made in assessing rates were not realised in practice.

The cover is dependent on the amount recovered from the policyholder's motor insurance policy as a result of the total loss. As the policyholder will be fully covered in any event, there is no incentive for him to query the amount recovered. The amounts could be lower than assumed and hence the amounts recoverable under the residual value insurance could be correspondingly higher than assumed. Also moral hazard from underinsurance of car.

A condition of the cover could be that the policyholder passes some responsibility to the company to negotiate the amount recoverable from the other insurer although this would increase administration expenses.

The volume of business could be much higher or lower than expected.

Higher could entail more risk than desired and could be mitigated by imposing a predetermined limit in the agreement with the car dealer.

There could be a requirement for additional solvency capital (but unlikely).

Too little volume might not cover the expenses incurred in writing a new line of business: part of the agreement might be early cessation of the contract if volumes do not exceed a certain amount to cut losses early.

Assumptions about the rate of residual value decay, frequencies for write offs and resale volumes pre loan expiry could be incorrect. These should be monitored and changes to rates sought if warranted.

Reinsurance (e.g. stop loss) may overcome some problems.

*Most candidates found this question difficult. The concept of “gap insurance” is not specifically covered in the core reading, but the risk that the cover was trying to protect against was fully explained in the question. This question tested the ability of the candidate to apply basic concepts, and a lot of common sense, to a possibly unfamiliar situation. Very few candidates tried to analyse the shape of the risk that was covered, but those who did quickly realised that the rate of depreciation was the key factor, and hence that a main rating factor was whether the car was new or second-hand.*

*In part (ii) most candidates mentioned that the main risk was the company getting the rates wrong, and many also commented on the effect of over- or under-estimating sales volumes. The other points above were generally missed.*

- 4** (i) *For any of following affected parties, any other reasonable reason why affected gained the marks.*

Shareholders of pension scheme sponsors whose funds will pay the levies.

The management of pension scheme sponsors whose performance indicators may be affected.

Distinguishing between current schemes and those who will still be around in a few years, who will pay more/less if initial levies turn out too low/high.

Employees of pension scheme sponsors who may want low levies that do not discourage sponsors from offering pensions.

Pension scheme trustees whose funding and investment decisions may be affected by a desire to reduce levies.

Pension scheme members and dependants who will want the FPP to be as secure as possible.

Government who won't want levies higher than predicted when introducing the legislation.

Taxpayers who might have to support the FPP if levies are too low and FPP is unable to meet benefit promises.

- (ii) Conflicts could arise if the actuary, as well as being an adviser has one or more of the following roles:

As advisor to existing pension scheme clients;  
As manager of a firm that may sponsor a DB scheme;  
As member of DB scheme;  
As taxpayer;  
As shareholder in firms that may sponsor DB schemes.

It will be very difficult for FPP to find an actuary who has no such conflicts. The FPP could look for advice outside the country, or appoint an actuary who has fewer conflicts. If the job was big enough, then the actuary could cease advising other clients or be full-time employee of FPP.

Any potential conflict must be disclosed to all relevant parties. Procedures should be established to prevent information being used in other areas (Chinese walls).

- (iii) Fundamental principles are to invest appropriately to the nature/term/currency of liabilities, and to aim to maximise returns subject to an acceptable level of risk.

Benefits are largely determined, but may not be able to be afforded.

Start with an assessment of the expected cashflows — promised benefits, expenses and investment return. These will be uncertain, particularly due to inflation and longevity, and so it will be necessary to assess the impact of these and other risks.

What options does the FPP have to mitigate these risks?

Ideally, there would be assets that would guarantee payments to match the benefit/expense outgo in term and nature (inflation-linked/fixed).

High quality bonds give the best match. Swaps may be available to smooth out the redemption terms if a suitable range of durations is not available. Sufficient liquid assets are necessary to meet cash flow requirements.

It may be impossible to find assets that match demographic risks because the term of the assets may not be long enough and the large size of the fund may be a constraint. So derive a portfolio that best matches the liabilities and build in additional reserves to cover the mismatching.

Investigate whether insurance policies are available that could cover some/all of the liabilities — the premium may be cheaper than the reserves it would be necessary to hold.

Almost inevitably, the market value of the target matched portfolio will not equal the value of the assets available. The rules of the FPP should address these situations.

If there are excess funds, then consider additional benefits.

If there are insufficient funds, then benefits will need to be reduced. Some categories of benefit may have higher priority.

Having adjusted the benefits, derive a target portfolio that is best suited to meet the (adjusted) benefit. Test the robustness of this by sensitivity analysis or stochastic modelling. Consider moving away from this portfolio in search of higher returns and risks of doing this need to be analysed.

Need to consider equity between members, because those who would gain from positive additional returns are different from those who would lose if the returns are negative.

Consider the transaction costs of moving from the existing portfolio to the target one, and the timing of the transition, bearing in mind any potential market impact.

There may be restrictions on what the FPP can invest in.

Tax regulations applying: could be different regime.

Establish suitable procedures for ongoing monitoring and review.

*Part (i) was well answered, with many candidates giving a good list of affected parties and good reasons for their interest. Answers to part (ii) were mixed, with most candidates mentioning the actuary's role as advisor to benefit schemes as well as the FPP, but only the better candidates thinking about other possible conflicts. In part (iii) most candidates stated the basic principles of investment matching, but only the better candidates took the discussion much further. Again, only a few candidates considered what to do if the value of the assets does not equal the value of the liabilities (as will certainly be the case).*

**5** (i) Models will need to satisfy the following requirements:

The model being used must be valid, rigorous enough for its purpose and adequately documented.

The model chosen should be capable of reflecting the risk profile of the products being modelled adequately.

The parameters used must allow for all those features of the business being modelled that could significantly affect the advice being given.

The inputs to the parameter values should be appropriate to the business being modelled and take into account any special features of the company and the economic and business environment in which it is operating.

The outputs from the model should be capable of independent verification for reasonableness and should be communicable to those to whom advice will be given.

The model, however, must not be overly complex so that either the results become difficult to interpret and communicate or the model becomes too long or expensive to run, unless this is required by the purpose of the model.

When using a model for product pricing:

The model needs to allow for all the cash flows that may arise. These will depend on the nature of the products being modelled and any discretionary benefits involved.

It also needs to allow for the cash flows arising from any supervisory or commercial requirement to hold reserves and to maintain an adequate margin of solvency.

The cash flows need to allow for any interactions, particularly where the assets and the liabilities are being modelled together.

Where the business being modelled includes options, the potential cash flows from such options and the take-up rate need to be allowed for.

The ability to use stochastic models and simulation needs to be allowed for, where appropriate.

The time period for calculating the cash flows in the projection needs to be chosen bearing in mind that:

- The more frequently the cash flows are calculated the more reliable the output from the model, although there is a danger of spurious accuracy.
- The less frequently the cash flows are calculated the faster the model can be run and results obtained.

(ii) (a) **Without profits term insurance**

The investment return assumption is the least important as only small reserves accumulate for term insurances.

The withdrawal assumption will be more important. Withdrawals in later years will be less significant, as no surrender value is likely to be paid, and on withdrawal the small reserve is released as profit.

Because of the high initial expenses, withdrawals at early durations will give rise to losses as expenses will not have been recovered. If there are selective withdrawals the mortality of the remaining lives may be worse than expected.

Mortality rates are more important. The rates are low (in terms of deaths per 1000 lives), but the sums insured are high, thus a small underestimation in death rates could lead to large losses.

The expense assumption will be the most important, because expense allowances will be a relatively large part of the premium. Underwriting and claims handling costs will be particularly important.

As premiums are fixed at outset, expense inflation will be important.

Marks were given for a clear statement of order: investment, withdrawal, mortality, expense; or investment, withdrawal, expense, mortality.

*To gain the marks in for order it was not necessary to list the order of importance specifically. The marks were awarded if the candidate demonstrated adequate knowledge of the relative importance in the answer.*

(b) **Without profit immediate annuity**

Withdrawals are unlikely to be allowed, so the assumption is unimportant.

The initial expense assumption is not particularly important, as expenses form a relatively small part of the single premium paid.

The importance of payment expenses and expense inflation depends on their size compared with the amount of annuity — they become more important for smaller policies. This is because the expense of making payments is generally independent of the size of the payment.

The investment return will be crucial, as the investment return on the single premium is a large part of the outgo on annuity payments and expenses. The guaranteed nature of the return increases the importance of the assumption.

If it is not possible to match income and outgo well there will need to be an assumption about reinvestment rates of return.

The mortality/longevity assumption is also crucial as it determines the average length of time the annuity will be paid. In the past improvements in longevity has been underestimated, and large losses have been generated.

Mark for order: withdrawal, expense, investment, mortality; or  
withdrawal, expense, mortality, investment.

(iii) (a) **Term insurance**

The main uncertainties arise from future events that cannot be estimated well at outset. These are expense inflation, withdrawal rates and mortality.

Expense inflation is not closely linked with the other assumptions, so would normally be tested by sensitivity testing with some deterministic assumptions.

Mortality and particularly mortality improvements could be tested through a stochastic model, as this is an important assumption. Although as it is known which direction generates the downside this may not be done.

If it is assumed that withdrawals are selective, it will be necessary to link the mortality assumption to the withdrawal assumption.

(b) **Annuity**

The main uncertainty is future longevity. Other relevant factors are future investment conditions, especially where reinvestment is necessary, and expense inflation.

Because of the risk involved, longevity could be modelled stochastically. However it is clear that it is improved longevity that will be the issue, so it would be possible to stress test a range of deterministic scenarios.

A stochastic investment model could be used because of the importance of the assumption. This would generate future expense inflation rates automatically.

The decision is whether to model both investment and mortality stochastically, and if not, which to choose. The run time and development cost of a model with two independent stochastic variables would have to be considered.

There are well developed and well document stochastic investment models available in the market. This is not the case with stochastic mortality models, so there will be a significant development cost

If only one stochastic variable is chosen the above considerations a likely to mean that a stochastic investment model will be chosen, and longevity tested by deterministic scenarios.

- (iv) The company might choose to sell the product at a cheaper or more expensive price than indicated by the pricing process.

A more expensive price could be used if there was no real competitive market in the product. Greater profit margins could be incorporated and the product still be competitive.

There may be a cartel keeping prices high.

The immediate implication is bigger profits. However customers may turn to a similar product from another provider that, although not fulfilling their needs completely, provides much better value for money.

Thus the total market size for the product would shrink. New business would decline even if market share were maintained. It might be possible to restore sales volumes quickly by a price cut to the price generated by the pricing process, and still remain profitable.

Regulators may take action against cartels. Adverse publicity may affect sales not only of the particular product, but of other business lines of the company.

A cheaper price might be as a result of taking a lower contribution to expense overheads and profit. As the total profit is the product of the number of units sold and the profit per unit, selling more units at a reduced profit margin may increase total profits.

Increased volumes may put capital pressure on the company through increased new business strain.

The cheap product may attract customers to other, more profitable products of the company. The company may expect greater profits across its whole product range. The risk is that in a developed market this may not work. Customers may find your “more profitable” products cheaper from other providers. The expected sales volumes may not materialise.

If the product is sold at a real loss, i.e. marginal expenses are not covered in the price, then the company is very exposed to the risk of more sales than expected and very high capital strains. As this could not be allowed to continue for long, the company could also be exposed to adverse publicity from steep price increases.

Tariff rates fixed by government could apply in some territories: the modelling is then done solely to determine profit.

*The length of this question, and the fact that it accounted for one third of the marks on the whole paper clearly worried some candidates who mis-allocated their time. However it should have been clear that, although linked by a theme, parts (i), (ii) and (iii) together, and (iv) stood on their own as three separate questions, and might have been asked independently.*

*Part (i) was two bits of bookwork, from different parts of the core reading. Surprisingly, very many candidates identified the first and were able to repeat it verbatim, but were not able to identify or reproduce the second.*

*In part (ii) a surprisingly large number of candidates did not know that withdrawal from term assurances does not normally involve any payment, and that withdrawal from an annuity is not normally permitted. Consequently too much weight was given to withdrawal experience for both contracts. The examiners were hoping that candidates would come off the fence and conclude their answers with an ordered list, sadly few did. Part (iii) was poorly answered with many candidates suggesting that almost everything could be modelled stochastically, notwithstanding the cost and run time implications that they had correctly identified in part (i).*

*In part (iv) many candidates correctly identified reasons why the product might be sold at a lower price than identified in the pricing process, but only the better candidates discussed reasons why it might be sold at a higher price.*

## **END OF EXAMINERS' REPORT**

# EXAMINATION

27 March 2006 (pm)

## Subject CA1 — Core Applications Concepts

### Paper 2 (Liabilities and Asset Liability Management)

*Time allowed: Three hours*

#### **INSTRUCTIONS TO THE CANDIDATE**

1. *Enter all the candidate and examination details as requested on the front of your answer booklet.*
2. *You have 15 minutes at the start of the examination in which to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have three hours to complete the paper.*
3. *You must not start writing your answers in the booklet until instructed to do so by the supervisor.*
4. *Mark allocations are shown in brackets.*
5. *Attempt all 8 questions, beginning your answer to each question on a separate sheet.*
6. *Candidates should show calculations where this is appropriate.*

#### **AT THE END OF THE EXAMINATION**

*Hand in BOTH your answer booklet, with any additional sheets firmly attached, and this question paper.*

*In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator.*

- 1** Outline the reasons why a general insurance company models its claims experience. [5]
- 2** Outline the reasons why a life insurance company requires capital. [5]
- 3** An insurance company has made the following purchases during the year:
- (a) a new city centre sales office
  - (b) a new computer system for the payment of annuities
  - (c) a new computer system for the payment of staff salaries
  - (d) the routine regular replacement of a proportion of staff cars
- Describe how each of these items might be dealt with in the annual analysis and allocation of expenses. [8]
- 4** A director of a company is negotiating a financial settlement on divorce. The director is to retain his accrued pension rights but their value is to be taken into account in the financial settlement. An expert witness is providing independent advice on a suitable value of the director's final salary pension for this purpose.
- (i) Discuss the factors that will influence the advice to be given. [6]
- It has been suggested that the value of the accrued pension rights be taken as the value of the director's pension benefits disclosed in the company's accounts.
- (ii) State the advantages and disadvantages of this suggestion. [3]
- [Total 9]
- 5** A large motor insurer has noted that claims management expenses as a proportion of claims costs have been increasing steadily over recent years. The proportion is now 6.25% of claims costs compared with 5% five years ago.
- (i) Discuss why this increase may have occurred. [3]
  - (ii) Discuss possible actions the company can take to reverse the position. [2]
- It has been suggested to the company that it can reduce both claims management expenses and the costs of carrying out vehicle repairs, by acquiring a chain of vehicle repair garages and requiring that repairs are carried out at the insurer's own garages.
- (iii) Describe how this approach may reduce costs. [3]
  - (iv) Outline the issues the company will need to consider before proceeding with the acquisition. [4]
- [Total 12]

- 6** (i) List the principal aims of regulation of a financial market. [2]

The financial markets of a small developing nation are unregulated and underdeveloped. The firms and individuals operating in these markets subscribe to a voluntary code of conduct. The government is now intending to introduce regulation for these financial markets for the first time.

- (ii) Outline the reasons why the government may wish to introduce regulation of the country's financial markets. [5]

- (iii) Discuss the advantages and disadvantages of introducing the following systems of regulation:

- (a) self-regulation  
(b) statutory regulation

[9]

[Total 16]

- 7** A long-established company operates in a country with a developed economy and developed capital markets. The company sponsors a pension benefit scheme for its employees.

- (i) State the principles for setting the scheme's investment strategy. [2]

- (ii) Describe how the nature of the scheme's liabilities could influence its choice of assets. [10]

- (iii) List the controls over pension scheme investment that the country's regulatory authorities might impose. [5]

- (iv) Describe the process the company could use when assessing the scheme's investment experience. [6]

[Total 23]

**8** An employer currently provides a wide range of employee benefits for its 10,000-strong workforce in a developed country. It is reviewing the effectiveness of its benefits programme and is considering introducing a flexible benefits system.

- (i) Explain how a flexible benefits scheme can be useful for an employer's corporate human resource strategy. [6]
- (ii) Describe two examples of how employees could select against the employer in a flexible benefits system and for each suggest a way it could be mitigated. [3]

Company A is a general insurance company that writes an annual travel insurance policy with the following features:

- worldwide cover is provided for any number of trips during the year
- medical expenses abroad are covered up to \$10,000,000 per person
- repatriation costs are covered in the event of an accident while abroad
- the policy cover excludes business travel

Company A also writes single-trip travel insurance policies, normally purchased shortly before the trip starts.

Company A has suggested to the employer that an annual travel insurance policy, with monthly premiums deducted from salary, could be offered as an option in the flexible benefits system.

- (iii) Comment on how the risk profile of the policies that Company A would write under this arrangement might differ from the risk profile of its existing individual travel insurance portfolio. [5]
- (iv) List reasons why Company A may seek to purchase reinsurance. [5]
- (v) Outline the factors Company A will take into account when determining whether to purchase reinsurance to manage the risk on its travel insurance portfolio. [3]

[Total 22]

**END OF PAPER**

# EXAMINATION

April 2006

## Subject CA1 — Core Applications Concepts

### Paper 2

### (Liabilities and Asset Liability Management)

## 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.

M Flaherty  
Chairman of the Board of Examiners

June 2006

### Comments

Individual comments are shown after each question, after each part question and within the solutions where relevant.

### General comments

*As the title of the course suggests, this subject examines applications of the core techniques and considers broad actuarial concepts in practical situations. 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 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.*

*In this exam sitting there was a large number of candidates sitting paper 2 only. In the transitional arrangements, there is only one further sitting where the two papers can be taken separately. It seems likely that the single paper candidates concentrated their efforts on this subject, and were rewarded with a much higher pass rate than those taking both papers*

- 1** A general insurance company might model its claims experience in order to:
- determine appropriate premium rates
  - determine the provisions needed for commitments in respect of existing policies.
  - construct asset / liability models
  - select rating factors for future product design
  - demonstrate the estimated effect of changing the level of cover by changing the level of excess or the effect of reinsurance, or to measure the effect of other scenarios for risk management purposes
  - assist in decision making by estimating the likely variability of claims experience.
  - update assumptions for future experience
  - monitor any adverse trends in experience so as to take corrective actions
  - provide management information for financial planning
  - assess profitability of different lines of business
  - comply with regulatory requirements
  - estimate the impact on reserves of any latent claims — for example, from long-tailed business

*Comments on question 1: This was a relatively straightforward question testing knowledge of the syllabus and was answered well by most candidates. Several candidates did not consider setting premium rates to be a key use of claims analyses — it is in fact the most important use. Inadequate premiums means real losses; inadequate reserving means mis-stated profits between years.*

- 2** Capital is required in order to demonstrate solvency to regulatory bodies. It is also of use to demonstrate strength to other institutions such as rating agencies and insurance intermediaries, which helps to secure new business.

Capital protects insurers from the effects of adverse deviations in experience, for example fluctuations on claims experience or unexpected costs.

Most forms of new business require capital in their early years to cover the initial strains from expenses, commission and reserving. Excess capital enables the life insurance company to pursue more aggressive investment or pricing strategies. Holding excess capital also reduces the need for external financing and can help insurers retain profits.

For with profits business capital can be used to smooth bonuses or pay more than asset share on maturity.

The company may use capital for investment in projects designed to create efficiencies in its business, and consequent future profits. Additionally, it may be used to develop new products or sales channels, in particular products with greater options and/or guarantees. Capital can also be used in merger and acquisition activity.

***Comments on question 2:*** *A straightforward bookwork question answered well by the majority of candidates.*

- 3**
- (a) A notional rent would be determined, based on market data of similar properties. The rent would be allocated as initial expenses. It could be allocated to policy types in proportion to commissions generated.  
  
If the staff in the office also carried out policy servicing activities, part of the rent should be allocated to renewal expenses. Apportionment would depend on the exact nature of the activities undertaken, but would most likely be as a per policy expense.
  - (b) The capital cost would be amortised over the expected useful lifetime of the system purchased. The amortised cost would be allocated to renewal expenses, and it would be specifically allocated to annuity business.
  - (c) The capital cost would be amortised over the expected useful lifetime of the system purchased. The amortised cost would be allocated across all policy types and between initial, renewal, and claims either in proportion to salary costs or staff numbers.
  - (d) The capital cost might be treated as a revenue item, since the impact is effectively amortised by the regular replacement programme. Alternatively it might be amortised over the length of time the vehicle will be kept, allowing for any residual value that might be obtained at the end of the period.

The cost would be allocated across policy types and between initial renewal and claim expenses as an addition to the salary costs of the individuals or departments involved.

***Comments on question 3:*** *A surprisingly large number of candidates ignored the fact that all the instances except the last were significant sums that would distort results if the entire cost were taken to profit in a single year. Even more candidates failed to realise that the property purchased would be a balance sheet asset that would be more likely to appreciate in value than need amortisation. Those that approached this question methodically and considered each case separately, looking for the differences between them, scored well. Examiners are unlikely to ask a four-part question where the answers to all four parts are the same.*

- 4** (i) The expert witness must give impartial advice, resisting pressures from either party, and taking account of any legislation or professional guidance.

If the divorce is acrimonious then the director may have a preference for assumptions that understate the value of these pension rights. The counterparty in the divorce case may have a preference for assumptions that overstate the value of the pension rights.

Assumptions will be necessary for economic and demographic items:

- mortality/longevity
- future salary increases
- future investment returns
- future inflation
- future discretionary increases

Best estimate assumptions should be the starting point. The assumptions used in previous divorce cases would also be considered for consistency.

These assumptions may have to be adjusted to be appropriate to the case under consideration. It would be necessary to take account of the probability of payment of the accrued benefits, and consider the relative weight to be given to the length of the marriage and the period of service in the scheme.

It will be necessary to determine that the overall value resulting from the combination of assumptions is appropriate. This permits small variations from best estimate to be used in some assumptions, provided that variations in the opposite direction are used in other assumptions.

The significance of the accrued final salary benefits to the director's other assets and thus the overall financial settlement must be assessed.

For a director, there may be special pension arrangements or benefit promises for these final salary benefits, which may mean that the accrued benefits are significant.

- (ii) **Advantages**

The figures given in the accounts will be independent of the parties involved in the divorce case. They are freely and immediately available to all involved.

The accounting figures will aim to represent the realistic cost of the accruing benefits.

### Disadvantages

The latest accounting disclosures will generally not give the value of the accrued benefits at the date required for the divorce case, as additional benefits will have accrued.

The figures in the accounts may be prepared in line with a statutory methodology, which may not be appropriate. Accounting standards may not use a best-estimate basis – for example, they may require a prudent basis.

The latest accounts may be unaudited and subject to revision.

*Comments on question 4: Part (i) is an example of a common type of question where a standard piece of work is considered in an unusual context. To score well, candidates needed to consider the context — an expert witness for a director's divorce case — which would generate applicable and valid points. Weaker candidates went no further than considering the assumptions that would be used in valuing the benefits, irrespective of context, and so lost many marks. Part (ii) was answered reasonably well by most candidates.*

- 5 (i) Costs for the different categories may have escalated differently over the period. For example, staff costs may have escalated differently as claims management activities are carried out by clerical and professional staff and vehicle repairs are carried out by manual workers.

Claims volumes may have fallen and no action been taken on claims department staffing.

The mix of claims may have changed, with a greater proportion of either large or small claims. For example, claims expenses, as a percentage of claims, may be greater for larger claims. Small claims may be admitted with negligible investigation, large claims will involve professional loss adjusters.

The company is likely to have fixed limits for various levels of claims management — e.g. only involve loss adjusters for claims above £1,000. If these amounts have not been increased in line with inflation, then a greater proportion of claims will have been categorised as “larger” and incurred higher expenses.

The feature may actually be a sign of a successful claims management approach. By spending more on claims management, fraudulent and excessive claims have been eliminated. Thus claims management costs as a proportion of claims may have increased, but the overall claims ratio (claims, including management costs, as a proportion of premium income) may have reduced.

*There were a number of other possibilities for which credit was also given. In order to be awarded marks, the arguments made needed to answer the question of a **steadily increasing** proportion over the last five years, not random fluctuations.*

- (ii) The company can review any fixed limits for levels of claims management in line with inflation. It could also increase limits in excess of inflation, or change the structure in some other way to reduce claims management costs. However this type of action may increase fraudulent or overstated claims, and thus increase rather than reduce overall costs.

The company may have statistical data relating fraudulent claims to the level of claims management — but it may be out of date or not exist. The company would have to keep a close watch on costs and be prepared to reverse the position if necessary.

Claims department staffing levels and/or the efficiency of staff could be reviewed.

Operational improvements for efficiency could be introduced.

*Sensible possible actions relating to the candidate's answers in part (i) were also awarded marks.*

- (iii) Independent garages may over-estimate the costs of repairs in order to increase their own profits.

With a subsidiary chain of garages, multiple estimates will not be required, and loss adjusters will generally not be used. Estimates for smaller claims will be accepted without question.

Independent garages may agree to doing additional repairs not caused by the incident and including them in the claim. The management controls available if the garages were a subsidiary chain could prevent these abuses and reduce costs.

A large chain of garages may achieve economies of scale.

A subsidiary chain of garages can either be non-profit making, or can pass any profits to the insurer through dividends.

- (iv) Does the chain of garages have nationwide coverage, or what arrangements can be made in uncovered areas?

Will any disclosure of this claims practice in advance be required, and if so will it affect sales volumes or customer satisfaction.

Will the practice impact vehicles' warranties or manufacturers' recommendations?

Will the garages be able to cope with the additional workload?

Apart from these specific items, the insurer will have to assess the acquisition as it would any other equity-type investment (as they will effectively be buying shares in the garage chain).

It would have to review profitability, operational methods, staff contracts and costs. It would also have to consider premises costs and the capital requirements of holding stocks of parts and equipment.

All these assessments would use past data from the garages, adjusted for the changed circumstances and the additional work generated. Consideration would be given to the actions (and reactions) of competitors.

The insurer would need to consider whether the benefits justify the costs involved, particularly bearing in mind that running garages is not a core activity for an insurance company.

**Comments on question 5:**

*Most candidates were able to have a reasonable attempt at part (i) of the question — almost any sensible suggestion was awarded marks. However, the stronger candidates were distinguished here by the clarity of their discussions in part (i), which lead directly into clearer and therefore higher scoring answers for part (ii).*

*In part (iii), most candidates considered how the suggested approach would tackle some of the possible real life problems with the existing approach and scored reasonably well here. However in part (iv), many candidates seemed to struggle. This part of the question called for consideration of the situation from a practical perspective. Surprisingly few discussed the specific geographical and workload issues, focussing on the more generic considerations of competitors, tax issues, and cost-benefit questions.*

**6** (i) The principal aims of regulation of a financial market are:

- to maintain confidence in the financial system
- to protect consumers of financial products
- to promote efficient and orderly markets
- to correct perceived market inefficiencies
- to help reduce financial crime

(ii) There may be problems with the existing voluntary code of conduct.

The existing system may be ineffective or may have broken down due to rogue operators refusing to comply with the code of conduct

The existing system may be out of date with the current financial markets leading to a lack of public confidence in it.

Introducing regulation of the financial markets may encourage development of the market and the economy, attract foreign investment, and maintain the future economic welfare of individuals in the nation.

This may fit in with the government's plans or comply with international standards as a prerequisite for joining an international organisation.

(iii) (a) **Self-regulation**

A self-regulatory system is organised and operated by the participants in a particular market without government intervention.

The advantages are:

- it may be easier to persuade the firms and individuals to co-operate with a self-regulatory organisation than with a government bureaucracy. especially given the firms and individuals in this market currently subscribe to a voluntary code of conduct
- the system is implemented by the people with the greatest knowledge of the market, who also have the greatest incentive to achieve the maximum cost benefit ratio
- the system should be able to respond rapidly to changes in market needs.

The disadvantages are:

- the closeness of the regulator to the industry it is regulating may mean the regulator accepts the industry's point of view, possibly leading to a weaker regime than is acceptable
- there might be low public confidence in the system, which may be a particular concern if there is low confidence in the existing voluntary code of conduct
- market participants may be relatively scarce and inexperienced.
- self-regulatory organisations may inhibit new entrants to a market.

(b) **Statutory regulation**

In statutory regulation the government sets out the rules and polices them.

The advantages are:

- it may command a higher degree of public confidence due to government involvement
- it is more easily enforceable and less open to abuse than the alternatives, which may promote further development of the market
- it may be run efficiently if economies of scale can be achieved through grouping its activities by function rather than type of business

The disadvantages are:

- it can be more costly and inflexible than self-regulation both for the government and for the companies involved, which may increase taxes and charges for the consumers involved
- the government may impose rules that are ill devised and do not achieve the desired aim, especially since it has not had any experience of regulating the financial markets
- consumers may actually take less responsibility themselves for their own decisions

***Comments on question 6:***

*In part (ii), the weaker candidates did not consider the context of the question and what the change would introduce compared with the starting point. Instead they focussed on the positive aspects of regulation. Stronger candidates used the context to score well. Reading the question is vital (as ever!).*

*Part (iii) was answered reasonably well by most candidates. Again, the higher scoring candidates used the context of the question to generate points relevant to the introduction of regulation, not just comparing the types of regulation in abstract.*

**7** (i) The principles of investment can be stated as follows:

A provider should select investments that are appropriate to the nature, term and currency of the liabilities.

Subject to the above, the investments should also be selected so as to maximise the overall return on the assets, subject to an appropriate level of risk.

(ii) Liability outgo = benefits + expenses – income

The liability outgo can be estimated over the future lifetime of the scheme, allowing for the probability that payments will fall due to be paid and for uncertainty about the amount of the payment.

For liabilities guaranteed in money terms try to invest in assets that provide a flow of income/capital to match the liability outgo.

For liabilities guaranteed in indexed terms (index may be national price/earnings index, or a specific one such as the employer's pay awards), again, try to match if there exist assets whose returns are linked to the relevant index.

Discretionary liabilities give more freedom to pursue maximum returns, subject to members' reasonable expectations.

Investment-linked liabilities may be linked to the actual performance of the fund, or may consider only the fund in respect of certain categories of membership — for example, considering the performance of the funds in respect of active members by first removing the assets held in respect of pensioners and deferred pensioners liabilities.

Investment-linked liabilities may simply link to a market index, or may link to the actual individuals' choice of funds in a DC scheme, allowing for lifestyle considerations.

In all cases it may be possible to match the investments or deliberately choose to mismatch the investments to seek higher returns.

Expenses are likely to be indexed to prices/inflation in some way.

Future income is an asset that will need to be taken into account appropriately, allowing for its nature.

(iii) Regulatory authorities may impose:

- restrictions on the types of assets that a fund can invest in
- restrictions on the quality of assets that a fund can invest in
- requirements to hold certain types of assets
- requirements to hold above a minimum (or below a maximum) proportion of certain assets (e.g. a minimum proportion in government stock)
- restrictions on the maximum exposure to single counterparty/issuer
- restrictions on the amount of self investment
- requirements to match by currency
- restrictions on the amount of mismatching permitted
- requirements to hold a mismatching reserve
- requirements on the sponsor to take professional investment advice
- restrictions on custodianship of assets
- restrictions on the type of assets that can be taken into account for statutory valuations (e.g. funding requirements)

- restrictions on the amount of any asset type that can be taken into account
- (iv) First choose an appropriate time period over which to assess the experience.

Identify the data needed for the assessment:

- investment performance stats should be readily available
- both actual investment performance, as well as market statistics
- need details of significant liability movements for comparison purposes (for example, details of a major redundancy programme).

Measure the fund's investment performance against the investment managers' objectives. Compare asset and liability gains and losses; assess the deviations from what was expected and how this compares with the sponsor's risk tolerance.

Decide how to use the results of the assessment. Consider whether the period studied is representative and/or indicates any trends and how to feed the results back into the process. Consider whether to take corrective action if experience is adverse, or to review the objectives of the investment managers

***Comments on question 7:***

*A methodical approach was called for in part (ii), with practical considerations of matching. Candidates who divided the liabilities by the nature of the member (active, pensioner, deferred) rather than the nature of the liability, started off in the wrong direction and generally struggled to get back on course. Very few candidates considered the effects of expenses and income.*

*Part (iii) was answered reasonably well by most candidates, with the stronger candidates able to generate most of the possible controls.*

*Part (iv) was a standard actuarial control cycle question. Those who approached it considering the control cycle process scored fairly well. However, a surprising number of candidates instead wrote down all they knew about dealing with investment experience - the answers in these cases did not cover the breadth of description required and so lost straightforward marks.*

- 8** (i) One objective of HR strategy is to reward each employee according to their contribution. The benefits package should therefore deliver value to each employee and aim to attract and retain staff.

A fixed benefit package will be of different value to different employees; for example, a spouse's pension is worth more to someone who is married.

A flexible benefits scheme gives employees the option to tailor their benefit package to their own needs. This can be achieved by buying more benefits and reducing cash pay (or selling benefits and increasing cash), thereby possibly paying less tax. Usually employees have the option of adjusting their package each year so an individual can change their package over time as their circumstances change.

The employer does not have to pay for benefits that employees do not value, and the package can be made attractive to different groups within the workforce.

Annual enrolment reminds employees of the value of the benefits they receive. The system increases the visibility of what the employer spends on benefits, so increasing employee appreciation.

New benefits can be introduced at little or no cost to the employer.

(ii) *Any two sensible examples were given marks, for example:*

With a lump sum death benefit: employees could increase cover after they receive a diagnosis of terminal illness. Mitigation: restrict how much cover can be increased at each renewal.

With private medical care: employees could take this up when they have something that needs treatment. Mitigation: exclude pre-existing conditions.

(iii) The majority of the retail market may be single-trip policies, the flex scheme will offer annual cover, so comparison needs to be with the annual policies in the retail portfolio.

Employees pay premiums from monthly salary as opposed to annually in advance. There is a risk that premiums may be lapsed (employee moves job, or dies), after the main holiday has been taken.

Employees likely to be limited in amount of holiday they take. This is different from the retail market, which may include retired people with time for many holidays.

This company's employees may not be typical in their lifestyle and holiday choices, which may be higher/lower risk than retail.

Employees may holiday together, leading to a concentration of risk.

Employees will only be able to purchase at start of the flex year, even if they don't plan to take a holiday for several months, and so present a lower risk than retail customers who may purchase just before they book/take a holiday.

As employees, they may be healthier/younger/older than purchasers of annual policies, so present lower (or higher) risk of needing medical care.

- (iv) The main purposes for which reinsurance is arranged are as follows:
- limitation of exposure to risk, either single event or cumulative events, or diversifying regional or portfolio concentration
  - avoidance of large single losses (e.g. liability claim)
  - smoothing of results
  - availability of expertise for new risks, unusual risks, or new territories
  - increasing capacity to accept risk either singly or cumulatively
  - financial assistance for new business strain, merger/acquisitions, or bolstering free assets
- (v) Consider the risks with this business line:

Travel insurance may be subject to concentration e.g. tsunami, airport closure, and reinsurance may offer ways of both diversifying this risk and of resolving liquidity issues.

Consider the extent to which Company A writes other uncorrelated risks:

If Company A only writes single trip rather than annual cover, then reinsurer expertise may be beneficial.

Need to assess the types of reinsurance available and compare potential levels of recovery against the cost, considering a range of potential outcomes. Take into account the likely volumes of business, Company A's capital resources, and the size of Company A.

Consider alternative forms of risk transfer, and assess whether reinsurance terms are attractive in relation to these.

***Comments on question 8:***

*This question is really two separate questions considering different aspects of the course and, if tackled as such, is not as onerous as its length may have suggested at first glance.*

*Flexible benefits schemes in the context of human resource strategy are discussed in the core reading. Given this, a surprising number of candidates gave relatively poor answers to part (i), sketching out points rather than explaining them fully. In part (ii), candidates who read the question and gave example of selection against the employer scored well. However, a number of examples merely considered aspects of moral hazard.*

*Performance on part (iii) was patchy: stronger candidates used the differences between the single trip cover and the annual cover to generate multiple valid points about the difference in risk from which they scored reasonably well.*

*Most candidates answered part (v) poorly. The majority did not answer the question in context, simply considering reinsurance in abstract terms. Generally there was little consideration of the risks of the business-line in question or any other risks with Company A.*

**END OF EXAMINERS' REPORT**

# EXAMINATION

4 September 2006 (pm)

## Subject CA1 — Core Applications Concepts

### Paper 2 (Liabilities and Asset Liability Management)

*Time allowed: Three hours*

#### **INSTRUCTIONS TO THE CANDIDATE**

1. *Enter all the candidate and examination details as requested on the front of your answer booklet.*
2. *You have 15 minutes at the start of the examination in which to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have three hours to complete the paper.*
3. *You must not start writing your answers in the booklet until instructed to do so by the supervisor.*
4. *Mark allocations are shown in brackets.*
5. *Attempt all 7 questions, beginning your answer to each question on a separate sheet.*
6. *Candidates should show calculations where this is appropriate.*

#### **AT THE END OF THE EXAMINATION**

*Hand in BOTH your answer booklet, with any additional sheets firmly attached, and this question paper.*

*In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator.*

- 1** List the requirements that a capital market regulator may impose on a bidder who is seeking to take over a publicly listed company. [4]
- 2** A government is introducing regulation of benefit schemes. The legislation will create the statutory role of an Actuary for each scheme. The Actuary will be required to carry out a valuation of the scheme, using assumptions set out in regulations, to determine the future level of contributions, and to report the results to the scheme sponsors.
- (i) State the items the Actuary might be required to certify in the formal report on this valuation. [3]
- (ii) Discuss the issues that the Actuary should consider when preparing the report. [3]
- (iii) Outline the main items that would be included in the report. [3]
- [Total 9]
- 3** An employer sponsors a final salary benefit scheme. The scheme includes the following features:
- Employees who leave employment with less than 3 years' service receive no benefit. Employees who leave after 3 years are entitled to a deferred pension payable from normal retirement age of 65 — deferred pensions are not increased between leaving and retirement.
  - On death in service, the scheme pays a lump sum of 3 times salary to an employee's dependants. No benefits are payable on death in deferment.
- The employer wants to amend these features of the scheme to make it more attractive to potential new recruits. His objective is to do this without significantly increasing the cost of the scheme to the employer.
- (i) Discuss why the existing scheme design may not appear attractive to individuals who are being recruited. [3]
- (ii) Describe two changes to the benefit structure that might achieve the employer's objective, and explain how each change would achieve this objective. [4]
- (iii) Discuss the implications for existing scheme members if the employer amends the scheme in any way that makes it more attractive to potential new recruits without significantly increasing the cost of the scheme to the employer. [7]
- [Total 14]

- 4** (i) Outline the reasons why the claims experience of two major private motor insurance companies might differ significantly. [4]

A reinsurance company provides reinsurance cover on private motor insurance business.

- (ii) Discuss the principal ways in which the reinsurer might assist a new company to enter the private motor vehicle market. [10]  
[Total 14]

- 5** A life insurance company prices level immediate annuity contracts on the assumption that it will earn an investment return 0.75 percentage points per annum in excess of the yield on appropriately dated government bonds. It invests 75% of the single premiums received for this contract in corporate bonds and 25% in ordinary shares.

Discuss whether this investment policy is appropriate, identify the risks to the company from following it, and suggest possible alternative investment strategies. [15]

- 6** (i) Set out a possible structure for analysing the risks of a financial product provider. [4]
- (ii) Discuss the main management control systems that can be used by a life insurance company to reduce its exposure to risk. [5]

A life insurance company writes whole of life assurance contracts on the following bases:

- (a) non-linked, without profits  
(b) non-linked, with profits
- (iii) Discuss how the company can limit its exposure to mortality and investment risks in each of the above contracts. [8]  
[Total 17]

**7** Company A is a small life insurance company. It has never written with profits business, but writes a wide range of without profits non-linked and unit-linked business. New business volumes have been declining steadily over the last ten years. Company A's chief executive will be retiring in the next twelve months. Company A is a wholly owned subsidiary of Company B.

Company B is a large general insurance company with a substantial share in the market for domestic residential property insurance. Both Company A and Company B have concentrated their marketing initiatives towards members of the legal professions in the country concerned.

Company C is a medium-sized mutual life insurance company, writing all classes of with and without profits business, and operating across the whole market.

In the territory in which all three companies operate, the regulatory capital requirement for insurance companies is based on the risk profile of the company's business, subject to a minimum monetary amount.

Company B is seeking to dispose of Company A, and has asked interested purchasers to make an indicative offer prior to entering into a due diligence and detailed assessment period.

- (i) Outline reasons why Company B might be seeking to dispose of Company A. [5]
  - (ii) Discuss the financial and operational issues that Company C would have to consider before deciding whether to make an indicative offer. [10]
  - (iii) Describe the calculations that Company C would undertake in order to quantify its offer. You should describe how to deal with the limited amount of data available at this indicative offer stage. [12]
- [Total 27]

**END OF PAPER**

# EXAMINATION

September 2006

## Subject CA1 — Core Applications Concepts

### Paper 2 (Liabilities and Asset Liability Management)

## 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.

M A Stocker  
Chairman of the Board of Examiners

November 2006

### Comments

Individual comments are shown after each question and within each question where relevant.

### General comments

*As the title of the course suggests, this subject examines applications of the core techniques and considers broad actuarial concepts in practical situations. 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 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** Require disclosure of large purchases.

Require disclosure of a purchase that takes a holding over a threshold.

Require a pause in further purchases when a bidder's holding reaches a threshold, and then require the bidder to make an offer for all remaining shares.

Restrict a bidder from retracting an offer.

Set a limited period for a full bid to be completed, and prevent further bids within a prescribed period.

Control any bids where the bidder/target would together have market domination.

*Comments on question 1: This question was generally well answered.*

**2** *Marks were given for relevant points, even if made in the wrong part of the candidate's answer*

(i) Proper records/data have been maintained for the valuation.

Statement of the funding level (assets/liabilities).

Opinion on whether there is proper provision for the liabilities.

Statement that assets/liabilities have been valued in accordance with the legislation.

Statement that liabilities and assets have been valued consistently.

Statement that contributions are sufficient to enable the scheme to meet the pensions promised.

An assessment of the future contribution rate on the statutory basis.

(ii) Be aware of the sponsor's potential conflicts - possible responsibilities to the scheme, the members, and to the shareholders of the employer.

Be aware of his own conflicts of interest if he advises scheme trustees or sponsors for other purposes.

Ensure that advice is clear and appropriate to the client's understanding.

Be aware of the specific scope of the role.

Take account of any relevant professional guidance.

Consider the suitability of and any gaps in the prescribed assumptions.

(iii) Explanation of the statutory basis.

Comparison of the statutory basis with any previous funding approach.

The data sources and any caveats regarding the data.

Analysis of changes in the data since the previous valuation

Analysis of changes in scheme surplus since the previous valuation.

Set out the benefits valued

Alternative contribution strategies (if permitted by regulations), and the implications of each for cashflow/security

Alternative uses of surplus.

Interaction between investment strategy and the statutory valuation

***Comments on question 2:*** *Part (i) was bookwork. The purpose and how the basis was to be chosen were set out in the question. A lot of candidates missed this and discussed the sort of valuation and how different bases could apply, for example for accounting purposes or a range with margins for prudence.*

*Part (ii) was less well done. Many candidates talked in bland generalities about taking account of all stakeholders or taking account of the readers of the report. There wasn't much of an attempt to tailor the standard wording in the course to the particular circumstance.*

*Most candidates covered the broad issues in part (iii) but didn't really describe the issues in the context of the question. Surplus and how/why it has changed was usually covered but most missed the issue of a change in basis.*

- 3 (i) If the employee leaves within 3 years, they get nothing. Even leavers with three years service get a fixed deferred pension that will not be worth much at retirement and has no value on death in deferment.

The absence of revaluation skews the value of the deferred benefit to older recruits.

Potential recruits don't know if they will stay long at the company - this is not necessarily in an employee's control.

Once significant service has been built up, the difference in value between the accrued pension on remaining in service and the accrued deferred pension will be large. This loss of pension will magnify the cost of potential redundancy. This redundancy risk may be one that prospective employees are not prepared to take. =

- (ii) *Marks were given for any two suggestions. Four possibilities are given here but credit was given for any other sensible suggestion. Suggestions had to be a change to the structure stated in the question, so no marks were given for commenting on portability, etc.*

Remove/reduce the 3-year nil benefit period.

Fairly small cost (if no revaluation) even if a high proportion leave within 3 years, but may have a high perceived value for new employees.

Introduce some form of revaluation to deferred benefits.

Likely to be significant cost, so will need to adjust other aspects (e.g. accrual rate or employee contribution rate) to re-balance.

Higher death benefits in deferment.

Meets employee's immediate concerns, so high perceived value, at relatively small cost.

Offer some form of defined contribution benefits.

Benefit value can be independent of age, and may be more obvious to younger employees. Need to consider the impact of possible significant changes in structure on administration costs.

- (iii) Cutting the nil benefit period is likely to be of such low cost that the employer would accept the increased contributions (if any). This will only affect existing employees with less than three years' service, and the new benefit would probably be extended to them.

Increasing death benefits say from three to four times salary would also be of low cost, as would paying a benefit such as the current value of the deferred pension entitlement on death in deferment. These costs might also be accepted by the employer, and extended to existing employees.

The employer would see no need to improve the terms for *existing* deferred pensioners, as they have already left employment. Greater increases in death benefits would be more costly.

Adding revaluation to deferred pensions would make the value of accrual more even over an employee's career.

The obvious route to improving benefits without adding to employer costs is to increase the employee contribution rate.

Employment legislation might make this difficult for existing employees, so the changed terms could only apply to new joiners, who pay a higher contribution rate. Recent recruits may be dissatisfied at not being offered the improved benefits.

Offering an option to existing employees might be anti-selective — those expecting to benefit from the option would be prepared to pay the higher contributions.

If neither employee nor employer contributions change then the effect must be to provide more to an employee who leaves and less to an employee who stays until 65, which would mean reducing the retirement benefits in some way.

Any such change would be adverse on existing employees and may not be possible as it would be a worsening in their terms of employment, unless they agreed to it or the reductions only applied to future service.

***Comments on question 3:***

*In part (i) candidates who concentrated on looking at the benefits specified in the question did well. Those who invented other benefit features, or who assumed that benefits not mentioned didn't exist, did less well. Better candidates commented on how the value of the benefit depends on the employee's career progression, which is uncertain. Part (ii) was generally well answered, with most candidates making sensible suggestions for changes.*

*Part (iii) was not well answered. Many candidates did not look to identify the range of benefits that could be increased at very little cost. Most identified that improving the more expensive benefits would be detrimental to existing members, if total cost was to remain the same, but very few commented on rebalancing benefits from late-career towards early-career.*

**4** (i) Experience may differ as:

The policies include different insurance coverage — for example inclusion of legal expenses insurance.

The companies may have different NCD or XS structures, which result in different claims patterns, even if the patterns of all claims are similar.

The companies impose differing underwriting procedures/guidelines or acceptance criteria.

There are differences in claim control — in particular the amount at which claims are accepted without investigation.

The companies have a different mix of business which exhibit different claims patterns, perhaps because of different target markets due to different sales channels, reputation, strategy, geographical location, etc., or due to the mix between comprehensive and third party only cover.

The companies may operate in specialist markets — for example concentrating on motor bikes or classic cars.

The companies have different reinsurance programmes, affecting their net results.

The companies have different reserving methods for reported and unreported claims.

- (ii) Reinsurance can limit the exposure to risk for the company, and can assist in avoiding large single losses or writing large risks. Reinsurance can provide protection against whole account adverse experience, either claims fluctuations, for example through excess of loss reinsurance, or catastrophes.

This may be vital to a new company to improve the statutory solvency position.

Stability of profits will be an advantage for a new company.

However, in general the reinsurer will load the reinsurance premiums for profit and contingencies, so a disadvantage to the company is that some of the profit will be passed to the reinsurer.

A balance between the risks and the costs of mitigating them must be struck.

The reinsurer can provide expertise on underwriting, product design, system design, and likely future experience, which the new company will initially lack as it has no past experience.

The reinsurer may also provide administration, actuarial services and other insurance advice, which may be at a competitive price for a new insurer. This generally means a reinsurance contract must be purchased, which may effectively tie the company to a single reinsurer from which it cannot readily escape if reinsurance terms deteriorate.

Reinsurance can also allow risks to be spread and a larger portfolio of risks to be written, for example through quota share reinsurance, which may be advantageous to the new company as a means of diversifying its portfolio.

Quota share will cede the same proportion of each risk, irrespective of size or variance, and a new company would ideally wish to cede only the larger, higher variance risks.

Reinsurance can also reduce the capital strain involved in writing new business, as the reinsurer will take on part of the new business financing requirements, which may be beneficial to the new company as it grows.

*Comments on question 4: Part (i) was generally well answered, with the better candidates adapting the general issues to the particular situation fairly well. In part (ii), few candidates answered at sufficient length for the marks available. For all its benefits, reinsurance does mean paying away part of the expected profit on the business reinsured. Very few candidates examined reinsurance from an explicit cost/benefit perspective, which route would have helped gain marks.*

**5** The **general principles** of investment are that:

A provider should select investments that are appropriate to the nature, term and currency of the liabilities and the provider's appetite for risk.

Subject to the above, the investments should also be selected so as to maximise the overall return on the assets, where overall return includes both income and capital.

To the extent that the company does not follow these principles it opens itself to risk.

### **Matching**

The liabilities are of known amounts at known times (provided mortality fluctuations can be ignored). Hence the natural matching assets are fixed interest guaranteed bonds.

The company will need to earn a rate of return in excess of 0.75% over the returns available on government bonds in order for the annuities to be profitable.

It may achieve this by investing in assets other than government bonds, but the company could face the risk of insolvency if it adopted an investment policy similar to that described in the question.

### **How far to mismatch**

Some risks may be unavoidable — for example matching assets by term may not be available, hence reinvestment risk — and the investment policy should be to minimise the risk, for example by immunisation.

The extent to which the company is able to take risks by departing from the above principle in order to maximise returns will depend upon the level of the company's free assets. If there are large free assets, then the company can take a long-term view of the returns it might earn on ordinary shares and use the free assets to protect it from short-term fluctuations in value.

## **Equities**

Equity values are volatile, so a large equity content is likely to lead to greater capital requirements. Over the long term, the shares might be expected to produce the required extra return above government bonds. However, there is no guarantee that this return can be earned over the duration of any particular block of business.

Using ordinary shares means that the liability outgo of the annuity portfolio cannot be matched.

## **Corporates**

Bonds issued by supra-nationals, for example the European Investment Bank and the World Bank, are guaranteed by a group of governments. There is negligible risk of default but they offer a higher yield than government bonds because of poorer marketability.

Corporate bonds will typically offer an even higher return to reflect both the poorer marketability and the risk of default. The default risk may be more acceptable than the risks of equity investment to gain the additional return required. Poorer marketability may not be an issue if it is possible to match the liability outgo of the portfolio since it is assumed that the assets will be held to maturity.

## **Alternatives**

It could invest in a portfolio of government bonds and attempt to increase returns through switching activity. It is unlikely that switching activity would generate an adequate additional return.

Overseas assets might give higher yields, but the currency risk needs to be taken into account.

A derivative/swaps/options strategy might increase returns, but costs may be prohibitive.

## **Expenses**

Future expenses are likely to increase in real terms, and a matching asset with similar characteristics is appropriate. Equities or index-linked bonds may be a good match.

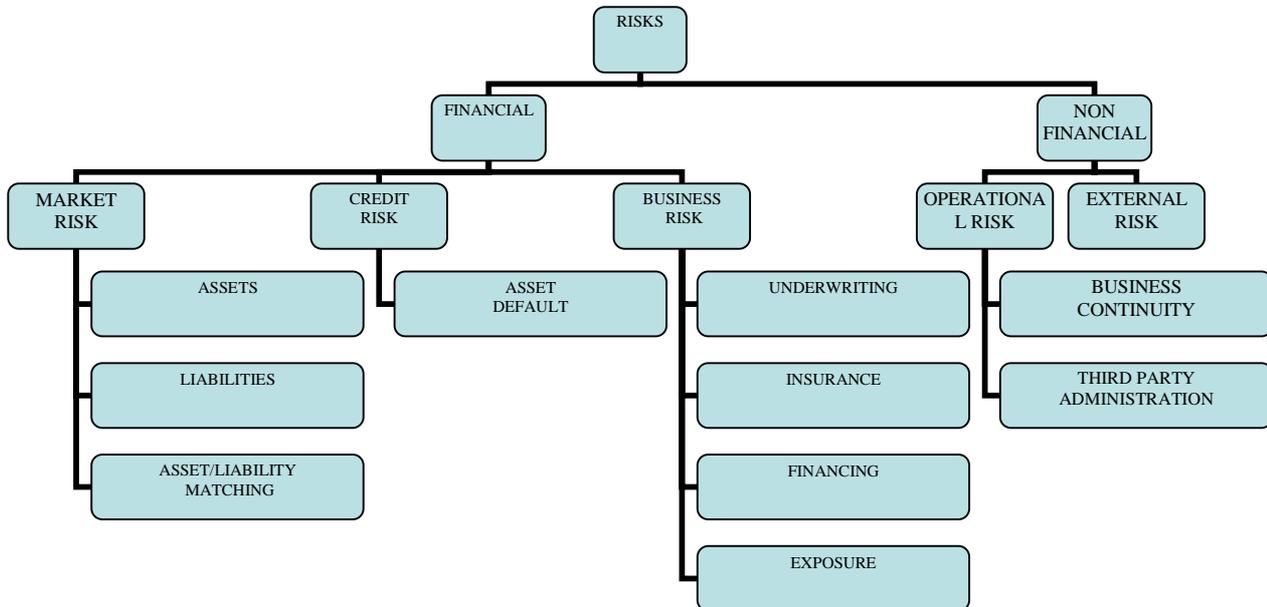
### ***Comments on question 5:***

*A surprisingly high number of candidates did not start this question by stating the general principles of investment. This is an important starting point for any practical problem around an appropriate investment strategy. Many candidates missed obvious marks by not describing the nature of the liabilities, and hanging their solution on that.*

*In terms of alternative strategies, many candidates proposed a different mix of bonds and equities, but very few considered other asset classes or alternative investment strategies. A number of candidates suggested redesigning the contract or increasing the premium, or just*

said the strategy was hopeless. The examiners were looking for a balanced argument where there is no perfect solution, as often happens in real life.

6 (i) A possible risk analysis structure is given in the following diagram:



One could add counterparty risk in the credit risk area

*It was not necessary to reproduce this diagram to gain the marks. Any other form of diagram, or a description in words was accepted.*

(ii) **Data recording**

Holding good quality data on all insured risks can assist in ensuring adequate provisions are established for those risks, and reduce the operational risks from having poor data.

#### **Accounting and auditing**

Good accounting and audit procedures enable proper provisions to be established, regular premiums to be collected and claims paid, and the providers of finance to the company to be reassured as to its financial position.

Good data recording and accounting and auditing procedures cannot change the company's exposure to the business risks underwritten, but they can protect against fraud.

Regular monitoring using the control cycle (including investment performance).

### **Monitoring of liabilities taken on**

This can protect against aggregation of risks of a specific type to an unacceptable level. It can also quantify the amount of new business to ensure that it is within the provider's resources.

In addition, since premium rating may involve cross subsidies from one type or class of business to another, then this can monitor the business mix achieved in practice against that assumed in the premium rates.

### **Monitoring options and guarantees**

Monitoring the state of options and guarantees offered in contracts can highlight where other risk management techniques may be useful in protecting the company.

#### **(iii) Mortality risks**

On a without profits basis, the death claim value is guaranteed.

Underwriting will be a significant means of limiting exposure to mortality risk. It will help in ensuring that actual mortality experience does not depart too much from that assumed in the pricing of the contracts being sold.

Reinsurance can be used to pass all, or a portion of, the risk to the reinsurer, although reinsurance also passes on profit making ability.

Diversification will assist in minimising the mortality risks — for example, diversification of lines of business and geographical areas of business.

### **Investment risks**

Diversification of investments will assist in minimising the investment risks, as will matching those assets which back the guaranteed liabilities as closely as possible. In practice matching can be difficult because of the long term of the liabilities.

Alternative risk transfer methods — such as swaps/derivatives — may be useful in this situation.

### **Issues specific to without/with profits**

For a without profits contract the full risk is borne by the company, the whole of the liabilities are guaranteed, and are theoretically able to be matched. For with profits policies, the policy value can reflect actual experience and so pass some of the risk to the policyholder. However, as payouts are generally smoothed, the company will pick up some risk in periods of volatile investment returns.

On a with profits basis, the final payment to maturing policyholders can be determined by consideration of the actual mortality experience of a group of policyholders. This is particularly the case if there is a significant final bonus that is not guaranteed until the date of payment. However, there may be practical constraints, for example due to guarantees or policyholder expectations.

***Comments on question 6:***

*Candidates who understood what part of the core reading the question was referring to managed to score well in parts (i) and (ii), which were essentially bookwork with some straightforward applications. Other candidates struggled to score many marks at all. Structured risk analysis is becoming an increasingly important part of the management of any business. Part (ii) was looking for high level management control systems, not individual techniques for risk reduction and mitigation such as reinsurance and underwriting.*

*In part (iii) the without profit sections were answered well, but most candidates did not explore the operation of with-profits in enough detail. They therefore missed some of the key points around managing a with-profits portfolio, such as delaying the granting of bonuses and that mortality experience will also be reflected in the bonuses declared. The weaker candidates filled up the space with digressions that did not answer the question asked.*

**7 (i) Company A is no longer core business for Company B.**

Profits may be declining or losses may be appearing.

Falling volumes of new business will increase unit costs (per policy). There will be compliance and management overheads that cannot be reduced in proportion to business volumes.

In force policy volumes will also be falling. Expenses will be increasing in excess of inflation.

Because a prudent provision for future expenses will be made in the valuation basis, this will increase the capital tied up in provisions.

Some overheads, such as office accommodation may be able to be absorbed by Company B.

Specialist skill sets may be in decline.

This will be exacerbated by the retirement of the CEO.

The flat monetary capital requirement for Company A may exceed the risk-based calculation. This would tie up Company B's capital, which it needs to support or develop its own business.

The alternative of developing attractive products for the target market may be seen as too risky. Expensive and with unknown probability of success.

- (ii) As it has no shareholders, Company C will have to regard the business as an investment for its policyholders fund.

It is an equity-type investment and so is only suitable to back with-profits business.

A standard risk assessment will be required.

Is it the best use of Company C's capital?

Without the sales link through Company B's market contacts will any new business at all be written through the legal profession. Alternatively, will the contacts that come with Company A's business enhance sales of Company C's products — i.e. is there any goodwill.

Company C may have limited access to capital to finance the acquisition externally, as it is a mutual. It needs to determine whether it has enough capital to invest., given that Company C will still need to demonstrate continued solvency on the supervisory basis.

Depending on the market it operates in, Company C may need to be able to demonstrate significant assets in excess of minimum requirements in order to maintain new business.

Can company C avoid putting up the flat monetary amount of capital — can it consider merging Company A's business into Company C rather than maintaining a subsidiary. (*Lots of issues here — outside the scope of the course and the question.*)

Will the business be able to be run on Company C's administration systems, or will two systems have to be maintained for a period — and how long.

Staff issues will need consideration:

- Where are the companies located.
- Will any staff transfer.
- If staff transfer, are there salary and benefit differentials that may cause problems.
- Can any staff who don't transfer be absorbed by Company B.
- What are the redundancy terms for others and who funds them.
- Pension issues for everyone.
- Can additional staff be recruited in company C's location if necessary?

Can all the Company A business be administered from Company C's existing premises, or will additional accommodation be needed. Will there be any savings in unit costs that will result in valuation expense loadings for the acquired business being reduced.

Are there taxation synergies, or taxation disadvantages.

Does it fit with C's operational culture (customer service, etc)

As Company C is a mutual, there are issues regarding membership for A's policyholders to be addressed, depending on its constitution.

Does it need C's members' approval. Might the regulator/competition authorities intervene?

- (iii) Company C will have to use data that is either in the public domain — statutory accounts, regulatory returns (if available), or data that is supplied to all interested parties by Company B.

Company C will have to approximate company A's business by using the models it has developed for its own business. The wide range of linked business in Company A may give rise to some difficulties.

Company C will have to estimate how the latest published data will move forward to the intended acquisition date. A history of past data may help do this.

Depending on its accounting policy, Company B might have published some sort of value of Company A's future profits in Company B's accounts. Attempts could be made to verify this, which would add validity to any models used. The value of Company A will be the sum of the shareholders' net assets and the discounted value of the future profits expected to emerge from the existing business.

The first item will usually not be difficult. Both Company B and Company C should have valued it similarly. Company C will want to assess the present value of future profits both as Company B might view it, with the existing operational position, and as it expects it to be after a sale, taking account of expense and tax synergies.

It will also be necessary to quantify the capital requirements and calculate the expected return on capital.

Company C will use its own business model, modified for the different contract types and other features. Because of the limited data the value after sale will need to include margins for data and model error.

This could be done by increasing the risk discount rate. But this approach reduces the value of the most distant cash flow, while leaving near ones little changed. Data difficulties may affect the near cash flows just as much as the distant ones. Thus it might be better to add margins into the cash flows before discounting.

Company C would need to decide whether to make any allowance for goodwill/brand — the value of future new business for Company A. In these circumstances, probably not.

Company C would hope that the assessment of the value of the business to Company C is greater than the value assessed by Company B. Thus an

indicative price between the two values would appear to give benefit to both vendor and purchaser.

Economies of scale from the acquisition will also affect Company C's business, reducing unit costs. It might be possible to reduce valuation expense loadings, which would release capital.

The costs of the transaction would need to be estimated and included.

***Comments on question 7:***

*Generally part (i) was well answered with most picking up the main issues. Not enough was said in the main on expenses or unit costs (most said low profits but didn't link it to expenses) particularly in the context of falling volumes. The flat monetary capital point was only mentioned by the better candidates. Many got too subjective about why A was doing badly and the consequences of this — hence inventing their own question.*

*In part (ii), few candidates recognised that as a mutual, Company C would need to purchase Company A as an equity investment in its policyholders fund. Some talked simply of merging the two business without providing recognition of the complexities that merging a with-profits company and a non-profits one would entail.*

*Often parts (ii) and (iii) were mixed up together and this lead to a lot of repetition. Marks were given wherever valid points were made. Very few candidates dealt with the limited data issue, which was specifically highlighted in the question. This element of the question required little more than some applied common sense but it clearly worried many candidates.*

**END OF EXAMINERS' REPORT**

# EXAMINATION

11 April 2007 (pm)

## Subject CA1 — Core Applications Concepts

### Paper 2

*Time allowed: Three hours*

#### **INSTRUCTIONS TO THE CANDIDATE**

1. *Enter all the candidate and examination details as requested on the front of your answer booklet.*
2. *You have 15 minutes at the start of the examination in which to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have three hours to complete the paper.*
3. *You must not start writing your answers in the booklet until instructed to do so by the supervisor.*
4. *Mark allocations are shown in brackets.*
5. *Attempt all 7 questions, beginning your answer to each question on a separate sheet.*
6. *Candidates should show calculations where this is appropriate.*

#### **AT THE END OF THE EXAMINATION**

*Hand in BOTH your answer booklet, with any additional sheets firmly attached, and this question paper.*

*In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator.*

- 1** For money market instruments:
- (a) Describe the principal characteristics.
  - (b) Describe the markets and the market-makers. [4]
- 2** A company has issued a corporate bond with an option to convert it into the ordinary shares of the company.
- Describe possible methods of valuing this bond. [7]
- 3** A proprietary general insurance company writes several classes of business.
- (i) Discuss the consequences of underestimating the effect of inflation when setting the claims reserves. [5]
- A director has suggested that in order to maximise the returns to shareholders the free reserves should be invested in high growth equities. The company has a high level of free reserves.
- (ii) Discuss the suitability of the suggestion. [3]
- [Total 8]
- 4** (i) Outline the considerations that need to be taken into account when designing an insurance proposal form. [5]
- An insurance company has decided to start selling health insurance.
- (ii) List the information from the proposal form that will need to be considered when pricing such a policy. [4]
- [Total 9]

- 5** (i) List the areas where an actuary could give professional advice to a manufacturing company. [5]

A manufacturing company offers its employees a salary continuance benefit that comes into payment in the event of long-term absence through ill-health. It also sponsors a defined contribution pension plan to which the employer contributes 10% of each employee's basic salary.

The salary continuance benefit is currently insured. The main features of the benefit are:

- The benefit is payable after continuous sickness absence of 10 weeks, up until the employee's 65<sup>th</sup> birthday or earlier return to work.
- The benefit payable is 70% of the employee's basic earnings (pre-sickness), increasing annually at a fixed rate of 4% per annum.
- During payment of the benefit, the employee remains a member of the pension plan and continues to accrue benefits – the insurance meets the cost of the 10% pension contributions.

The company has asked how it could reduce the cost of the salary continuance benefit.

- (ii) Discuss the actions the company can take. [10]  
[Total 15]

- 6** An insurance company in a small developed country is pricing a range of annuity contracts for the first time. It wants to understand the mortality risk it may be exposed to.

- (i) List the types and sources of data that the insurance company could use in its investigation. [4]
- (ii) Assess the issues relating to using these data sources to determine the potential mortality risk [16]  
[Total 20]

**7** A major professional sports team is based in a stadium complex near the centre of a large provincial city. The majority of the shares in the club are under the control of one family. The shares are not quoted. An investor has been offered the chance to buy a significant block of shares.

- (i) (a) Suggest reasons why the shares may have been made available.
- (b) Give reasons why the investor may wish to invest.
- (c) Outline specific features of the club's balance sheet that the investor should consider before investing. [12]

The club currently does not provide pension benefits for any of its employees, but it is considering introducing them.

- (ii) Describe the two main types of pension benefit schemes that could be provided. [3]
- (iii) Discuss the appropriateness of each type of scheme in (ii) for the club and the different groups of people it employs. [7]

The club is reviewing its group arrangements for life assurance, long term sickness insurance, and accident insurance.

- (iv) State the general features of these markets. [3]
- (v) Discuss how the mortality and morbidity experience of the club's employees may compare to that under other group arrangements. [6]

The club has recently signed a star player from overseas, who has asked for investment advice.

- (vi) Outline the major points that would be made and the information required to carry out an appropriate assessment. [6]

[Total 37]

**END OF PAPER**

# EXAMINATION

April 2007

## Subject CA1 — Core Applications Concepts

### Paper 2

## 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.

M A Stocker  
Chairman of the Board of Examiners

June 2007

### Comments

*As the title of the course suggests, this subject examines applications of the core techniques and considers broad actuarial concepts in practical situations. 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 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.*

Comments on individual questions are given in the solutions that follow.

- 1** The market is dominated by the clearing banks who use the instruments to lend excess liquidity funds and to borrow when they need short term funds.

The loans and deposits are very short-term investments, often overnight, and the instruments are generally very marketable and very secure.

Interbank rates are usually taken as the benchmark for short term interest rates.

Central banks, as lender of last resort, stand ready to provide liquidity to the banking system. Central banks also use their own operations to establish the level of short term interest rates.

The money market is not a physical market.

*This was a basic bookwork question and well-prepared candidates therefore gained high marks. Some students listed all the different types of money market instrument — this was not a good use of time, as it does not directly answer the question.*

- 2** The approach to valuing the bond depends on the bond yield, conversion option price, current share price and the term outstanding.

The quoted market price of the convertible would also be considered if it were available.

A number of other approaches are possible:

### **Discounting the future income stream**

Consider the convertible bond as having two components:

A fixed income stream until the date of conversion.

A stream of dividends starting at the date of conversion.

The date of conversion is then taken as the date for which this present value will be maximised. This is the first date at which the dividend income on conversion exceeds the fixed income from the bond.

It is necessary to make the following assumptions when using the method:

The rate of dividend growth on the underlying equity stock.

The investor's required rate of return.

### **Comparison with the share price**

A convertible can be valued by considering it as equivalent to the underlying share plus an extra amount of income for the period until conversion.

Thus the value of the convertible is taken as the market price of the underlying share plus the discounted value of the income received in excess of ordinary dividends in the period before conversion.

### **Comparison with loan stock or preference share price**

This is a corporate bond with an option; therefore the value should be a minimum of the current value of an equivalent loan stock or preference share issued by the company ignoring the option to convert.

### **Option valuation method**

Option theory can be used to value the bond including the embedded option to convert. Using option pricing theory a convertible can be valued as a loan stock plus the value of the option to purchase the underlying shares.

*In contrast to question 1, this was an application question. Many candidates simply regurgitated bookwork descriptions of market value, smoothed market value, book value, adjusted book value, fair value etc, without considering whether they were appropriate to this particular security. Very few candidates realised that conversion will take place once the dividend income exceeds coupons. The candidates who did well were those that recognised the importance of the option and its inherent uncertainty, and considered how best to deal with that feature.*

- 3** (i) If inflation is underestimated then the liabilities will be understated in the accounts and the apparent solvency will be overstated.

Excessive profit will be disclosed, which will lead to a higher tax charge and possibly excessive dividend payments, which in turn may lead to future solvency problems.

Investment freedom will initially appear to increase and the company may apply assets to other projects.

Inappropriate reinsurance arrangements may be set in place.

If too low a rate of inflation is used for pricing new business, then the premium rates charged would be too low. If the position is reassessed at a later date, adverse market reaction may make it difficult to attract good business in future and there may be problems with the regulators.

- (ii) Provided that the reserves are calculated on a prudent basis, the company may have sufficient free reserves to adopt an aggressive investment strategy.

However, the first priority of the company and the shareholders is to meet their liabilities towards the policyholders, and so the investment of the free reserves should not be considered as a separate action from the overall investment policy.

The shareholders, the owners of the free reserves, are rewarded by the overall profits of the company and so their investment should be rewarded on the basis of the company as a whole, not just the investment vehicle.

If the shareholders wish to invest in high growth equities they can do so directly, rather than through the shares of this company.

Other options for the free reserves should be considered and assessed against this proposal.

*Candidates who considered the range of practical effects of underestimating inflation in a logical manner scored highly: thinking about reserving, profits, tax, reinsurance, pricing etc. The candidates who didn't move past the theoretical — assumptions, types of inflation, claims models — didn't score as well. Many candidates described under-reserving as being a direct threat to solvency and described at length the consequences of insolvency. They did not realise that this is only the case if the company decides to do something else with the assets that would otherwise be supporting the (higher) reserves, such as distributing them to shareholders or undertaking a high risk investment strategy.*

- 4** (i) When determining the premium to charge for a risk, the prime information source will be the details given on the proposal form. It is therefore important that it produces relevant and reliable information for the system. Subject to this, there are marketing advantages in having in having as short a form as possible.

Questions need to be well designed and unambiguous, so that the proposer will give the full, correct information and the underwriting department can process the application readily, adding any coding that is necessary.

In particular the form will need to identify risks where further information will need to be sought.

The form must comply with relevant regulation — for example, in relation to age discrimination.

Regardless of regulation, the market acceptability of the form should also be considered — for example, questions regarding genetically transmitted diseases may not be deemed ethically acceptable in the market.

This information (together with any subsequent changes) will need to be held for a number of purposes, including cross-checking against the claims information at the time of any claim. This should enable the automatic checking of the validity of the claim and the updating of the policy information.

Detailed information on the risks accepted will enable appropriate provisions to be determined for the liabilities taken on.

(ii) Information:

Current age and gender of policyholder  
Smoker/non-smoker  
Height & weight  
Alcohol consumption  
Type of cover (hospital type, group or individual)  
Extent of cover (excess, limits)  
Occupation / income  
Medical information — both past history and present conditions  
Address, as an indicator of likely regional hospital costs  
Relevant family history.

*This was a standard piece of bookwork, and was answered well, although some candidates padded their lists in part (ii) with a host of irrelevant items.*

**5** (i) Advice regarding:

Protection against financial loss arising from employees' death or ill-health, in particular for key individuals.

Insurance protection of tangible and intangible assets.

Risk analysis and mitigation.

Provision of benefits that will attract and retain good quality staff, and managing the operation of the pension and ill-health schemes.

Advising on legislation or tax.

Managing the costs of running the business.

Quantification of the amount of surplus capital in the business.

Investment policy.

Raising additional capital.

Project appraisal and project management.

- (ii) The cost of the salary continuance benefit equals the cost of benefit payments plus expenses plus insurance loadings.

Could control benefit costs by restricting eligibility, for example, only to employees with more than two years' service.

Could control benefit costs by altering the benefit terms:

Increasing the waiting period.

Reducing the maximum age.

Ceasing the benefit after a fixed period of payment (say 10 years).

Reducing the initial level of benefit or offsetting any state ill-health benefit payments.

Restricting the pension contributions (e.g. freeze at pre-sickness level).

Reducing/removing/capping the annual rate of increase.

Introducing a more restricted definition of ill-health.

Could control benefit costs by more effectively managing ill-health absence, such as requiring medical reports both during the deferred period and during payment of the benefit, or by introducing a specialist firm to manage ill health absence more effectively and successfully.

Could try to reduce incidences of ill-health through lifestyle management and health and safety policy at work — e.g., on-site smoking policy.

Could control finance costs by changing or reviewing the insurance provider and by reviewing how much of the benefit to insure (say, could self-insure payments up to 12 months).

Could control its own expenses of managing the benefit (although most expenses effectively passed to the insurer).

Could stop the benefit altogether either for all employees or just for new employees.

*Although part (i) was only seeking a list, candidates needed to write down more than single words to show they had a grasp of the context of the question and gain full marks. For example, "Capital" wasn't enough, but "how to raise capital", or "working capital requirements" was. In part ii), candidates who used the product details to generate actions scored reasonably. Those who scored well used all the information given in the question and considered the wider options that may be available, considering expenses, insurance, management options, etc.*

**6** (i) Data that could be used:

Historical population data for country  
Historical insured life/pension scheme data for country  
Projections of mortality improvement for country  
Historical population data for other similar countries  
Historical insured life/pensions scheme data for other similar countries  
Projections of mortality improvement for other similar countries  
Medical papers about future longevity  
Research papers by experts  
Any data that the insurance company or its reinsurers have

- (ii) Past data can be used to project future mortality improvements, however, the conclusions will rely considerably on use of judgement. Due to the uncertainty it may be useful to compare the actuary's judgement with the range of views within the industry.

In a developed country it is likely that extensive population data will be available, though whether there is significant insured life/pension scheme data depends on whether and for how long annuities have been available in the country.

The country is small so the volume of data will mean it has lower credibility, particularly if there are significant numbers of sub-divisions. Data may be over-simplified or not detailed enough.

It is important that the past data used is relevant to the group of individuals about whom assumptions are to be made — for example, general population data may not be relevant for use with insured lives. The insurance company's own past data may relate to different products.

Using data from other countries would alleviate some of the data shortage, however, it will be necessary to either adjust the data or at least recognise differences between the countries both now and historically over time.

The social and economic conditions are likely to have changed to some degree over any period of history. This will affect the factors that the actuary needs to project. The actuary therefore needs to consider the conditions that will apply in the future period to which the projections will relate and how those conditions will lead to a difference from the past data that is being used.

The relevance of past data to future projections must also be balanced against the need for sufficient data for its analysis to be statistically credible. The actuary must manage this conflict between credibility and relevance.

When using past data the actuary therefore needs to consider how to deal with:

- Abnormal fluctuations
- Changes of the experience with time
- Random fluctuations

- Changes in the way in which the data was recorded
- Potential errors in the data
- Changes in the balance of any homogeneous groups underlying the data
- Heterogeneity with the group to which the assumptions are to relate
- Effects of economic changes
- Effects of healthcare and lifestyle changes

Mortality data is affected more by medical advances than by economic circumstances. Past data should be considered with this in mind. This is likely to result in significant emphasis being placed on the most recent data, with consideration of past trends and their underlying reasons being important in determining the extent of future change.

Because the mortality data is significantly affected by medical advancements, it will be necessary to consider the views of doctors and other healthcare professionals to understand the range of views about future medical advancements when determining the range of potential future changes.

*The candidates who performed best on this question were those who used well the core reading information and lists on data issues, especially the section on using past data. Many answers to part (ii) were unspecific and repetitive. To score reasonably, it was necessary to ensure that the answer to part (ii) covered all of the sources identified in part (i). The better candidates noted that longevity improvements are the key to annuitant mortality, and used this feature as base to hang a logical discussion on.*

- 7** (i) (a) There are two main reasons: either to raise money for the club; or to raise money for the family.

The club may want to use the money to develop the stadium and its facilities, or to use spare land for related purposes, such as a hotel or conference centre.

It may wish to buy new players, expand into new areas linked to sport, e.g. clothing, or expand into other sports and set up new teams.

It may have large debts or other liabilities (e.g. tax) that it wants to clear.

The family members may be getting older and have lost interest, with no clear succession. They may wish to cash in part of their investment. If more investment is needed outside investors may have more resources.

External shareholders may bring in better management and financial discipline, which could benefit the family longer term. This could a first step to gaining a quotation.

- (b) The main reason would be because he expects to get a good return. The investor may consider that the club or the sector (sport) has good medium or long term prospects.

The sector may be becoming fashionable or other club specific developments may be about to happen, such as sponsorship deals. This could give rise to possible short-term speculative gains.

The investor may have other operations, such as media subsidiaries that could lead to gains from synergies.

This investment will have particularly different features to other traded shares, and therefore the investor could benefit from diversification.

*The reason was required to gain credit — “diversification” on its own was not sufficient as an answer.*

Sport could be the investor's area of expertise or it may be his narrow investment objective.

Depending on the site, it could be viewed as a property investment with large development potential.

The investor may see it as an ego boost or as a glamorous “hobby” — so not really a commercial investment.

- (c) The balance sheet will set out the assets and liabilities of the club. The investor would want to check that nothing unexpected was present and that what they expect to see is covered.

A major point will be to check that the values given in the balance sheet are realistic and to consider the accounting regime under which they are prepared.

The club may have significant land and property assets or it may rent the ground from others. The ownership needs to be clarified and the realistic value of any property assets assessed. The value as a sports complex may be less than that of a redeveloped site. Are there any covenants that could restrict the uses of the site.

The club may show sponsorship, merchandising or TV rights deals as assets. Are the values realisable and how are they depreciated.

If the club shows players as assets, on what basis and can the values be realised. The values can be volatile.

Given the ownership, the investor will need to look carefully at any loans: who they are they from (the family?); what they are secured against; what the repayment terms are - can they be called in immediately?

Consider any current liabilities carefully. Look for items that could cause problems such as unpaid tax, wages or other contractual obligations to players.

- (ii) The two types are defined contribution and defined benefits.

Under a defined contribution scheme, contributions are allocated to an account set up for each individual member. The benefits that each member is entitled to are those that can be purchased by the accumulated contributions. There is no cross-subsidy between members, as the cost of the benefits in any circumstance is met by the individual member's fund.

Under a defined benefits scheme, the scheme rules set out the members' benefit entitlements. The benefits are paid irrespective of the investment returns.

In a DC scheme the member primarily bears the investment risk whereas in a DB scheme the employer primarily bears the investment risk.

- (iii) Given the likely number of employees, resources may be scarce. Hence administration and complexity issues are relevant.

The legislative framework surrounding defined benefits schemes can be onerous. The employer may have to pay a lot for the requisite expertise.

The mechanisms in running a defined contribution scheme can be complex. However there may be providers who can handle all the administration for a fee.

A lot may depend on the practice within the country or industry. The employer will probably not wish to be too far out of line with similar companies. This will also encompass employee expectations.

Possible groups to consider are: players, coaches/managers, executives and other "normal" employees.

Players are likely to be on relatively short contracts. They are unlikely to stay for a long time. They may have a retirement age that is lower than normal, or be subject to a special legislative framework. Their earnings are likely to be high but volatile with lots of bonuses etc. The club may want to treat each player on an individual basis.

For these reasons the flexibility offered by defined contribution arrangements may be preferable.

Coaches and managers may be similar to players but may be older, and in general will stay for a longer time.

Executives may be offered relatively generous pension benefits, as they are usually a tax efficient way of gaining remuneration. Each executive may have

negotiated individual terms or may want flexibility from their pension arrangements.

Again, defined contributions probably offer the best means of tailoring and differentiating between executives. Alternatively, executives could be members of a company wide defined benefits scheme but also receive top up benefits from an extra arrangement.

The arrangements for the other employees may depend on the makeup of the workforce, the turnover rates, and whether the employer wants to provide the guarantees implicit in defined benefits schemes.

Credit was also given for other reasonable and well argued conclusions for these groups.

- (iv) Policies tend to be sold on a one-year risk premium basis.

Reserves under the policies are low.

Markets are competitive, with policyholders frequently changing insurers.

It is easy to compare rates, putting pressure on margins.

The value of a claim can be high relative to the premium charged.

Insured lives are often accepted with minimal underwriting.

Many policies are sold with exclusions or excesses, e.g. no payment if the claim arises from an excluded risk, no payment of the first £x of any claim.

Frequently market can be for a bundled product covering all these arrangements.

- (v) This is likely to be a small group and so the profile may be non-typical. The club is based in a provincial city and so local health or mortality factors could have an influence.

Again, consider the same possible groups: players, coaches / managers, executives and other “normal” employees.

Players are likely to be male, young and physically fit. One would expect them to have lower than average mortality rates. However sport can put a lot of strain on the body and so they may be more at risk from stress/cardiac complaints.

For similar reasons one might expect a lower rate of sickness. Depending on the nature of the sport, the risk of injury due to accidents may be higher than average.

The usual lifestyle issues associated with young men will be present to a greater degree, e.g. fast cars and fast living.

Accident experience may be reduced if players are prohibited from undertaking dangerous pursuits. Expert medical care could mean injuries or sickness doesn't last as long as for other group.

Coaches and managers will be older than the players and are likely to be fitter than the general population, though the role of manager may induce greater stress.

Executives and senior management will be hard to categorise. If ex-players are present, this could distort the experience. Experience for this group could be very variable depending on the lifestyle of the individual concerned. High living could imply higher mortality and sickness risk. But equally, affluence and education could imply the individuals take better care of themselves.

The remainder of the workforce are likely to be clerical, administrative, and manual ground staff. As such, their profile is likely to be the most similar to the general insured population in terms of age, sex and lifestyle.

However, this will depend on the nature of the employees covered by group schemes. For example, in an industrial economy these employees may have lower than average mortality and morbidity, but in a more service-based economy their experience could be assumed to be standard.

(vi) Information required:

- The length of the contract and what earnings potential exists after the end of the contract.
- The guaranteed level of income plus what the player expects from bonuses each year.
- Other sources of income, e.g. sponsorship or advertising deals.
- Where tax will be paid and at what rates
- Whether income can be paid overseas to minimise tax liability.

Sufficient information would be required to know the client prior to giving any advice - for example details of their family, their preferences and their habits.

After determining the level of income, the conclusion will be high income for a relatively short period of time.

Net income will need to be determined after looking at expected outgo. For example, the player may take a lax view on spending so leaving little for longer term investments.

Consider where the player will live — will the club provide or cover the costs or will the player buy or rent property from his own funds. Buying could be a sound investment in any event.

Consider the target date for retirement. For example, he may wish to have enough saved so that he no longer has to work from, say, age 35. In this case, the aim will be to accumulate funds to provide the player with the resources to fund his chosen lifestyle.

Although a high return from real assets may be the most obvious route, a more cautious view may be better if the player is going to rely on the fund for future income over a long period. For example, assets with secure income.

Allowance for existing assets may be relevant — but there may not be many existing assets if the player is relatively young. Existing liabilities and debts should also be considered.

The funds involved could be large and so diversity via direct assets could be possible. If not, indirect vehicles could be considered.

Overseas assets may be wise if the player is likely to return home or go to other countries at the end of the contract.

If the player foresees long term high earnings potential or wants to take a risky approach, then more speculative, higher return type assets or investments could be looked at, such as business ventures exploiting his name.

*Most candidates realised that despite being worth 37 marks, this was actually a set of shorter questions linked by a common theme, and most of the parts were answerable independently. Those parts of the question that are not bookwork required a logical approach that is related to the particular context of the question. In turn this required both general knowledge and common sense. Candidates who showed both these features usually did well.*

*In part (i) (a) relatively few candidates identified that there could be two distinct drivers: the desire of the **family** either to exit or to raise cash for personal reasons, and the need for the **club** to obtain more investment capital. In (c) many candidates described features that would not appear on a balance sheet such as revenue items.*

*Part (ii) was bookwork and generally well answered although the descriptions were often too brief relative to the three marks available.*

*The candidates who performed best in parts (iii) and (v) were those who differentiated clearly between the needs and circumstances of the different groups of employees. Some students simply wrote at a high level about the pros and cons of the two different types of pension scheme and did not apply their answer to the specific situation described, and therefore would not have done well on this question part.*

*Many candidates appeared to have mis-read part (iv) and described the **specific** features of each **product**, rather than the general features of the market, and consequently scored poorly.*

*Part (vi) was generally answered well.*

## **END OF EXAMINERS' REPORT**

# EXAMINATION

24 September 2007 (pm)

## Subject CA1 — Core Applications Concepts

### Paper 2

*Time allowed: Three hours*

#### ***INSTRUCTIONS TO THE CANDIDATE***

1. *Enter all the candidate and examination details as requested on the front of your answer booklet.*
2. *You have 15 minutes at the start of the examination in which to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have three hours to complete the paper.*
3. *You must not start writing your answers in the booklet until instructed to do so by the supervisor.*
4. *Mark allocations are shown in brackets.*
5. *Attempt all 7 questions, beginning your answer to each question on a separate sheet.*
6. *Candidates should show calculations where this is appropriate.*

#### ***AT THE END OF THE EXAMINATION***

*Hand in BOTH your answer booklet, with any additional sheets firmly attached, and this question paper.*

*In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator.*

**1** Explain the relationship between real and nominal government bond yields. [3]

**2** (i) Discuss the application of the actuarial control cycle to the investment management of a fund. [4]

(ii) Describe the monitoring needed to ensure that the investment management of the fund will remain appropriate. [4]

[Total 8]

**3** Company A is a life insurance company that is interested in setting up an operation in an overseas territory, which it believes has significant new business potential.

Company B is a life insurance company that operates only in this territory. It has just been put up for sale by its parent company.

Outline the advantages and disadvantages to Company A of purchasing Company B rather than setting up a new operation in the overseas territory. [13]

**4** (i) List the investment characteristics of direct property investment. [7]

(ii) Discuss how the returns on direct property compare with those on property company shares. [8]

[Total 15]

**5** A major retail company sponsors a well-funded final salary pension scheme. Recently the costs of the scheme have been increasing dramatically. The finance director of the company has set the objective of reducing the future volatility of the contribution rate, without making any changes to the scheme's benefit structure.

(i) Outline the options that are available to achieve the finance director's objective. [7]

The company decides to control the costs of the scheme by limiting the growth in pensionable salary. Increases in pensionable salary will be restricted each year to the rate of price inflation, and non-pensionable bonuses will form a larger element of overall remuneration.

If an employee is promoted, their pensionable salary may be increased to reflect their new responsibility. This promotional increase would be in addition to the annual inflationary increase.

(ii) Comment on the practical issues that will need to be addressed in order to implement this strategy. [4]

It is now three years since the strategy was implemented. The inflationary increases to pensionable salary in the last three years have been 1.8%, 0.8% and 3.3% respectively.

The following tables are excerpts from the membership data for the actuarial valuation due to be carried out this year, and from the actuarial assumptions used in the last valuation.

Table 1: details of average pensionable salaries by age for members who have been in service continuously from the last valuation to this valuation

<i>Age nearest <math>x</math></i>	<i>Average pensionable salary at this valuation for members aged <math>x</math> at this valuation</i>	<i>Average pensionable salary at last valuation for members aged <math>x</math> at this valuation</i>
	€	€
38	31,374	28,980
39	28,841	25,776
40	57,894	53,646
41	37,640	34,676
42	32,415	30,160

Table 2: promotional salary scale assumption  $s_x$  used in the last valuation

<i>Age nearest <math>x</math></i>	$s_x$
35	223
36	228
37	233
38	238
39	243
40	247
41	250
42	253

The promotional scale  $s_x$  excludes any allowance for annual inflationary increases to pensionable salary.

(iii) Extend Table 1 to show calculations for the following figures in respect of the above scheme membership over the triennial intervalation period:

- actual promotional salary growth
- expected promotional salary growth
- the actual/expected percentage for promotional salary growth

Include details of the formulae you have used. [6]

(iv) (a) Comment on the results in part (iii), and

(b) Describe the further investigations and actions that might be appropriate.

[7]

[Total 24]

- 6**
- (i) Describe how underwriting is used to manage a life insurance company's risks. [5]
  - (ii) List the sources of information that a life insurance company can use in the underwriting process to establish the level of mortality risk for a particular applicant. [3]

A life insurance company operates in a country where it is compulsory to purchase an annuity with the proceeds of pension policies at retirement. For many years the company has offered enhanced annuity rates to people in poor health. The rates offered have been based on a medical examination of each applicant. The company has a specialist medical officer who determines the applicant's likely additional mortality by analysing the medical examination report.

The company has now decided to implement a "points scoring" underwriting process, where it assigns points to the most common conditions, based on the severity of the condition and the extent and duration of the symptoms. The annuity rate offered depends on the total points scored.

- (iii) Discuss the implications for the company of implementing this process. [9]
- [Total 17]

**7** A medium sized insurance company specialises in property insurance (buildings and contents).

- (i) Outline how the company can ensure it records good quality policy data. [5]
  - (ii) State the general features of excess-of-loss (XL) reinsurance. [2]
  - (iii) Discuss why the company might wish to obtain some type of XL reinsurance, and comment on the risks that each different type might protect against. [7]
  - (iv) State reasons why the company may wish to take out some form of alternative risk transfer contract instead of traditional reinsurance. [3]
  - (v) Give two examples of companies outside the insurance sector who might find it advantageous to swap packages of risk with this insurance company. [3]
- [Total 20]

**END OF PAPER**

# **EXAMINATION**

September 2007

## **Subject CA1 — Core Applications Concepts**

### **Paper 2**

#### **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.

M A Stocker  
Chairman of the Board of Examiners

December 2007

#### **Comments**

Comments on individual questions are given in the solutions that follow.

- 1** Nominal yield = risk free real yield + expected future inflation + inflation risk premium.

The inflation risk premium reflects the additional yield required by investors with real liabilities for bearing the risk of uncertain future inflation.

*This was generally answered well, although candidates who failed to give a formula had difficulty describing the relationship in words.*

- 2** (i) Specify the problem — set long term strategic objectives for the investment management of the fund. These might include guidelines on the types of investment permitted, minimum/maximum limits in asset types, sectors and individual stocks, and target performance benchmarks.

Developing the solution — consider the types of investments that best fit the long term strategy, and select suitable high quality investment managers to operate the strategy.

Monitoring the experience — regular monitoring of all arrangements in place relative to the objectives and performance targets, and feeding back the results to modify the original solution.

All the above needs to be carried out with a professional approach and in the context of the general and commercial environment.

- (ii) Monitoring should be focused on the different decision points in the cycle, to ensure departures from targeted outcome are identified and assessed. This should incorporate regular reassessment of both assets and liabilities to determine whether the investment objectives remain appropriate for the current and expected future situation.

At the investment manager level — will need to monitor both performance and risks undertaken.

At the management structure level — will need to analyse suitable manager types (value/growth, large/mid/small cap, active/passive) and decide whether the overall balance is still appropriate.

At the strategic level — assessment of the asset types that fit the strategic objectives will be required, along with consideration of whether any investment limits are still appropriate.

Regular assessment on whether there are new asset classes that should be considered will also be required.

*Part (i) was answered well, with most candidates pitching their solution at the right level of detail given the marks available. In part (ii) answers were in general not sufficiently wide-ranging. Most candidates focussed on performance measurement against a benchmark, and*

*did not consider the more strategic matching issues. As usual candidates wrote “regulation” and “tax” down without putting the points in context. Some candidates write these two words in the answer to every question in the hope that sometime they will get some marks for them.*

### **3 Advantages of purchasing Company B**

This may be a cheaper option, depending on the sale price.

It may be difficult to obtain a licence to start a new company in this particular country. It may also be harder for a foreign company than a local company to sell business.

Starting from scratch may be made more difficult by language or cultural barriers.

Could make use of otherwise unavailable tax losses or other synergies. *Note that in this case, the simple phrase “Tax benefits” was not enough.*

Purchase would gain experienced staff who understand the regulatory and taxation environment. Staff will also already be trained in the type of products sold in this country. There would also be no need to recruit staff, which can be costly and time-consuming.

Company B would have existing infrastructure generating possible expense synergies, such as company properties, systems for administration, accounting, and valuation.

Acquisition of existing business gives an immediate market presence and the opportunity for cross-selling. It will be possible to sell new business immediately. It may be possible to continue using an existing brand that already has a market reputation. This would also remove potential competition. Company B may have an existing client base and salesforce or relationships with agents.

Company B will have past experience analyses which can use as part of actuarial control cycle to set assumptions for future pricing.

There will be an immediate investment performance track record.

### **Disadvantages of purchasing Company B**

It is necessary to consider why Company B is being sold.

- Its market reputation may be bad.
- There may be legacy problems with Company B's business, which may be a drain on management time and a potential reputational risk.
- The purchase price may be over-inflated, for example in a bidding war or auction.

Company A may wish to sell different types of product than those currently being offered, and the conversion would therefore still take time and money to achieve.

Company B might not adapt easily to Company A's internal culture. It may have to put in place measures to ensure that key staff do not leave on change of ownership.

There may be elements of Company B that are not attractive, and which might be expensive to dispose of.

Company A may have to find more initial capital to finance the purchase than if grew organically. This might have an effect on the dividend payments to shareholders in the short term, or might increase the company's gearing.

Company B may have legacy employee benefit issues (such as pension deficits) or dependencies on its parent company for some services, e.g. investment.

*This question enabled the better candidates to shine, while the less good tended to misread or misunderstand it. Note that the question states that the company has already made the decision to sell business offshore. Many candidates considered the advantages and disadvantages of a move offshore, for which no credit was given. A well structured and planned answer really gained benefits. The unstructured answers were very repetitive, wasting much time without gaining additional marks.*

- 4** (i) The investment characteristics of real property:
- a real asset that is expected to provide a hedge against unanticipated inflation;
  - a running yield typically between that available on equities and bonds;
  - rental income subject to infrequent rent reviews (may be upwards only);
  - very unmarketable;
  - high dealing costs;
  - security of income depends on the quality of the tenant, and on risk of voids;
  - capital values can be volatile over the longer term;
  - susceptible to Government controls;
  - buildings suffer from obsolescence and property maintenance costs, but land always likely to have some value;
  - there are management costs – rent collection, rent reviews, new leases, etc.
  - unit size is large;
  - each property is unique;
  - no central market with quoted property prices so no real value known until sold;
  - valuation is a matter of professional judgement;
  - investment characteristics can be changed by the owner/marriage value.

- (ii) Direct property values tend to be less volatile than property shares in the short term because the true picture is obscured by the effect of long periods between valuations.

Property shares are in a company therefore the price will depend on the value of the company itself which is only partly dependent on the value of the underlying properties. The company can smooth the return to investors through its dividend policy.

Property companies usually are financially geared, direct property is not usually geared. Financial gearing increases the risk from property shares but could increase the long term expected returns.

In the longer term property shares may provide greater stability as they provide diversification that may not be possible with direct investment due to the large size of individual properties.

Property companies undertake higher value added property investment activity, such as development, providing higher returns longer term than direct property.

Property shares may provide higher returns by being bought at a discount to net asset value.

Property shares may be subject to losses if the company has a cash flow problem, however, direct property is only exposed to forced sale losses if the investor becomes a forced seller.

Property shares are much more marketable than direct property, which may affect the return.

The tax treatment of direct property and property shares may differ, depending on the territory concerned, impacting the returns achieved.

Property shares may provide economies of scale and so provide cost savings compared with direct property. Direct investment may allow the investor greater control over management costs and so generate extra return.

*Part (i) was answered well by most candidates. In part (ii), some candidates did not appreciate that 'property companies' will experience some of the features of direct property investment because they invest in real property along with other activities, so that their results will reflect this. Many candidates failed to read the question and discussed the different features of direct property investment and property companies, failing to concentrate on the returns from the two asset types. The better answers said "direct is... but shares are ... and this means ...", all in the context of returns.*

- 5 (i) Consider a spread of surplus over a long period to reduce the volatility of employer's contributions.

Consider buying out existing liabilities e.g. existing pensions in payment or deferred pensions to reduce risk carried by the employer.

Ensure that any risk benefits are insured.

Amend remuneration structure to control pensionable salary growth.

Consider an Asset/Liability model to look at any asset-liability mis-match, and amend the investment policy to minimise this.

Review the following items and consider whether a change would impact the volatility of the contribution rate:

- The level of risk accepted by the Investment policy, in particular the diversification of assets and the asset types held.
- Currency mismatching risk between assets and liabilities.
- Closing to new entrants by amending employment contracts.
- The Funding method and funding assumptions adopted e.g. advance funding to reduce volatility.
- Any policy for awarding discretionary benefits — for example, discretionary pension increases or early retirements at the company's discretion.
- The policy on transfers in and out of the scheme.
- The charges made by the advisors to the scheme, possibly requiring fixed fees.

- (ii) It is necessary to consider:

- The impact this strategy is projected to have on the costs of the scheme.
  - Which price index to use.
  - Whether the company can maintain such control on the salaries.
  - How best to communicate this strategy to the employees.
  - Avoiding any disputes with any unions.
  - Achieving employee agreement.
  - When the strategy can commence.
  - Whether new administration/payroll systems will be required.
  - Whether the strategy will affect recruitment.
  - Or retention of employees.

(iii) Table extended to show the following:

<b>A</b> <b>Age</b> <b>nearest</b> <b>x</b>	<b>B</b> <i>Average</i> <i>pensionable</i> <i>salary at this</i> <i>valuation</i>	<b>C</b> <i>Average</i> <i>pensionable</i> <i>salary at last</i> <i>valuation</i>	<b>D</b> <b>Actual</b> <b>promotional</b> <b>salary</b> <b>growth over</b> <b>the period</b> $= (B/C)/1.06^\dagger$	<b>E</b> <b>Expected</b> <b>promotional</b> <b>salary</b> <b>growth over</b> <b>the period</b> $= s_x/s_{x-3}$	<b>F</b> <b>Actual /</b> <b>Expected</b> <b>percentage</b> <b>over the</b> <b>period</b> $= D/E$
<b>38</b>	31374	28980	<b>102.1%</b>	<b>106.7%</b>	<b>95.7%</b>
<b>39</b>	28841	25776	<b>105.6%</b>	<b>106.6%</b>	<b>99.0%</b>
<b>40</b>	57894	53646	<b>101.8%</b>	<b>106.0%</b>	<b>96.0%</b>
<b>41</b>	37640	34676	<b>102.4%</b>	<b>105.0%</b>	<b>97.5%</b>
<b>42</b>	32415	30160	<b>101.4%</b>	<b>104.1%</b>	<b>97.4%</b>

$\dagger$  the total cost of living 1.06 is calculated from  $1.018 \times 1.008 \times 1.033$

Notes:

- the columns in **bold** above are required in the solution
- non-bold columns are not required in the solution but are shown above for reference

Marks were given for:

- a layout in a format that makes it clear that the instruction “extend the table” has been reasonably followed
- Showing calculation of total cost of living increases:  
 $1.018 * 1.008 * 1.033 = 1.060006752$  or 1.06
- Calculating total cost of living increases correctly
- Showing correct formula for actual growth calculation (column D)  
i.e.:  $D = (B/C)/1.06$  (or alternatively  $= (B/C)/1.06 - 1$ )
- Calculating all actual growth formula figures correctly (column D)
- Showing correct formulae for expected growth calculation (column E)  
i.e.:  $E = s_x/s_{x-3}$
- Calculating all expected growth formula figures correctly (column E)
- Showing correct formula on column F
- Calculating all column F figures correctly from D & E

The question does not specify that percentages are expected in the tables in columns D and E, although the approach of using absolute values will mean that it will be almost impossible to derive column F, where a percentage is required. Therefore marks were given where absolute value calculations were used. The results are:

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>
<b>Age nearest x</b>	<b>Average pensionable salary at this valuation</b>	<b>Average pensionable salary at last valuation</b>	<b>Actual promotional salary growth over the period =B-(C*1.06)</b>	<b>Expected promotional salary growth over the period =C*s<sub>x</sub>/s<sub>x-3</sub></b>
<b>38</b>	31374	28980	<b>655.2</b>	<b>1949.3</b>
<b>39</b>	28841	25776	<b>1518.4</b>	<b>1695.8</b>
<b>40</b>	57894	53646	<b>1029.2</b>	<b>3223.4</b>
<b>41</b>	37640	34676	<b>883.4</b>	<b>1748.4</b>
<b>42</b>	32415	30160	<b>445.4</b>	<b>1241.2</b>

A candidate who went on to ratio columns D and E to generate an incorrect column F (for which there were no marks), should have noticed that age 39 is an outlier. Candidates who commented on this feature in their answer to part (iv) were given credit for any sensible comments made in both (iv) (a) and (iv) (b).

- (iv) (a) Additional data is required to assess the credibility of the analysis, for example, membership numbers and/or total salaries.

The A/E figures are all reasonably close to 100%, but they are all below 100%. This indicates that the promotional scale has overstated the promotional salary growth experienced by this slice of the membership over this period.

The overstatement is roughly 1% pa for these members, which may result from the intentional use of a smooth or prudent scale.

- (b) A full salary analysis should be considered over the whole membership, isolating special one-off features from long term trends.

It might be possible to consider national statistics or industry data.

If the analysis indicates that the experience of this membership extract is representative of the experience of the whole membership and if the recent experience can be taken as a guide to the future long term expectations then there may be a case for reviewing the assumption for the promotional scale.

This would be in conjunction with discussions with the company regarding any stated intent on the anticipated pattern of promotions,

the level of pensionable salary increases awarded on promotion, and the desired level of prudence in funding the pension scheme.

*In answering part (i) some candidates proposed changes to the scheme's benefit structure, despite the information given in the question. Reduction in the level of contributions was not required, only in the volatility of the contribution rate. Many candidates talked about instituting a closer matching policy, but for full marks it was necessary to explain how this reduces volatility.*

*Part (ii) was generally well answered, although many candidates went into far too much detail for the number of marks available. Apart from the interpretation issues covered above part (iii) was attempted well, although a significant number of candidates were frightened by the need to use a calculator, and gave up without trying!*

*“Comment on results” questions are often the easiest ones set, as there are a lot of marks for simply describing the results achieved. In part (iv) most candidates failed to comment on the restricted range of ages analysed and the need to extend the investigation to cover all ages. The final part highlighted a general lack of understanding of what the purpose of the exercise was. The aim is to assess the salary scale used for the valuation to see if it is still suitable. The whole focus of the question is on the pension scheme and not on the company's remuneration policy. Many candidates seemed to regard the point as to assess whether the new remuneration practice was fair or working properly.*

- 6** (i) Underwriting at the proposal stage can be used to manage risk in the following ways:

It can protect a life insurance company from anti-selection, and in particular is used to identify lives whose health is so seriously impaired that they would have to be deferred or declined.

It also identifies risk arising from geographical location, occupation and lifestyle.

The underwriting process will enable a company to identify lives with a substandard health risk for whom special terms would need to be quoted.

A company may however aim to accept a large proportion of the business it accepts at standard rates of premium.

For the substandard risks, the underwriting process will identify the most suitable approach and level for the special terms to be offered.

Adequate risk classification within the underwriting process will help to ensure that all risks are rated fairly.

Underwriting will help in ensuring that actual mortality experience does not depart too much from that assumed in the pricing of the contracts being sold.

For larger proposals the financial underwriting process will help to reduce the risk from over insurance.

Lives could be individually underwritten rather than being put into broad risk bands.

Claims underwriting will be used for admitting and monitoring claims on products such as Income Protection and Critical Illness. It can also be used to assess the validity of other claims, for example, by checking for non-disclosure and implementing exclusion clauses.

The standard of underwriting can influence the reinsurance terms that might be available.

- (ii) Evidence can be obtained from the following sources:
- Questions on the application or proposal form completed by the applicant.
  - Reports from medical doctors that the applicant has consulted.
  - A medical examination and report carried out on the applicant.
  - Specialist medical tests (such as AIDS/HIV test).
  - Applicant's answers to further questions asked by the company, such as lifestyle questions.
  - Previous applications to this or other insurers.
- (iii) There will be a significant cost in constructing the points table, changing the company's systems, and then maintaining the table in the future. The company has been writing business for many years, so should have sufficient data to construct the table, at least for the most common conditions. This is likely to involve analysis of all past applications, the results of the medical examinations and the company's specialist's conclusion.

For lives who have died, the appropriateness of the underwriting decision can also be reviewed.

It is likely that reinsurers would wish to review the terms offered.

The benefit is that for the most common conditions the expense of the medical examination and the specialist's analysis of the report can be avoided. There would be an offset in terms of additional processing carried out by the company's staff.

However, as the decision is based on less detailed information, a greater margin for risk will need to be built into the assessment. In terms of the rates offered, the additional risk margin might offset the effect of the expense saving.

Lives in poor health, who may not be employed, may have need of their pension quickly. The more efficient process may be of great value to them, as the time in the underwriting process will be greatly reduced.

However for conditions that are just beyond assessment by the points table, the process will be lengthened, and the original process will have to be followed once the points table result indicates that further information is necessary.

The company may be prepared to accept a measure of self-certification for simple conditions — for example that the applicant is a smoker or a diabetic, and for small policies. This would save the cost of obtaining a full medical examination.

Even if self-disclosure is limited, checking the applicant's statements with a general practitioner is likely to be more efficient and cheaper than a medical examination. The company is trying to confirm the extent of a condition the applicant says he has, not find out if he is suffering from one of many conditions denied.

The company may find that its mix of business changes. For example it might increase sales to lives who can be assessed using the points table. As the points table is derived for common conditions, where most data are available, this might reduce the company's overall risk.

If the company's points table was in the public domain, it might be copied by competitors, thus offsetting the unique selling point.

*Parts (i) and (ii) were bookwork, and generally answered well. In part (iii), most candidates did not give enough attention to the problems associated with developing and maintaining the points table. This part was answered less well than the rest of the question. To succeed, candidates needed to have a clear view of their intended answer before starting to write, otherwise answers were confused and repetitive. Sadly many candidates quoted bookwork without considering the context – assuming that there could be lapse and re-entry issues with annuities, for example.*

- 7** (i) The company can ensure good quality policy data by ensuring consistency between its sources of data. For example between the proposal form and underwriting data; and between the claims form and claims underwriting data. This enables cross-checking between policy and claims data.

Questions on the forms need to be unambiguous, sufficiently detailed to obtain all information needed, and in a format that enables information to be readily transferred to the database, and cases where additional underwriting is needed to be identified quickly.

Staff should be adequately trained to collect data and enter it correctly into the database.

There should be reasonableness checks on the data.

- (ii) XL reinsurance is non proportional cover. The reinsurer will pay claims over an “excess point” up to an upper limit, beyond which the insurer is back on risk. It is possible to have several layers.
- (iii) Reasons for XL reinsurance:
- to accept risks that might give rise to large claims.
  - to reduce the financial effects of claim fluctuations.
  - to stabilise technical results.

The company might consider Risk XL in order to protect against a large individual loss, for example damage to a very large building, or very high third party personal injury claims.

It might consider Catastrophe XL in order to protect against large losses arising from a single event, for example a very large number of claims from a storm, or a number of very large claims (such as from a terrorist incident).

It might consider Aggregate XL, in order to protect against an unusually high number of claims over a period from a particular peril, for example, a large number of flood damage claims arising during an extended period of wet weather.

It might consider Stop Loss, in order to protect against unexpectedly high claims over a whole class of business, or even the company's whole account.

*Note that no credit was given for all the standard points about the benefits of reinsurance that many candidates made.- technical support from reinsurer, etc.*

- (iv) Alternative risk transfer might be considered:
- to provide cover that might otherwise be unavailable
  - to stabilise results
  - because it is cheaper
  - if there are tax advantages
- 
- for greater security of payment if there is a claim
  - to manage solvency margins
  - for more effective risk management, e.g. diversification of risk portfolio
  - as a source of capital.
- (v) An energy company which will make less profit if winter weather is warm — can swap with the insurer's greater claims costs from cold weather.

A water company which will replenish its reservoirs if very wet weather — can swap with the insurer's greater claims costs from flood.

A building firm whose profits will increase when they get more work after a windstorm — can swap with the insurer's greater claims costs.

*Credit was given for similar sensible suggestions. If more than two examples were given, the two best were marked. The examples need to be distinct. For example the effects of the weather on an electricity company and on a gas company are really the same example.*

*Much of this question involved reproduction of sections of the core reading. Part (i) was well answered. Most candidates got the main point sought in part (ii), but the majority wrote far too much given that only two marks were available. In part (iii) many candidates were not sufficiently precise in defining the various categories of XL reinsurance. The examples given were rather limited.*

*Candidates who recalled the section of the core reading on alternative risk transfer generally dealt with the final two parts of the question well, but a significant proportion struggled with them. In part (v) most candidates did not adequately explain how the insurance company could benefit from the swaps proposed.*

## **END OF EXAMINERS' REPORT**

# EXAMINATION

7 April 2008 (pm)

## Subject CA1 — Core Applications Concepts

### Paper Two

*Time allowed: Three hours*

#### **INSTRUCTIONS TO THE CANDIDATE**

1. *Enter all the candidate and examination details as requested on the front of your answer booklet.*
2. *You have 15 minutes at the start of the examination in which to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have three hours to complete the paper.*
3. *You must not start writing your answers in the booklet until instructed to do so by the supervisor.*
4. *Mark allocations are shown in brackets.*
5. *Attempt all 7 questions, beginning your answer to each question on a separate sheet.*
6. *Candidates should show calculations where this is appropriate.*

#### **AT THE END OF THE EXAMINATION**

*Hand in BOTH your answer booklet, with any additional sheets firmly attached, and this question paper.*

*In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator from the approved list.*

- 1** (i) State the principles of investment. [2]
- (ii) Describe the actuarial techniques that can be used to determine an investment strategy. [5]
- [Total 7]

**2** An insurance company has decided to enter the market for long-term sickness insurance.

Discuss the effect of the external environment on the development of a product for this market. [8]

**3** A large company has sponsored a funded defined benefit pension scheme for many years. Fifteen years ago the scheme was closed to new members, and also to future accrual of pensionable service for existing members.

The scheme now has a small number of members still employed by the company, but several thousand members either with pensions in payment or with deferred pensions expressed in terms of an annual amount that increases with inflation both in deferment and in payment.

- (i) Describe the risks that the company faces in continuing to sponsor the defined benefit scheme. [6]

It has been suggested that the company could transfer the risks relating to pensioners and deferred pensioners to an insurance company who would issue them with individual policies that will guarantee the benefits to which they are currently entitled under the scheme.

- (ii) Discuss the advantages and disadvantages of this suggestion from the viewpoint of the company. [7]
- [Total 13]

**4** An insurance company is considering introducing a wedding insurance policy. The insurer intends to sell the policy through a large supermarket chain. The policy would be branded in the name of the supermarket, but the insurance company would cover the risks.

- (i) List the main risks that the policy should cover. [4]
- (ii) Explain why the insurer may wish to use the supermarket as its sales channel. [4]
- (iii) Discuss the rating factors the insurer could use in setting premiums. [6]
- [Total 14]

- 5**
- (i) (a) Define self-insurance in the context of general insurance.
  - (b) Explain why some organisations may choose to self-insure some of the risks that they face. [3]

A small company owns a chain of 30 retail units in and around a large city. The vast majority of transactions in the business involve cash. The annual turnover for each retail unit varies between \$500,000 and \$3,000,000. At present, the company does not have insurance against robbery, burglary or theft.

The company has now decided to obtain quotations for such insurance cover.

- (ii) Outline the general information an insurance company would need in order to set appropriate premiums. [7]
  - (iii) Describe specific measures that the retailer could take to reduce the risk of a claim and hence obtain a reduction to the premiums in (ii) above. [6]
- [Total 16]

- 6** A regional bank operates in a particular area of a country and provides residential mortgages.

- (i) Describe the sources of risks faced by this regional bank that relate to its residential mortgage business. [4]

The country's central bank increases short-term interest rates. Consequently, the regional bank's cost of borrowing rises and it decides to pass on its increased costs by increasing the interest rate it charges on residential mortgage lending.

- (ii) Describe the impact the changes might have on:
  - (a) the economy as a whole;
  - (b) the regional bank in particular. [9]

Part of the regional bank's mortgage portfolio consists of residential mortgages where it has lent money to higher risk borrowers and is charging a higher mortgage interest rate. The regional bank has decided to reduce its credit risk by securitising this part of its portfolio.

- (iii) Describe the considerations an institutional investor should take into account in determining an appropriate price to pay for this investment. [7]
- [Total 20]

- 7** (i) List the main items that should be set out in a written strategy for a project. [2]

A wealthy private foundation wishes to inspire a future generation of ultra-efficient vehicles.

It has been suggested that the foundation could sponsor a high profile international competition, which could offer a multi million dollar prize to the first team to develop a commercially viable vehicle that meets specified efficiency criteria.

- (ii) Discuss:
- (a) the expected costs of sponsoring such a competition;
  - (b) how these costs may be financed. [8]
- (iii) Describe other aspects of this suggestion that the private foundation will need to consider when developing the project strategy. [12]
- [Total 22]

**END OF PAPER**

**Subject CA1 — Core Applications Concepts  
Paper Two**

**EXAMINERS' REPORT**

**April 2008**

**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.

M A Stocker  
Chairman of the Board of Examiners

June 2008

**General comments**

*As the title of the course suggests, this subject examines applications of the core techniques and considers broad actuarial concepts in practical situations. 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 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.*

Comments for individual questions are given after each of the solutions that follow.

- 1**
- (i) The principles of investment are that:
- A provider should select investments that are appropriate to the nature, term and currency of the liabilities and the provider's appetite for risk.
  - Subject to the above, the investments should also be selected so as to maximise the overall return on the assets, where overall return includes both income and capital.
- (ii) Investment objectives will normally be stated with reference to both assets and liabilities.

The method for setting an investment strategy in respect of such objectives should take into account the variation in the assets simultaneously with the variation in the liabilities. This can be done by constructing an appropriate model to project the asset proceeds and liability outgo into the future.

The outcome of a particular investment strategy is examined with the model and compared with the investment objectives. The investment strategy is adjusted in the light of the results obtained and the process repeated until the optimum strategy is reached.

Modelling can either be deterministic or stochastic. A deterministic model is based on a set of specific assumptions about the future. These can be varied to model a series of different possibilities in what is known as "scenario modelling".

In a stochastic model the random nature of some of the model parameters is allowed for. The output of a stochastic model is a distribution of possible outcomes of the particular strategy adopted. Most practical stochastic modelling is carried out using simulation, but simple stochastic models can be constructed using analytic techniques and the results calculated as well defined distribution functions.

*Comments: Part (i) has been asked once a year for the last four years and the answer is the same every time. Even so a surprisingly large number of candidates failed to reproduce the standard answer and lost two "free" marks. Most candidates realised that part (ii) was also looking for a piece of bookwork, but very few identified what the examiners were seeking.*

- 2**
- A long-term sickness insurance contract enables individuals to provide an income for themselves and their dependants during periods of incapacity due to accident or illness. Such contracts typically terminate at retirement age. The group equivalent can be used by an employer to provide a sick-pay scheme for employees.

It is important to bear in mind the external environment when framing actuarial advice:

The company will need to consider if there is any legislation affecting this product - for example, data protection requirements or discrimination legislation for age, gender or disability.

Regulations may influence the type of financial product most suited to a consumer's needs when there are a number of otherwise acceptable products.

The regulation of the sales process for different types of product may influence the types of product that are brought to market by product providers. Requirements for detailed explanation to consumers of any complexities may mean that some products are not marketed however suitable they might be for consumers' needs.

It will be necessary to consider the benefits the state provides for long-term sickness. These may be at a low level which may only be sufficient to keep individuals just out of poverty. Many individuals will want to have a higher level of benefit.

It will also be necessary to consider any benefits provided to an individual by their employer to ensure that the product gives an appropriate total level of coverage for the individual during periods of incapacity.

The tax treatment of benefits can also have an impact on the needs of individuals. It will be necessary to consider how this benefit will be taxed.

Competitive advantage and commercial requirements will need to be taken into account - a balance will need to be struck between designing a standard product that can be competitively priced and an innovative product that may be potentially more expensive.

The company will require finance to launch a product and therefore the ability of the company to raise capital may affect the development of the product.

It will be necessary to consider the position of this business in the underwriting cycle and also whether there will be any cross subsidies involved.

The position in the economic cycle will also be relevant – for example, if there is a downturn in the general economic cycle there would generally be a smaller market for this insurance.

Changing social trends can have an impact on financial products, and the company will need to consider whether they will affect this business - for example, through lower levels of state benefits or through an increased level of income leading to an increased demand for this product.

Changing medical and healthcare trends may also have an impact on this business – for example, through increased incidence of certain diseases or decreased impact of others.

Lifestyle considerations may also influence demand for this business – for example, any shift to healthier lifestyles for the working population may decrease the perceived need for this insurance.

Technological changes will also be relevant. For example, in the extent to which technology enables incapacitated individuals to perform other jobs.

The company will need to consider the effect of the internet in selling business. They must bear in mind that many of their competitors may be using this method even if they do not decide to do so themselves.

*Comments: This question was answered well. There were many good answers that applied the core bookwork features to the particular product. Most successful candidates remembered the general headings that have to be considered under external environment, and therefore produced a well-structured answer that was easy to mark. Candidates who didn't restrict their comments to external factors wrote for no marks.*

- 3** (i) Market risk – the assets that the scheme invests in may not deliver the expected return, and the company will have to make up the shortfall. Asset/liability matching is a subset of market risk. The bulk of the benefits are fixed in real terms, increasing only with inflation. Only a small proportion increases with salaries. High exposure to equity risks in these circumstances will increase market risk.

Credit risk – to the extent that the scheme invests in non-guaranteed assets, whether equities or debt, there is a risk that the issuer will default on payments. Where a third party holds certain assets owned by the scheme, failure of the counterparty can affect the asset proceeds, or more usually how easy it is to access the assets.

Business risk – the scheme may have insufficient provisions established to meet the costs relating to the pensioners and deferred pensioners. Excess costs will fall on the scheme sponsor. This might be the case, for example, if future longevity has been underestimated. The costs of administering the scheme, either in-house or with a third party, might be greater than anticipated.

External risk - the government may impose a regulatory change such as changes in solvency requirements or tax changes, which may lead to additional burdens on the company through matching requirements, compensation schemes etc.

Operational risks – these relate to inadequate or failed people, processes and systems. Operational risk might include having inadequate plans to recover the operation of the scheme after a fire or other external event; fraud; holding inadequate data to enable benefits to be calculated accurately, etc.

(ii) **Advantages of transferring risks**

The company may be contributing only in respect of increases in salaries on the historic service of what is now a small number of individuals. The contribution rate, and the actual amount of contributions is unlikely to be high.

Emergence of any of the risks above that affect pensioners or deferred pensioners may involve a large amount of money. This could lead to very volatile contributions, particularly if expressed as a percentage of salaries of the small number of active members. Depending on accounting regulations this could also lead to volatility in the company's disclosed profits.

Transferring risks will require an immediate cash outflow, but future volatility will be greatly reduced. Record keeping for a large number of people that the company is not particularly involved with will be removed.

Running the pension scheme is not the company's core activity, and currently the potential financial consequences if risks emerge are such that management time must be diverted to the scheme.

Benefits for the members are only guaranteed to the extent of the employer's covenant and any statutory support scheme. On transfer to an insurance company, particularly in a regulated environment, the guarantees for scheme members will be greater and more valuable. (But there is a cost to this – see disadvantages).

**Disadvantages of transferring risks**

The main disadvantages of transferring the risks is that the premium required by the insurance company will probably be greater than the assets held by the scheme in respect of the transferring members.

This is likely to be because:

- The additional guarantees given to members will probably involve matching more closely with fixed interest and index linked stocks. The potential additional return from equity investment will disappear.
- The scheme will be funded on a best estimate basis, possibly with a degree of prudence. When the insurance company sets the premium required, the risk of the employer needing to make additional contributions will be factored into the price up-front. By transferring the risks the scheme loses any potential upside if the risks do not materialise – for example, for mortality experience.

The insurance company will include risk and profit margins in its price.

Thus the employer will need to make a one-off payment to benefit from the risk transfer.

If the company is considering transferring all risks then a disadvantage is that the company may not get a good price for all of them; it may therefore decide to transfer only those risks where it is able to get a good price.

Diseconomies of scale will come into play for the remaining active members – there will be much higher costs of investment and administration, and there may possibly be investment restrictions.

*Comments: The better candidates thought about the types of risk and produced a logical, well structured answer for part (i) that optimised mark-gaining potential. In part (ii), many candidates did not consider the cost of transferring the pension benefits to the insurance company (and how these costs would compare with the assets currently held). Thus there were comments about “release of funds” and 'surplus' rather than the additional costs that would have to be met. Many candidates thought that either the employer, or the current active members, would be particularly concerned about former employees – most companies are no longer so paternalistic.*

**4** (i) Cancellation cover, for any of a set number of reasons

Damage or loss of

- Wedding attire
- Wedding rings
- Wedding presents, etc

Loss of deposits on financial failure of any supplier prior to the wedding

Non appearance or inadequacy of pre-booked

- Photographs/video
- Marquees, or other venue
- Transport
- Flowers
- Cake/catering
- Entertainment

Legal expenses

Public liability

*Comments: Credit was given for other sensible alternative examples within the general categories above.*

(ii) The supermarket will have a lot of outlets with a lot of customers passing through, and it will be used to employing marketing and presentational techniques to boost sales.

The supermarket may attract customers who wouldn't normally buy from the insurance company. Particularly as the policy may be something of an impulse purchase that wouldn't otherwise have been considered.

Supermarkets tend to have strong brands. Customers may trust a supermarket more than an insurance company. This could boost sales. The supermarket may have efficient systems (e.g. lower paid “sales” staff). This could reduce expenses to the insurance company.

The insurance company will gain access to data on a wide range of potential customers. This could be useful in cross-selling other products.

- (iii) Rating factors are the items the insurer will use in order to distinguish premium rates for different levels of risks.

The insurer needs to consider which factors will cause the chance of a claim to vary. This may be something of a subjective exercise since detailed claims data may not exist. Even if it does, the insurer may not have access to it.

Note the cover will be indemnity cover, covering the amount of loss at the time the event occurs.

Hence the most significant and quantifiably variable risks may relate to cancellation and liability costs. Claims for other perils may be more uniform across the insured population.

Age could be a discriminating factor with younger people being more likely to claim.

Certain areas of the country may be more prone to claims – for example, urban versus rural.

Some measure of income or social class could be a discriminating factor. Higher income groups may be less prone to a claim.

The chance of a claim could vary depending on whether it is a first or subsequent marriage, with first marriages being more likely to give rise to claims. To a degree this factor is linked to age.

However, it is likely that such differences will have a minimal impact on risk. Trying to set a lot of different rates may add to complexity and reduce marketability.

There would usually be exclusions or special premiums within the policy for certain risks. For example, a special premium if the wedding is to be held abroad or in an unusual location.

The insurer may provide a menu where the insured can choose which risks they wish to be covered. Premium rates would vary depending on the risks chosen.

Alternatively, the insured may be able to choose from various tiers where the sums insured for each peril vary. Premium rates would vary across tiers,

primarily due to the lower impact of per policy expenses on larger premium policies.

*Comments: Parts (i) and (ii) were generally well answered. They required application of some actuarial principles, and a great deal of common sense and general knowledge to a real life situation. In part (iii) common sense started breaking down. Candidates produced long lists of possible rating factors, but failed to realise that the premium for the risk would be relatively small – claim values might reach one or two thousand pounds, but rarely ten thousand pounds. Hence the risk premium would be small and the amount that could be spent on underwriting would also be small. A practical approach is therefore needed.*

**5** (i) (a) Self-insurance is defined as the retention of risk, as distinct from obtaining insurance cover.

(b) In principle, self-insurance may appear attractive because insurance companies will aim to make profits after allowing for their expenses and the cost of claims.

For some risks, the cost of any claims could be trivial in the context of the business. In these cases insurance will be deemed unnecessary. In other cases, the cost of claims could be significant but the amounts and timing of claims may be predictable. The main risks of self-insurance may be related to unpredictable and volatile costs.

If a business can plan accurately for its outgoings, insurance may not be needed.

(ii) In order to calculate premiums, the insurance company will need to estimate the future cost of claims. They will need information that helps them quantify future claim rates and the average expected claim size.

Given the different types of units, it is likely that rates would vary between units. It is also possible that the retailer would only wish to insure some of the units, for example, those subject to the greatest potential volatility in claim amounts. Therefore data would be needed on an individual unit basis.

The insurance company would expect the retailer to provide the relevant historical loss data over a sufficient period, say the last five years. The insurance company may be able to check this company data by looking at claim rates for similar units it currently insures.

The most important factor will be location, both general location – for example postcode, and specific location – for example, on a main road or a side street, in a well-lit area, or close to a police station, etc.

The nature of the business will have an influence:

- what they sell
- how valuable is the stock

- how the stock is displayed
- where reserve stock is kept
- what security procedures exist around the stock
- what are the opening hours – in particular do they open at night.
- How many staff are on duty. Single staffed units are more vulnerable.
- The amount of cash left on the premises during working hours or overnight
- How regularly cash is banked or collected by secure vehicles.

Information on current security measures and procedures would also be considered.

- (iii) The measures to be taken will be additional to those the insurance company would normally expect any retailer to adopt.

The premises should be secure when closed. For example, several layers of protective gates and doors etc should be used, and all potential entrances including windows should be blocked or covered by strong shutters.

Security systems should be used and be seen to be in use. If possible, any security feed should be capable of continuous monitoring. Some form of radio link with other retailers and local police with channels being always open would help. Other initiatives by groups of retailers such as employing security staff may help.

The security of the stock should also be considered – for example, security tagging of stock, if applicable.

As a lot of cash will be involved, cash handling procedures will be important. Tills should be inaccessible to customers and money in tills should be kept to a minimum. No cash should be kept overnight, and during the day most cash should be held in secure safes. Keys or combinations should be held/known by as few people as is practical.

Staff fraud could be an issue. The retailer should be able to demonstrate that it vets staff carefully and monitors them during work as far as the law will allow.

Consider whether it is practical to move towards cashless transactions such as credit and debit cards.

*Marks were given for other sensible distinct examples of security measures.*

*Comments: Many candidates failed to define self insurance correctly, but nevertheless the question was done well. Some candidates discussed the type of policy and excesses rather than general premium setting information. Most candidates had a very good knowledge of security measures, and presumably a similarly good knowledge of how to get round them (hopefully not from practical experience!).*

- 6 (i) Sources of risk include:
- The risk that a borrower is unable or unwilling to make payments required under the mortgage agreement. (Credit risk) If they do default, then there is the risk that the value of the security taken (the property) doesn't cover the loan.
  - The risk of borrowing short and lending long. (Mismatching risk)
  - The risk that the borrower has an inability to meet payments when they fall due because of inadequate cash or other liquid assets. (Liquidity risk)
  - The exposure to a high level of risk in any sector. (Concentration risk)
  - The risk that there is no market into which to sell these products, having invested in development and marketing. (Business risk)

For residential mortgages early repayment of the outstanding mortgage is a source of risk as the lender may be exposed to the risk of having to bear any costs of cancelling the deal.

- (ii) (a) The impact of the central bank increasing short term interest rates is to discourage investment spending by firms and reduce the level of consumer spending. Thus increasing the short term interest rates will reduce the rate of economic growth in the short-term.

Increasing short-term interest rates will increase demand for the domestic currency and tends to increase the exchange rate. This will increase the relative cost of exports and reduce the relative cost of imports.

Increasing short-term interest rates will increase the cost of servicing unsecured personal debt, this is combined with an increase in mortgage payments.

Higher short-term interest rates and higher exchange rates will reduce economic activity and change inflation expectations. In the short term, if companies can pass on extra borrowing costs in prices, inflation will increase. If the slowdown in the economy is prolonged, inflation will reduce. This is likely to have an impact on employment levels, increasing unemployment.

- (b) The level of credit risk faced by the regional bank will increase from both those who have become unemployed and those in employment because both will be less able to make the payments under the mortgage agreement. There is an increased likelihood that borrowers will fall behind with their mortgage payments.

The level of liquidity risk will also increase as borrowers may be unable to sell their property to repay borrowing. Forced sales,

including repossessions may lead to property prices falling. In turn falling property prices can cause an increase in credit risk as the outstanding mortgage may exceed the property value.

The level of bad debts faced by the bank will increase and this will impact the bank's profitability. Volumes of future business may decrease, as the bank may introduce more stringent lending requirements, and people may have less money available.

A regional bank has higher concentration risk as its residential mortgages are in a particular region and that region may be more adversely impacted by the economic changes than the economy as a whole.

The bank may not be able to increase the rates on all its portfolio, for example, there may be both fixed rate mortgages and variable rate mortgages in the portfolio.

- (iii) To determine the price to pay for the securitisation the investor should evaluate the risks relative to a risk free investment, such as a government bond of the same term. The investor should then allow for the fact that these mortgages have a higher risk profile and the credit risk is higher.

The investor should investigate the initial lending criteria used to evaluate the credit risk profile – for example, whether lending criteria included affordability considerations and how strictly they were applied.

The investor should also investigate the economic exposures within the particular region. The focus will be to identify whether there are particular risks within the region. For example:

- Is the region in economic decline? – for example, due to a declining regional industry
- Does it have a higher economic sensitivity to economic changes, including interest rates?
- The local demographics – are the mortgagees concentrated within a particular area within the region?
- Are the mortgagees exposed to a particular employer, for example a major regional employer?

It will also be necessary to consider the nature of the mortgages – whether they are interest only or repayment mortgages. Repayment mortgages will be more secure as the ratio of loan to property value will be reducing over time.

The difference between the higher risk mortgage rates and other mortgage rates is a factor. If the difference is large, then when the borrowers' financial position changes so that they become eligible for mortgages charging lower rates then there is both a pre-payment risk and the risk that the credit risk in the

portfolio will tend to deteriorate, due to better risks re-mortgaging to better deals.

The size of the mortgage portfolio will also influence the concentration risk.

The transparency of assets may be an issue, in that the investor may not be able to immediately tell what they are getting within this investment.

*Comments: This was a highly topical question when it was set in the autumn of 2007, and remained topical up to the date of the exam. Parts (i) and (ii) were answered reasonably well, although in part (ii) very few candidates commented on the effects on employment levels, or made an argument for what might happen to inflation (either up or down is possible). In part (iii), many candidates did not answer the question, writing generically about how to securitise and not the considerations in the context of the question, in particular the additional risks. There was a lack of focus on the regional aspects of the bank's position.*

7

- (i) A written strategy for a project should include:
- The aims of the project
  - The issues necessary for the implementation of the project
  - The areas of risk that could affect the viability of the project
  - Alternative strategies for dealing with areas of risk.

- (ii) (a) The expected cost of the competition will be influenced by the following factors:

The expenses of setting up the competition which will include any specialist consultants' time, the cost of any launch events, media coverage and publicity, and the costs of adjudication.

The prize money paid out if the competition is successfully won, plus any money paid out for runners up, or for the closest competitor if the competition is not won outright.

The amount on offer as the prize may need to be large to generate the publicity and entrants to the competition. This needs to be balanced against the likelihood of it being paid out.

The opportunity cost if other means of achieving objective – i.e.: direct investment.

Ongoing expenses and costs of administration depend on the timescale of the competition, which in turn affects the likelihood of there being a winner and the prize money being paid out.

- (b) The private foundation may simply guarantee to pay out the prize money in the event of a winner.

Additionally or alternatively, there may be opportunities for corporate sponsorship, or investment by the existing industry.

Entrants could be required to pay a nominal fee to enter the competition and cover the costs associated with registration – this would also encourage only serious competitors.

Donations may also be invited from other individuals or foundations.

There may be suitable competitions already running – it may be more efficient to simply sponsor these.

The expenses of running the competition may be handled separately to the prize money.

A fund may need to be established to ensure that the competition runs successfully over its lifetime and has sufficient funds available for its expenses.

There may be tax advantages for certain financing methods depending on the charitable status of the foundation.

Due to the likely financing structure, there may be little possibility of traditional insurance or reinsurance.

- (iii) Consider the areas a written strategy should consider for this project, other than expected cost and the financing policy:

#### **Identification of the objectives of the project**

The project objective is to inspire a future generation of ultra-efficient vehicles. Will the launch of such a competition achieve this objective? If managed successfully, the launch of a high profile competition could generate research, investment, and publicity in this area.

#### **How the objectives will be met and acceptable quality standards**

To meet the objectives there may be quantitative targets to be achieved, such as the number of teams entering the competition, or in areas such as investment, or more qualitative targets such as the level of media coverage.

This could be achieved independently of whether the competition was won or not.

#### **The role of the project sponsor**

The private foundation is the project sponsor, and their role will need to be agreed.

Depending upon the make-up of the foundation, there may be individuals in the foundation who have a keen interest in this area and would like to have a

greater public role in this project, or alternatively the foundation may be happy to simply fund the prize money.

There may also be political constraints to be considered both within and outside the private foundation.

### **The role of any third parties, and the communications and IT policies**

The organisation and launch of such a competition is a specialist area. The foundation may need to work with consultants or others who have been involved in such competitions, or equivalent global projects before.

They will also need to work with experts in this automotive field to draft the criteria by which the competition will be judged.

The external communications policy is critical to the success of the objective, as the competition must be high profile globally to both tempt sufficient entrants to the competition to make it successful from a marketing point of view, as well as educating the general public and inspiring the next generation of efficient vehicles.

A high cash prize will help here, as would high profile sponsorship.

The use of information technology will be important to the launch and administration of the competition to ensure smooth administration, media coverage and public involvement.

### **The financial and economic objectives, and the risk management policy**

If this is an altruistic move by the private foundation, the financial objective may not be to generate a monetary return on the investment, but rather to achieve a global benefit by increasing vehicle efficiency.

Alternatively, the foundation may benefit in other ways by achievement of the objective – for example, through licensing technology, synergy or compatibility with other projects etc.

There will need to be a balance between the efficiency advances set out in the criteria for winning the competition, the likelihood of the competition criteria being met, and the amount of the prize money being offered.

If the financial prize will only be awarded on the criteria being met, the immediate financial risks may be limited to the expenses of setting up and running the competition – in effect the competition structure passes the risks of investment to the entrants of the competition.

However, risks of loss of reputation or bad publicity may be relevant to the foundation.

Consider analysis of all risks to the objective and options for mitigation.

### **The policy for dealing with legal issues**

Competition rules will need to be carefully worded to avoid disputes. It will be necessary to ensure that the criteria are clear and cover all required areas, such as efficiency, commercial viability, safety, performance, capacity etc.

Consideration will also need to be given to any other legal risks, for example confidentiality or non-disclosure requirements during adjudication, where entrants are using patented technologies.

### **The technical policy**

For the competition to be equitable, the technical aspects of the criteria must be established absolutely at the start of the competition. These cannot be amended partway through the competition – although there may be room for clarification of some aspects.

### **Key milestones for project review**

The timescales for the phases of the project – launch, tests, deadlines etc. – should be established. Key milestones should be in place to review the project – for example, monitoring entries to ensure the competition is set to achieve the objective.

### **A breakdown of the work to be completed**

A structured breakdown of the work to be completed under the project should also be established, involving assessment of feasibility, competition financing, technical consultation, launch, administration, and media/communications.

*Comments: The number of marks for part (i) should have given candidates a clue that it was a short and therefore high level list that was sought. In the rest of the question the candidates that scored well were those with well structured, thought out answers. Many answers reflected a repetition of bookwork rather than the specific situation of the question, although keeping to the structure of the bookwork leads to a well-structured answer.*

**END OF EXAMINERS' REPORT**

# EXAMINATION

15 September 2008 (pm)

## Subject CA1 — Core Applications Concepts

### Paper Two

*Time allowed: Three hours*

#### **INSTRUCTIONS TO THE CANDIDATE**

1. *Enter all the candidate and examination details as requested on the front of your answer booklet.*
2. *You have 15 minutes at the start of the examination in which to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have three hours to complete the paper.*
3. *You must not start writing your answers in the booklet until instructed to do so by the supervisor.*
4. *Mark allocations are shown in brackets.*
5. *Attempt all 7 questions, beginning your answer to each question on a separate sheet.*
6. *Candidates should show calculations where this is appropriate.*

#### **AT THE END OF THE EXAMINATION**

*Hand in BOTH your answer booklet, with any additional sheets firmly attached, and this question paper.*

*In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator from the approved list.*

- 1** (i) Describe two of the main methods that can be used to value the assets of a pension scheme. [3]
- (ii) Explain why valuations of the assets of a defined contribution pension scheme may be needed. [5]
- [Total 8]

**2** An insurance company is planning to enter the market for providing annuities and other vehicles for retirement income. It is considering a range of contracts under which a client will receive income during their retirement, in exchange for a lump sum premium payable when the client retires.

- (i) Outline the areas in which the provider will incur costs in setting up and managing these contracts. [4]
- (ii) Discuss how the size and incidence of these costs would be affected by the precise form of the contracts and any options/guarantees that might be included. [4]
- [Total 8]

- 3** (i) Describe the three components of market risk involved in the construction of an investment portfolio. [3]

Prospective and retrospective tracking errors can be used as measures of risk in investment portfolio construction.

- (ii) Describe each of these two measures. [4]
- (iii) Explain how the two measures differ. [2]
- [Total 9]

**4** An investor has decided to invest part of his asset portfolio in a particular equity market. He considers that the likely immediate outlook for that market is a sustained bear market period, but nevertheless wishes to remain invested in the market.

Discuss five distinct ways in which he can outperform the market's benchmark index by making investment transactions associated with that market. [10]

- 5** (i) (a) Explain the term "underwriting cycle".
- (b) Define the term "risk premium", and state the general formula that may be used to calculate a risk premium. [4]

A large general insurance company writes warranty business for construction companies that build housing. The warranties are for a period of twelve years and cover major damage caused by building defects in new homes. The company has been writing this business for the last ten years.

- (ii) Outline the main data issues that will need to be considered when calculating a theoretical risk premium for this business. [2]
- (iii) Outline the factors (other than the theoretical risk premium) that should be taken into account when determining the actual premium to be charged for this business. [6]

A particular construction company has requested that its premium rates be reviewed.

- (iv) Discuss the further considerations that the insurance company will take into account when responding to this request. [4]
- [Total 16]

**6** A government is reviewing its system of state retirement benefits.

- (i) List the roles that the government can play in retirement provision. [2]

The country currently has no formal state pension. Instead individuals over age 60 are eligible for means-tested benefits at more generous rates than for those under age 60. The government now proposes to abolish the more generous rates and replace them with a system of compulsory retirement savings by establishing a range of government-approved defined contribution pension plans, with a minimum retirement age of 60. Each individual will be required to contribute 5% of their employment income into one of these plans, and their employer will also be required to make a matching 5% contribution, with self-employed persons being required to contribute 10% of their income.

- (ii) Discuss the likely impact of these reforms on the overall amount that individuals under age 60 save for their retirement. [4]
- (iii) Comment on whether or not the new system will result in all individuals receiving an adequate income in retirement. [7]

Opponents of the government have raised the objection that it is not appropriate to require all individuals to lock their savings away until they retire.

- (iv) Outline other events for which individuals might need to have long-term savings. [2]
- (v) Suggest ways in which the government's proposals could be adapted to meet this objection. [2]

The government decides instead to replace the current arrangements with a new state pension scheme that will pay an income of 30% of national average earnings to all individuals who are over age 65 and have lived and worked in the country for at least 20 years. It is intended that a fund will be established in order to finance this scheme.

- (vi) Outline possible methods for defining the level of the target fund. [4]
- (vii) Comment on how the change in the state retirement system could affect the government's expenditure in the short term. [4]

[Total 25]

- 7 An individual is considering various methods of providing nursing home care for his widowed mother in the event that she needs residential nursing care in old age. He is the sole beneficiary of his mother's will. Apart from her home, which she owns, his mother has no savings and only receives a small pension.

He is considering the following options:

- (a) Agree with his mother that her home is sold when the need for care commences, and the sale proceeds are then used to cover the care costs.
- (b) Purchase a single premium insurance policy now, which pays a fixed lump sum when the need for residential care arises.
- (c) Purchase a regular premium insurance policy that pays a level annuity throughout the remaining life of his mother; premiums are payable for ten years or until the annuity commences if earlier; the annuity commences when his mother fails to be able to perform certain specified activities of daily living, for example being unable to wash or dress herself.
- (d) Purchase a single premium insurance policy that will cover the full cost of nursing home fees.
- (e) Purchase a single premium insurance policy that will cover the full cost of nursing home fees after the first two years in the home.

The individual has sufficient capital available to follow any of the above options.

- (i) Describe the risks avoided and accepted by the individual, and the risks transferred to the insurance company, for each option being considered. [16]
- (ii) Outline the issues the insurance company will need to consider when pricing the insurance risk for each of the various insurance policies described in (b) to (e) above. You do not need to consider investment or expense risks. [8]

[Total 24]

**END OF PAPER**

# Subject CA1 — Core Applications Concepts

## Paper Two

### EXAMINERS' REPORT

September 2008

#### 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.

R D Muckart  
Chairman of the Board of Examiners

December 2008

#### General comments

*As the title of the course suggests, this subject examines applications of the core techniques and considers broad actuarial concepts in practical situations. 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 show is an inability to read the question carefully, and having done so, to answer the question that the examiners asked. Too many candidates write randomly around the subject matter of the question, and gain few marks.*

*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.*

Comments for individual questions are given within the solutions that follow.

- 1** (i) The two main methods are market value and discounted cash flows (or another off-market-value method such as smoothed market value).

Market value is the current prevailing price in an efficient and active market. In some cases market values may be unavailable and so will need to be estimated possibly from recent trades. There could be ambiguity over the market value to choose.

To discount cash flows, an estimation of the future proceeds from an asset (income or capital) needs to be made. These proceeds are then discounted at an appropriate rate to give a current value. The choice of discount rate should reflect the risk of the assets being valued and the rate should be consistent with other elements of the valuation basis such as growth in levels of income.

For smoothed market value, an average can be taken over a specified period to damp down short-term fluctuations. To give a consistent liability valuation, one might determine the discount rate (and other financial assumptions) from the average of relevant market yields over the specified period. Some care is needed if the smoothing period brings in historic data (such as a material gain/loss event in the case of valuing a company's equity).

*Marks were given for market value and for any sensible alternative.*

- (ii) Employees will want to know how much their account is worth; to understand their financial position and investment allocations; to project the benefits they might receive; and to plan future pension contributions. If they change employment, they will need to know the amount of any transfer value.

The fund value will be needed to assess the performance of the scheme's assets. This performance will cover a comparison against the assets of other schemes and a relative assessment of the various funds employees of the scheme can select. This may also affect the asset management fees, or may prompt review of the investment managers.

The employer will use fund values to estimate whether the current level of contributions will provide an appropriate level of benefits. They may not want to provide benefits that are either relatively too high or too low, or there may be specific target or underpin benefits.

Auditors and Trustees will want to check that the assets are actually owned by the scheme and have been correctly valued. They will be concerned to assess whether there has been any fraud or misrepresentation.

Assets may need to be valued for the purposes of taxation.

Regulatory authorities may need to use values to ensure that all legislation is being complied with (e.g. maximum benefit levels), or Scheme Rules may require a valuation.

*Part (i) was well answered although many candidates defined the market value method as using the "market value" of assets without describing/defining it any further. In part (ii), some candidates seemed to think the DC arrangement was DB and discussed valuations, comparing assets and liabilities etc. and experience compared to assumptions.*

- 2** (i) Costs will be incurred in
- contract design and pricing
  - market research and marketing/advertising
  - commission to brokers
  - setting up new clients records on administration system
  - ongoing administration of maintaining records and paying benefits
  - ceasing or altering payments on death (e.g. reduced payment to a surviving spouse)
  - investment management costs
  - overhead costs (offices/IT/etc.)
  - cost of capital and profit margin
  - underwriting costs (financial underwriting or medical underwriting for impaired life annuities)
  - valuation/accounting

- (ii) The more complex the contract and the more options/guarantees, the greater the costs, as a generalisation.

Options and guarantees will increase the capital needed and hence the cost of capital throughout the contract period. Options involve choice for policyholders that need to be communicated at the relevant time and recorded after individuals have made their decisions, all adding to costs.

Different types of contract may have different market commission rates.

Investment management costs will be higher for contract types that (implicitly or explicitly) will be invested more actively, such as with-profit/unit-linked annuities.

There may be a lower profit margin requirement and lower underwriting costs for contracts that have lower risk for the provider such as income drawdown as opposed to annuity contracts.

*Part (i) was generally well answered. The command verb "Outline" implies that something more than a list is required – but not much more, give the marks available. In part (ii) there was some confusion between costs and profits. Many candidates talked about the impact of options and guarantees in the context of pricing for them rather than the costs of administering them.*

- 3 (i) The overall risk is the “sum” of the active, strategic and structural risks.

**Strategic Risk**

An appropriate asset mix for the fund will need to be established – the strategic benchmark. The strategic (or policy) risk of the fund is the risk of poor performance of the strategic benchmark relative to the value of the liabilities.

**Active Risk**

The strategy can be implemented by the selection of one or more managers, and a decision on the appropriate level of risk that these managers should take relative to the strategic benchmark. This is known as the active (or manager or implementation) risk.

**Structural Risk**

There may also be some structural risk associated with any mismatch between the aggregate of the portfolio benchmarks and the total fund benchmark.

- (ii) Prospective tracking error is an estimate of the standard deviation of returns (relative to the benchmark) that the portfolio might experience in the future if its current structure were to remain unaltered.

This measure is derived by quantitative modelling techniques and depends on assumptions including: the likely future volatility of individual stocks or markets relative to the benchmark and correlations between different stocks and / or markets.

It provides an estimate of the investment risk within a portfolio at the time it is calculated.

The retrospective or backwards-looking tracking error is defined as the annualised standard deviation of the difference between portfolio return and benchmark return, based on observed relative performance.

It provides a measure of the investment risk based on realised returns of both the actual portfolio and the benchmark.

Tracking errors make no distinction between upside risk and downside risk.

- (iii) The prospective measure assumes an unchanged portfolio and benchmark. It relies on assumptions that are unlikely to be achieved in practice.

The retrospective measure is based on the actual portfolio and on the performance of that portfolio against the benchmark but it reflects experience over a particular period that may not be repeated.

*Candidates clearly realised that part (i) was bookwork, but only about half identified what the examiners were seeking. In part (ii) many candidates assumed that the question asked “Define”. The instruction was “Describe” and candidates who stopped at a definition*

*gained few marks. Part (ii) clearly needed candidates to say something more that “prospective” looks forward and “retrospective” looks backward, but less successful candidates couldn't think what else to say.*

- 4** If the investor doesn't own shares in the market, he could borrow shares and sell them. When the price has fallen, he can buy back the shares, ready to return to the lender. This is **short selling**, and comes with the risk that the investor may become a forced buyer when he has to give the shares back, if prices have actually risen, and to possible regulatory restrictions.

Similar transactions could be undertaken using **derivatives**. For example, if an investor held shares he could buy put options or sell futures on the market: the capital gain on the derivative could offset a capital loss on the portfolio. Alternatively, if the investor didn't own shares, he could write call options, which, if the market falls, wouldn't be exercised so the income received would generate a straight profit.

He could invest in **defensive shares** with have high dividend yields. It is possible that the income from such stocks will offset any capital losses from the share price falling during the bear market, although one might expect such stocks to see a higher than average price fall.

Investors could generate profits by skilful **stock (or sector) selection** because all stocks won't move uniformly in a bear market. Some well managed companies or those in certain sectors (e.g. energy companies when oil prices are high) could still perform well.

The investor may make profits from **good timing**. Share prices will not fall uniformly throughout a bear market: there will be periods when prices will rise, offset by longer periods of falling prices. Skilful investors could buy on short-term recoveries and sell again when prices start to fall again.

The investor could **sell shares** in his portfolio and buy them back at a lower price when (if) prices fall, but only if the investor already holds shares in this market. *This does not really fit the requirements of the question.*

In all cases, returns will be net of dealing/management expenses and taxes

*Marks were given for other sensible arguments and examples, but only the five best discussed examples were counted.*

*This question was probably answered the worst on the paper on average. However there was a wide range of quality of responses, with some candidates producing very good logical answers. Other responses were disorganised and repetitive. Some candidates suggested investing in non-equity assets, which is clearly not what the question is seeking.*

- 5** (i) (a) The underwriting cycle is the process whereby relatively high and thus profitable premium rates that often result in an increase in the supply of insurance lead to increased competition and the lower and less profitable premium rates usually associated with this.

These in turn may be followed by a decrease in supply as companies leave the less profitable market which leads to reduced competition and a return to higher premium rates.

- (b) The risk premium is the amount of premium required to cover claims expected for a risk.

Risk premium = average claim amount  $\times$  average claim frequency

- (ii) When calculating the risk premium the main issue will be lack of data to determine the expected claim amount and claim frequency when the exposure period is not complete for the current policies.

In this case very little will be known about the more recent insurance years, since the policy term is 12 years.

As it is necessary to estimate claims for policies being written now, experience on not-recent insurance years will be less relevant.

Data quality may be unreliable, especially for less recent periods.

- (iii) An actual premium charged would be based on the theoretical risk premium but would additionally allow for:
- any differences between the basis used to determine the expected cost and the basis used to set future provisions for the liabilities
  - expenses of setting up the policy, maintaining records throughout the twelve-year period, and costs incurred in payment of claims (if these are not included in the risk premium)
  - commission
  - contribution to profit allowing for the risk inherent in the long term of the policy, and noting that the contribution to profit may be negative, depending on competition in the general market and the provider's position in the market
  - contingency loadings
  - allowance for the risk of rare events or a catastrophe due to any geographical concentration
  - investment income on the balance of the premium remaining, due to the long term of the policies
  - The impact of inflation on claims and expenses
  - the cost of the capital supporting the product

- the impact of taxation
  - reinsurance costs
  - profit sharing, or other allowance for particular policyholder experience.
- (iv) The actual premium to be quoted in this case would be assessed taking account of:
- The size of the existing policy with the construction company
  - The rates that have previously been charged to this company
  - How the rates compare to those previously quoted by competitors...
  - ...and those currently quoted by competitors
  - Whether the business should be priced as a loss leader with a view to maintaining customer relationship
  - Whether analysis of past experience for this construction company indicates in any way that the risk is non-standard...
  - ...allowing for appropriately limited credibility of this analysis, given the policies are still in force
  - Whether there are any expectations of variations or trends in the risk specifically applying to this company...
  - ...which would not be allowed for by existing rating factors...
  - ... such as unusual construction methods used, a propensity to build on flood plains or “brown field” sites
  - The market position of the construction company...
  - ...and the financial status of the construction company.

*Part (i) was well answered by most candidates. A few candidates gave an investment risk premium definition (e.g. equity risk premium). It is clear from the context of the question that this isn't what was being sought. In part (ii) candidates who related the general points to the specific situation given scored well; other responses were too bland.*

*The question for part (iii) clearly states “other than the risk premium”, but this did not put off several candidates who wrote pages on how to calculate a risk premium, and gained no marks. It is clear from the number of marks available, and the use of “Outline”, that more than a list is needed. Part (iv) was one of the better answered sections. Many candidates showed a good commercial appreciation and gave good suggestions especially on the impact on other policyholders.*

- 6 (i) A government can
- Provide benefits itself A1
  - Require/encourage other parties to provide benefits B1
  - Educate people about the need to save and their options C1
  - Regulate those who provide retirement benefits D1
  - Providing investment products DD1
- [Subtotal 4 + 1 bonus]

- (ii) Individual employees who were not saving (or saving less than 5%) will be forced to increase their savings, as will the self-employed saving less than 10%

Individuals who were saving more than 5%/10% may simply reduce their other savings so as to maintain their aggregate saving at what they can afford. They may think that the state-approved funds will provide an adequate pension and so reduce their aggregate savings, or they may carry on with their existing saving and so increase their aggregate saving.

Employers' contributions will be an additional source of saving, except that employers may attempt to reduce any existing retirement provision they sponsor, in order to offset the new required contributions (subject to legal / industrial relations constraints). If employees do not replace any such reductions then savings overall will not rise by the full amount.

Employers may give lower future salary rises (or cut other benefits) in order to control the increase in total employment costs. This would reduce the ability of individuals to afford private saving.

Abolishing the generous means-test might remove a disincentive for some individuals to save, and so lead to an increase in saving.

- (iii) Transitional arrangements will be a major issue, especially if the higher rate means tested benefits are switched off for everyone at a point in time. This will have a significant effect on those currently receiving benefits.

It is likely to be some time before most individuals have accrued a meaningful DC fund, so individuals who retire in the near future may still need means-tested benefits.

5%+5% may not provide an adequate benefit in the long term, especially for those with less than average earnings, or who wish to make provision for their dependants, and is even less likely to be adequate for individuals who do not work a full career, perhaps because of unemployment, or ceasing work to bring up children.

This depends on how long the government expects people to work. Later retirement may be more realistic as life expectancy increases, but individuals can expect to receive relatively less if they retire earlier.

The funds are DC so outcome is variable because of the uncertainty over investment returns if funds are invested in return-seeking assets and annuity conversion rates are based on different assets.

Annuity conversion rates will depend on longevity expectations.

Some individuals will draw their funds at low points in investment markets and so get less than they expected.

Some individuals may start with an adequate benefit at retirement but this may not continue throughout retirement, if pension increases do not keep pace with inflation.

Adequacy is more likely if individuals have other sources of retirement income in addition to the State system.

The system is likely to be reviewed by future governments before many individuals reach retirement.

(iv) Other needs:

- Medical care and living expenses on ill-health (both before retirement and during retirement).
- To support dependants in the event of death.
- Housing and other major capital outlays.
- Education/training for children/self.

(v) How to adapt:

- Enable money to be released from the pot before retirement
- ... possibly in restricted circumstance to ensure “proper” use
- ... or to purchase insurance against death/incapacity
- Allow pot to be paid to dependants on death
- Use the pot as security against loans.
- Flexibility over the contributions required or opt-out of the state scheme

(vi) Target fund could be:

- at a level intended to smooth contributions under a pay-as-you-go approach, allowing for fluctuations in cashflows
- or the expected cost of the benefits that will eventually be payable to everyone who has completed the 20-year qualification and is over age 65 (that is, terminal funding when first tranche payable)

- or expected cost of the benefits that will eventually be payable to everyone who has completed the 20-year qualification. (that is, terminal funding when potential entitlement established)
  - or expected cost of the benefits that will eventually be payable to everyone who has completed the 20-year qualification, plus a proportion of the expected cost for those who are part-way through the 20-year period (that is, regular contributions)
  - or expected cost of the benefits that will eventually be payable for all individuals (that is, lump sum in advance)
- (vii) Initially there will be nothing in the fund, hence there will be a deficit against the target fund. The size of deficit will depend on the chosen approach to funding - the approaches above are in increasing order of target fund.

The government might set an objective of reaching the target within say 10 years and pay contributions into the fund accordingly, allowing for the expected increase in the target fund over the period.

The government would then review these contributions periodically. The contributions would need to be met either from existing tax revenues or by raising additional tax.

Note that the government would save money if over-60s were no longer eligible for the more generous means-tested benefit and because over 65s may cease to be eligible for any means-tested benefit if they receive the new pension.

The actual position depends on what (if anything) the government does for people who do not qualify for the new pension and on how it transitions people who are already in receipt of the current benefits.

There will be additional administration/communication costs in the short term.

*Part (i) was answered well. In part (ii) many candidates had clearly not read either the preamble or the question thoroughly and started to write down points regarding whether savings would be adequate, rather than how they would change. When these candidates arrived at part (iii) they had nothing more to say, so there was a lot of repetition. The core points in this part were answered well, although the less successful candidates were too superficial in their responses.*

*Responses to part (iv) were good, and the better candidates also came up with suggestions for part (v) that were both sensible and practical.*

*Several candidates produced good answers to part (vi), although few really took the funding concepts and explained them in this context of this example. Part (vii) dealt with the transition to the new scheme. Not many candidates got beyond the obvious issues of new administration costs, and it seemed that because they couldn't think of anything else, this was laboured excessively. The successful candidates discussed the eligibility issues and change in retirement ages and so scored relatively well. The structure of the question was designed to*

help candidates. Part (vii) follows part (vi) and so the issues covered there can be used to structure the response to the later part.

**7** (i) (a) Sale of home

Once the sale proceeds of the house are used, then the individual accepts the whole cost of future care, perhaps subject to any social security benefit his mother may receive.

In particular he accepts the risks of his mother's longevity, nursing home fee inflation, and the investment risk during the period when the sale proceeds of the house are invested but not yet spent on fees.

There is a risk of forced sale of house when need for care commences, and foregone benefit from possible house price inflation in the period between the sale of the house and his mother's death. He accepts the requirement to finance care costs in the period before the house sale can be realised.

He avoids reducing his personal assets as long as possible, or at all should the property proceeds be enough to finance the total cost of care, or care never be needed.

Tax on his mother's estate may be reduced or avoided.

No risks are transferred.

(b) Single premium policy paying a lump sum

Once the proceeds of the policy are used, the individual's position is exactly as in (a) in terms of the costs of future care and the acceptance of longevity and fee inflation risk.

The individual will have to manage the house while his mother is in the nursing home. His mother's estate (and thus the individual eventually) will have the risks connected with letting residential property: rental voids, damages, etc., against which must be set rental income.

There is also the possible benefit that house price inflation might be greater than the individual might earn on other investments, or the risk that it is much less.

An estate that includes the value of the house may incur an additional tax liability.

He accepts the risk that the policy may never pay out if the need for care never arises, or that the fixed return may be poor value for the investment if a long time elapses before care is needed.

He accepts the risks connected with the loose definition of the insured event. The point at which nursing home care is needed is highly subjective and frequently depends on personal circumstances.

He transfers the investment risk on the premium to the insurance company. He also transfers the risk relating to the length of time between taking out the policy and care being needed. If this is short, the policy will be good value.

He accepts the risk of insurer default.

(c) Regular premium deferred annuity

The individual accepts the full cost of care, but has the annuity payments to offset this. Thus the position is as in (b), except that the longevity risk is partly transferred to the insurance company.

All the property-related points in (b) apply.

If care is not needed, or needed late in life, the policy will not pay out, or the value of the return may be poor.

With regular premiums, he avoids much of the investment risk of using part of his personal capital. Premiums could be financed from income.

The tight definition of the insured event avoids risks of dispute. The annuity will commence even if his mother is not cared for in a nursing home – but the definition may be too tight, leaving care costs uninsured.

As well as part of the longevity risk once the annuity has commenced, he transfers the risk relating to the length of time until the payments commence to the insurance company – because if this is short, only a few monthly premiums will have been paid.

(d) Single premium full indemnity.

The individual transfers all the risks relating to the costs of future care, longevity and fee inflation to the insurance company.

All the property-related points in (b) apply.

If care is not needed, the policy will not pay out.

The points about the loose definition of the insured event in (b) apply.

The points about the investment risk on the single premium in (b) apply.

(e) Single premium tail indemnity

Effectively this arrangement is the same as (d), except that the individual accepts all the risks of care for the first two years, and then transfers all subsequent risks.

All the property-related points in (b) apply.

If care is not needed, the policy will not pay out. The individual will also not need to make any payments himself.

The points about the loose definition of the insured event in (b) apply.

The points about the investment risk on the single premium in (b) apply, although the premium will be very much less than in (d).

(ii) The policy in (b) pays a lump sum at the point of claim.

Thus the main concern will be the probability that nursing home care starts to be needed at each age. These are a set of transfer probabilities with a similar structure to sickness claim inception rates.

There is likely to be a select period because the contract is less likely to be purchased if the life is in good health.

There may not be much experience on which to base the rates. Thus margins for data error need to be included.

The definition of the insured event is loose. The company might feel obliged to pay claims in circumstances that it was not originally anticipating. The rates might include a specific margin for this, or it might be included in a general prudential margin.

The policy in (c) pays an annuity once the claim is admitted.

The issues in (b) are all relevant with the exception of the margin for the loose definition of the insured event.

The value of the benefit at the point of claim is an annuity that will depend on future life expectancy in the home.

It is likely that mortality rates will have a long select period – in other words they will depend on both age and duration since entering the home.

It may be that the duration in the home is more important than age at the advanced ages that are usually involved. Thus age could be grouped into broad bands except at very advanced ages, and the primary decrement might be duration.

The benefit in policy (d) is a full indemnity.

Thus in addition to the issues for policy (c) the cost of nursing home care, and the inflation of the cost both before and after payment commences needs to be taken into account.

The uncertainty of this suggests that appropriate margins need to be included. The margin for the loose definition of the insured event is also necessary.

In policy (e), there is no payment for the first two years once a claim is admitted. As the risk insured will be very much reduced compared with (d), the risk premium will similarly reduce.

But the insurer accepts the risk of a high severity claim (a very long period of nursing home fees), so the volatility is high and the margins will need to be re-assessed.

This might result in the margins being a much greater proportion of the risk premium, which might give rise to marketing problems.

*Part (i) was lengthy and there were lots of marks available. It is clear that some repetition is necessary, but the examiners were looking for the differences between each scenario. On the whole this part was well answered, particularly by those who had structured their answers before they started writing. Very few candidates dealt with the definition of the insured event, which is a fundamental risk mitigation tool – a tight definition saves argument, reputation, and costs. The requirement was thoroughness and depth – lots of marks need lots of points. Some candidates seemed to get bored and ran out of steam by (d) and (e) and so missed easy marks.*

*Part (ii) was poorly answered. The question says “insurance risk”. It then goes on to help those who did not read this clearly by saying “ignore investment and expense risks”. Despite the examiners trying to help, this did not stop a large number of candidates answering a full premium rating question complete with looking at competitors, loss leaders, underwriting cycles, asset matching, new business strains, etc., all of which gained no marks.*

*There were other areas of weakness in reading the question. Some read “(b) to (e)” as “(b) and (e)”, while others read insurance risk as meaning death benefits not care benefits and so missed the points.*

*The angle was risk and its implications. Most successful candidates got the basic issues (and looked at it from the right perspective – the insurer) but very few developed it. The aim is to build on each section – to discuss the extra issues needing consideration each time. The concept of risk and uncertainty needing margins was generally missed.*

## **END OF EXAMINERS' REPORT**

# EXAMINATION

21 April 2009 (pm)

## Subject CA1 — Actuarial Risk Management

### Paper Two

*Time allowed: Three hours*

#### **INSTRUCTIONS TO THE CANDIDATE**

1. *Enter all the candidate and examination details as requested on the front of your answer booklet.*
2. *You have 15 minutes before the start of the examination in which to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have three hours to complete the paper.*
3. *You must not start writing your answers in the booklet until instructed to do so by the supervisor.*
4. *Mark allocations are shown in brackets.*
5. *Attempt all seven questions, beginning your answer to each question on a separate sheet.*
6. *Candidates should show calculations where this is appropriate.*

#### **AT THE END OF THE EXAMINATION**

*Hand in BOTH your answer booklet, with any additional sheets firmly attached, and this question paper.*

*In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator from the approved list.*

**1** A futures exchange guarantees contracts between parties that participate in the exchange.

Describe how the exchange manages its credit risk exposure. [6]

**2** An individual intends to take out a 25-year mortgage of £60,000 to finance the purchase of a new home. The individual is considering the following policies:

(a) Income protection policy: The policy will provide an income of 60% of gross earnings in the event that the insured is unable to work due to illness or accidental injury. The income commences three months after the event.

(b) A regular premium 25-year unit-linked endowment assurance with a sum assured of £60,000 payable in the event of critical illness or death.

(c) A regular premium 25-year term assurance with a sum assured of £60,000 on death together with a waiver of premium on ill health.

Discuss the risks avoided by the individual with each of the insurance policies. [7]

**3** An actuary has been asked to carry out a small, one-off investigation for a client, which will require the use of a model.

Discuss the factors the actuary should take into account when considering how to approach the development of this model and choosing the source of the model. [8]

**4** An individual, whose motor insurance policy is due for renewal, uses a website to compare quotes from a range of providers including his current insurer.

The individual supplies personal and other details and specifies the type of cover required. Based on this information, the website gives a wide range of premiums, all of which are lower than the premium currently being paid.

Explain possible reasons for the range and size of the results of this comparison exercise. [11]

- 5 In twelve months' time, a country is due to hold an election to choose its government. There are likely to be five parties contesting the election. A respected polling organisation currently estimates the probability of each party winning the election to be:

<i>Party</i>	A	B	C	D	E
<i>Probability %</i>	40	30	15	10	5

A company wishes to use this data to construct an investment product linked to the result of the election.

In return for a single premium, investors will be able to select the party that they think will win. If their selection does win, they will receive a fixed multiple of their original investment. If their selection does not win, the investment is lost. The multiples offered vary between each party and for each party they will vary over time depending on the relative probabilities of victory at each point in time.

The multiples can be non-integral, for example 4.333 or 2.375 per unit invested

Twelve-month money market interest rates are currently 5%.

- (i) Calculate, stating the assumptions you use, the multiples that the company should currently offer in respect of each party winning the election. [6]
- (ii) Discuss the issues relating to the determination of the election result that will need to be clarified when drawing up the terms of the contracts. [3]

Six months later, two of the parties withdraw from the election.

- (iii) State the actions the company could take in respect of investments already made on each of the original five parties. [2]

A rival company offers the following terms on the three remaining parties:

<i>Party</i>	X	Y	Z
<i>Multiple</i>	4.0	2.5	3.5

- (iv) Explain why these terms could cause problems for this rival company. [2]

Many companies offer similar products using the results of a range of events as the underlying investment on which contracts are based. Primarily, these products involve predicting the outcomes of individual or an accumulation of sporting contests. Most results are known and winning payouts made on the day, or within a few days, of the investment being made.

- (v) Explain how the concept of reinsurance could be used to manage the risk inherent in these products. [6]
- [Total 19]

- 6** An insurance company is designing a life insurance product where cheaper rates are offered to customers who are considered to have a relatively low mortality risk compared with the general population.
- (i) Discuss the rating factors to apply when pricing this new product. [10]
  - (ii) Outline the design features of this product that could be incorporated to make the product more marketable. [3]
  - (iii) Describe the factors from the external environment to consider when designing this new product. [9]
- [Total 22]

**7** Company X is a subsidiary of a large multinational group, Group Y. Group Y has an extensive range of businesses in the country in which X operates. X is going to be demerged from Y, and the demerger agreement requires X to set up pension arrangements for its employees, which should be broadly similar to the defined benefit pension scheme operated by Y. X has very little in-house resource or expertise for pension operations.

- (i) (a) List the main parties (other than Group Y) including professional advisors, that will be involved in establishing Company X's new pension arrangements.
- (b) Explain the role of each of the parties in (a). [5]
- (ii) Discuss how the actuarial control cycle could be used in relation to the benefit design for the new pension scheme. [12]

Two years after the scheme was established, an actuarial investigation is being carried out into the funding position of the scheme, and the surplus/deficit is being calculated.

- (iii) Outline the data that is needed for this investigation. [6]
  - (iv) Outline the checks that would be performed on the data. [4]
- [Total 27]

**END OF PAPER**

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

**EXAMINERS' REPORT**

**April 2009**

**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.

R D Muckart  
Chairman of the Board of Examiners

July 2009

## **General comments**

*As the title of the course suggests, 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 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.*

*Comments for individual questions are given in the solutions that follow.*

- 1** A Futures contract involves 2 parties either of which could default and hence the need for the exchange. Credit risk arises in respect of the guarantee: if one side defaults then the exchange is liable

The exchange protects its credit exposure to participants in the futures market in several different ways.

Institutional investors, corporates and individuals who wish to effect futures transactions must have their trades cleared by members of the exchange with clearing status. Clearing status involves authorisation, having certain minimum capital and operational standards. Clearing members of the exchange must pass on at least the initial margin requirement and the variation margin calls to their clients. They can of course pass on higher margin requirements.

The exchange imposes initial margin requirements on clearing firms (and hence their clients) as part of the procedure of entering into a futures contract. Typically, the initial margin requirement would provide the exchange with sufficient capital (usually with 99.5% certainty) to weather an adverse price movement in the futures contract in the event that the client/clearing member defaulted.

The credit exposure of the client/clearing member to the exchange varies with the value of the futures contract. For example, where the client has a short futures contract on the FTSE 100 index and the index rises the client's exposure to the exchange via the clearing member increases. Variation margin is also required where the initial margin falls below a threshold specific to the contract. This provides collateral movement from the client to the exchange that varies with credit exposure of the client/clearing member to the exchange.

Price movement limits allow the exchange to suspend trading in a contract if its price moves up or down by more than set limits. Such limits allow the exchange to limit its credit exposure to clearing members/clients in the event of sudden moves in the price of the futures contract.

The margin requirements for speculators may be different to those for hedgers, as speculators may not have the underlying asset to deliver.

Exchanges usually reserve the right to increase the margin requirements if they deem it fit and to close a contract if margin is not produced.

The exchange could limit its exposure to a counterparty and/or particular contact

*Generally this was not well answered. Many candidates got the concept of margin but didn't explain it clearly or in enough detail. Better candidates distinguished clearly between initial/variation, described how margin related to risk, and explained the distinction between exchange member and ultimate client.*

- 2 (a) In the event of illness or accidental injury the insured would be provided with an income, which could be used to allow them to continue to afford to live in their home.

But:

- No income is provided for the first three months after illness or accident occurs.
- 60% of earnings may be insufficient.
- Income may not be provided even after 3 months or is terminated if the injury is not accidental, or the illness or accidental injury is not sufficiently severe to meet the conditions insured against.

- (b) On diagnosis of a permitted critical illness or on death the mortgage can be repaid using the sum assured, and the policyholder is making provision to repay the mortgage after 25 years.

But:

- There is a risk that the mortgage could not be paid if an illness or accident occurs that prevents the insured from working but that does not meet the critical illness conditions or does not result in death.
- If the policyholder becomes ill they may be unable to afford the premium.
- At the end of the policy term there is no guarantee that the maturity benefits are sufficient to repay the mortgage.

- (c) In event of death the sum assured will repay the mortgage, and in event of illness, the premiums will be paid and cover will continue.

But:

- In event of illness the insured may be unable to afford interest payments on the mortgage.
- No provision is being made to repay the mortgage after 25 years (assuming mortgage is interest only).
- The definition of ill health may be too tight.
- As the mortgage decreases then may have over-insured, if a repayment mortgage.

*By some distance, the question that most candidates scored best on. Most grasped the discuss point and so covered the “buts”, though some went too far and commented on things*

*not covered rather than clarifying what was covered. Some candidates dealt with all 3 contracts together rather than individually, leading to repetition and confusion.*

**3** There are really three possible sources for the model. The actuary could either:

- Buy a commercial modelling product.
- Use an existing model possibly after modification.
- Develop a new model.

In general, the approach used will depend on:

- The level of accuracy required.
- The expertise and resources the actuary has access to.
- Whether the model needs to be flexible so as to carry out related tasks.
- The cost of each option relative to any budget.
- Availability of data to do the task

It will also be necessary to make sure that the model is fit for the purpose for which it is being used. This is particularly relevant when a model is being purchased from an external provider or when an existing model is being reused for a different purpose. Since it may not be apparent for a while (and after some expense) that the model can't do what is required of it.

The nature of the investigation is important. Many models are available but if the task is obscure or unique, then a new model will need to be developed. In this case, it would appear that the resources to spend on the model are limited. Hence developing a new model may be too costly or time consuming.

Even though the investigation is one-off, a new model could have applications for other work either for this or other clients, which could mitigate the costs. It may be possible to sell the model to other actuaries or potential users if it is novel with a range of applications.

If the model required is unlikely to have wider applications, the actuary may take a very broad-brush approach (within the constraints of professionalism) using judgement rather than detailed modelling.

*Most candidates got the standard bookwork, but often not clearly or concisely. The focus should have been on this client and how to get a suitable model, rather than what a general model should do and discussions of deterministic v stochastic.*

- 4** Two features need to be explained. Firstly why there is a wide range of quotes. Secondly, why all the quotes are lower than the premium currently being paid.

### **Wide Range**

The policyholder specifies the type of cover. But for practical purposes this is likely to be expressed in generality eg third party, fire and theft, comprehensive etc. Within this broad categorisation, the details of each policy from each provider is likely to differ

For example, differences may exist in terms of excesses, maximum payouts, amounts and methods of determining no-claims discounts and if protected or courtesy car, unnamed driver or breakdown cover.

There will also be differences in terms, conditions and definitions (e.g. what comprehensive means) for example what is covered by liability, exclusions and how values on a claim are obtained (there may be replacement value or a current sale value view taken).

Such nuances will clearly lead to different premiums for what at first glance may seem to be the same cover.

The main reason however, could be due to different interpretations and experience of the various ratings factors.

Some companies will simply charge differently for the same exposure. Principally this may relate to age or sex of driver, location, value (or engine size) of car, occupation, annual mileage etc.

Such differential rating could be down to views on future experience (perhaps with reference to past experience) or it could result from a positive decision to target (or avoid) certain sections of the market. Some companies may see profitable niches that they can exploit. Perhaps they have expertise (e.g. lots of good data) in certain areas.

Some companies may be moving away from pricing purely on experience and taking commercial, longer-term decisions to boost (or reduce) market share in certain areas. That is they may alter profit or contingency loadings.

Some companies may be more efficient than others e.g. only sell via the internet and so have lower overheads and be able to charge less.

Some companies will have economies of scale and therefore can charge less.

Some companies may have large free reserves, which could help them to follow a more aggressive investment strategy or subsidise rates.

Some companies may be based overseas and so may have less onerous tax or regulatory regimes to comply with.

Some companies may have stricter underwriting criteria both on acceptance and claim (e.g. rejecting poor risks means less subsidy from good risks). Lower premiums may mean that the company is less willing to pay out on a claim — more investigations and hoops to jump through.

Some companies may have links to the comparison site. They may have negotiated better terms than others in ways that could reduce costs or boost volumes (e.g. commissions paid to or charged by the site provider or have their products more favourably displayed or commented on).

The payment method (e.g. annual versus monthly or paying via direct debit) may have affected the premium offered.

### **Lower than current premium**

The fall in premium rates may relate to the stage of the underwriting cycle. It could be that competition is forcing prices down as new entrants come in due to previous good profits in the sector.

There may economic or social factors contributing here. For example, in times of economic growth, there may be fewer claims (less fraud). Alternatively, tougher regulation (e.g. speed cameras) or policing and better education may cut down claims. Essentially, future experience is expected to be “better”.

The rating factors may be out of date (e.g. new information).

The current premium may have arisen through a more expensive sales channel.

Rates for new business may be more competitively priced than for renewals. A web renewal may be viewed as new business in that the policyholder is clearly shopping around. Those who renew in a more lazy way may not need encouragement to stay and so are prepared to pay more for less hassle.

The level of cover may be different. For example the car is now older and less valuable and so may cost less to insure. Alternatively, the policyholder may have altered the type of cover required from comprehensive to something cheaper.

One more year without a claim, may lead to a reduction in the premium if they haven't yet reached the maximum no claims discount.

Also, rates may be quite sensitive to age.

There may have been a data error in either year's premium.

*There was a fairly wide range of scores on this question. Very few candidates answered broadly enough to score very well, given the marks available. Many grasped one aspect e.g. change of circumstances and laboured the point with many examples, which were essentially repetition.*

*A big distinguishing factor was the approach adopted. Those who clearly distinguished between “range” and “size” tended to do best.*

- 5** (i) Under any contract, the benefit is linked to the premium by the probability of the event happening. Hence the pure benefit per premium is calculated as  $1/\text{probability}$ . This would give multiples of:  
A: 2.5, B: 3.333, C: 6.667, D: 10.0, E: 20

Allowance needs to be made for the investment return the provider could obtain on the premium prior to benefits being paid. Given the term and nature of the liability, cash would be an appropriate, low risk investment. So load all multiples up by 5%.

Allowance needs to be made for the expenses of the provider and for margins for profits and contingencies. So divide all multiples by 1.15 (say). This would give multiples of:  
A: 2.25, B: 3.0, C: 6.0, D: 9.0, E: 18

With such products, one will need to look at the market and could skew prices towards the market. Provider may also accept lower margins on parties with higher volume of business (for example, on the parties with higher chances of winning). This could give multiples of:  
A: 2.375, B: 3.25, C: 6.0, D: 8.0, E: 15

This assumes that the provider accepts the data provided by the pollsters. If they disagree or have other information not widely available, returns would be adjusted accordingly.

- (ii) The most important issue will be a clear definition of win.

This will depend on the nature of the election for example the party with the highest number of seats or votes or the party that provides the prime minister or president. Any criteria used will have to agree with those commonly accepted in the country concerned.

This will be particularly important if the election consists of more than one round. The ultimate winner rather than, say, a first round winner must be specified.

Clarification will be needed if the result is inconclusive or contested. Preferably, this should be linked to the verdict of an independent body e.g. an electoral commission. Decisions may be needed as to whether to void investments in such circumstances or have them stand for any re-run.

Clarification will also be needed if the election is postponed. Perhaps a time limit will be applied.

Procedures will need to cover drawn elections, the withdrawal or merger of parties or entry of new parties before the election.

- (iii) There are two issues: investments on parties that withdraw and investments on parties that remain. The treatment of one directly influences the treatment of the other.

Investments on withdrawing parties could be refunded. If so, the multiples on parties that remain will have to be reduced. Deductions will be needed to reflect the greater probability of victory for each remaining party. In effect, the contest has always been a three party one.

Alternatively, investments on withdrawing parties are lost. In this case, the original terms for investments on the remaining parties can stand as there is no refund on “losing” investments

- (iv) Essentially, an investor could arrange his premiums so as to guarantee a profit or no loss. For example, investing 1 on X, 1 on Z and 1.5 on Y, would return 4.0, 3.5, or 3.75 for a total outlay of 3.5. The provider could go bust.
- (v) Providers in these markets (bookmakers) can use reinsurance techniques to control and manage the risks that they face.

Bookmakers could suffer large losses as a result of certain sets of results. This would arise if profits on losing bets didn't cover losses on winning bets for one or a series of events.

Risk analysis would be carried out to analyse the net liability the bookmaker would face for each potential result (together with the current chances of adverse results arising). In cases where the bookmaker views the risks to be too great, they could make bets with other providers that in the event of an adverse result would provide returns that offset the liabilities they have to their investors.

Risks could arise from a particularly large individual stake. The bookmaker could in effect share a proportion of the risk by laying-off part of the bet with another bookmaker. This has the advantage of allowing the provider to take on large bets that their capital otherwise wouldn't allow them to write.

Other risks could arise due to the concentration of a lot of relatively small bets on the same result. For example, with major football tournaments, English bookmakers have a huge proportion of their liabilities payable on an English win. To hedge this risk, they could place bets on England with overseas bookmakers who can price on a more realistic view of the underlying probabilities (or who have similarly skewed liabilities).

There are risks relating to multiple or cumulative bets. Here a small stake could give rise to a very large payout albeit with a small chance of occurrence. The problem here is really in identifying such build ups and choosing the correct moment to hedge without losing profit potential

For small bookmakers, hedging could enable them to access the pricing, data and technological resources of larger bookmakers. They cede some profit for the use of others' expertise.

Much of the reinsurance will be done on credit. This will help with working capital and cashflow requirements since returns need to be paid to investors on demand but can be deferred on inter-industry transactions.

*Many candidates seemed to struggle to apply actuarial concepts to a "non-actuarial" situation.*

*In part (i) most candidates scored for the basic calculations, but few made the additional comments required to explain their loadings and score high marks, despite the clues in the question. Some candidates stated they were ignoring expenses/profit, which is clear but not appropriate in a practical pricing question. Some candidates seemed to think that the terms needed to offer at least a fair return to investors, rather than at least some profit for the provider.*

*In part (ii) many candidates made good points with a lot of practical awareness, often starting by asking what "win" means. Some others diverted themselves by discussing issues not relevant to the question about determining the result.*

*In part (iii), most candidates correctly stated the broad options of refund or not, though few commented on investments already made on the remaining parties.*

*Part (iv) was generally poorly answered – many looked at implicit probabilities but failed to comment on what a sum of less than 1 meant.*

*Part (v) was reasonably well answered. Weaker candidates just described types of re-insurance without applying them to this case. Better candidates tailored their points to the question – for example commenting on the need to identify outcomes with high payouts, whether or not the outcomes were perceived as high/low probability.*

**6** (i) Factors include:

- Sex: rates will need to be developed for males and females separately. Females will generally have lower risk.
- Age: rates will need to be developed by age – younger lives generally have lower risk.
- Height and weight: a measure such as BMI can be used to adjust for weight and associated risks – the higher the BMI the higher the risk.
- Lifestyle: factors such as being a member of a gym can be used to identify preferred policyholders. However the most important underwriting consideration is whether the membership is used or not. Hazardous hobbies identify less preferred policyholders.
- Smoking status: non smokers will receive lower rates as the risk of death is lower.

- Alcohol consumption: low consumption of alcohol indicates a lower risk and hence should receive lower rates.
- Employment status: occupational classes can be used to identify lower risks.
- Marital status: can be an indicator of lower mortality (i.e. married males generally lower risk).
- Address: provides an indication of affluence which also indicates lower risk.
- Individual's medical history: will indicate any specific conditions.
- Relatives' medical history: may indicate genetic/cultural predispositions.
- Sum Assured/Level of Income: provides an indication of affluence which indicates lower risk.

(iii) Could offer “discounted” lifestyle options that act to reduce the risk. Examples include:

- gym membership
- assistance with quitting smoking
- weight loss programs

Provide additional benefits

- e.g. critical illness
- other riders
- ability to extend the contract
- change type of contract (e.g. convert to savings product)

(iv) It is important to consider external factors when designing such a product, particularly as it is new to the company.

- Legislation/regulations, as the product is different to other life insurance products, the documentation provided to customers must be clear.
- State benefits; similar considerations for usual insurance products since insurance is not provided.
- Tax; subject to the same tax regulations as other insurance products.
- Accounting standards: the product will be treated the same way as other insurance under accounting standards.
- Capital adequacy and solvency: the company will need to assess its capital requirements and allow for the different underwriting requirements.
- Risk management requirements: a number of risk categories will be affected (e.g. insurance risk, underwriting risk, operational risks due to differences) and this must be allowed for in the capital calculations.

- Competitive advantage: the marketing of this product may provide a competitive advantage.
- Changing cultural and social trends that might affect the market for this product.
- Changing demographic trends might affect the market for product.
- International practice: if this product is sold in various countries experience there can be used to refine the product design.
- Care needs to be taken to ensure that cultural differences are factored into the design of the product.
- Technological changes: technology can be used to underwrite the product automatically. The internet and other facilities can be used to sell the product, although it is important to require evidence of each of the risk factors that reduce the premium payable.
- Discrimination – are there any rules that need to be considered.
- Contestability – will the initial application form be able to be checked at claim.
- Inflation – need to consider current and expected inflation rates and consider how this will be reflected in design of product.

*Apologies for mis-numbering the question parts.*

*Part (i) was generally well answered and we looked for candidates to address the context rather than simply cover standard concepts. The better candidates set the scene by showing what the scenario implied in terms of what to focus on and then gave some explanation on a range of specific rating factors. Others missed the point and looked at a pricing model i.e. expenses, investment returns, margins etc. or discussed annuities.*

*A wide range of scores on part (iii). Better candidates imaginatively suggested specific examples that made the link with reduced risk for the target market. Many candidates spent too much time on general marketability rather than on “design features”.*

*Again a wide range of scores on part (iv). The best candidates took each factor in turn, made them distinct and applied them to the specific product.*

**7** (i) Actuarial: costings/design and financial management.

Legal: drafting the documents.

Accounting: proper accounts for the arrangement.

Administration: establish procedures for accurate record-keeping and payment.

Company X and its financial backers: ensure the agreement is put into place and to understand the finances/risks of the new arrangement.

Company X's employees: ensure the new scheme meets the terms of the agreement.

Trustees will also want to ensure that the terms are met.

Regulators: ensure that the new scheme meets all the regulations.

(ii) **Specifying the Problem**

Assess the risk being taken on by the company in respect of mortality, and investment, and other areas such as disability.

The benefit structure must meet the requirement of broad comparability, but may be adapted to meet the needs of the company and its workforce, and the broad comparability requirement may only be temporary.

The design should have acceptable levels of cost/risk.

**Developing the Solution**

We can build a model to project the scheme's financial position on any statutory or other relevant funding measures, showing the contributions that will be required from the company and how the scheme will be reported in the company's accounts.

It will be necessary to make assumptions about future experience and to illustrate the sensitivity of the outcomes to the assumptions.

Discuss with the company how great is its tolerance for risk bearing in mind the other business risks that it faces, and compare this with the volatility shown by the model and consider whether/how pension risk can be laid off.

May be useful to research employees as to preferred design options and to compare with relevant competitor employers.

When developing the solution, professionalism must be considered.

## Monitoring the Experience

Compare actual experience with the expected outcomes, bearing in mind that the scheme's specific experience may not be very meaningful due to lack of data and (initially) a short experience period, but more general experience may be relevant and financial/economic conditions may have changed.

Review the appropriateness of the original benefit design accordingly considering whether the company's circumstances have changed and any trends in pension provision or the competitive position.

- (iii) Asset data at the valuation date and 2 years ago (transfer date) at market value and analysed by asset type.

Market data (including inflation and bond yields) for economic assumptions.

Membership data at the valuation date on current employees and those who have left/died/retired, with relevant data on benefit entitlements such as salary/pension and service dates, and relevant data for valuing the entitlement (assumptions) such as age and marital status.

Details of membership movements since establishment.

Details of cashflows in the period: contributions and benefit payments, any transfers in/out and investment flows, from audited accounts preferably.

- (iv) Reconcile the membership against original data, and check salary growth for those employed throughout and check benefit payments against membership movements.

Investigate any unexpected data items (such as high ages).

Spot check some individuals.

Check contributions paid against salary data, and check investment income against assets, and check asset values (especially if unaudited).

Take particular care on data not under your control (such as that provided by the sponsoring company).

*In part (i) the best answers had 6 or so distinct and important parties with a concise description of what they do. Some candidates commented on Y despite the question's instructions, and some candidates wasted time/effort with repetition (for example different versions of X's management)*

*In part (ii), disappointingly few candidates focussed their answer on benefit design. Many answers were too general and only covered the standard points without a clear application, perhaps due to an inclination to rush in rather than to plan before starting to answer.*

*Flowing from design is the risk aspect of the ACC in relation to benefits, contributions and affordability – but no detail was required on investment strategy, administration, governance, actuarial modelling, etc.*

*Most candidates scored well on part (iii). The best started from “to get surplus we need asset and liability values, hence the data we need is ...”. Too many looked at liabilities only, or just gave lists without any context/justification.*

*Part (iv) was fairly straightforward, but many candidates missed out on full marks because of repetition, not focussing on data, or not being specific.*

## **END OF EXAMINERS' REPORT**

# EXAMINATION

30 September 2009 (pm)

## Subject CA1 — Actuarial Risk Management

### Paper Two

*Time allowed: Three hours*

#### **INSTRUCTIONS TO THE CANDIDATE**

1. *Enter all the candidate and examination details as requested on the front of your answer booklet.*
2. *You have 15 minutes before the start of the examination in which to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have three hours to complete the paper.*
3. *You must not start writing your answers in the booklet until instructed to do so by the supervisor.*
4. *Mark allocations are shown in brackets.*
5. *Attempt all seven questions, beginning your answer to each question on a separate sheet.*
6. *Candidates should show calculations where this is appropriate.*

#### **AT THE END OF THE EXAMINATION**

*Hand in BOTH your answer booklet, with any additional sheets firmly attached, and this question paper.*

*In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator from the approved list.*

**1** List reasons why an investor's preferences may change over time. [4]

**2** Two types of interest rates are defined as:

- (1) Short-term interest rates in the commercial money markets, that is short-term loans not involving the government; and
- (2) The base interest rate set by the economy's central bank, or equivalent. This base interest rate is the rate charged on very short-term money that the government lends to or borrows from commercial banks to provide liquidity in the market.

In the country concerned, the rates described in (1) above have traditionally been slightly higher than those in (2).

Describe circumstances where the margin between these two rates may increase. [5]

**3** (i) Define the terms: credit risk and credit rating. [2]

(ii) Discuss how the credit risk of an investment fund that invests in corporate bonds could be reduced. [8]

(iii) Outline the limitations of credit ratings. [3]

[Total 13]

**4** A large company operates a defined benefits scheme for its employees. A supervisory valuation of the scheme has just been completed. The supervisory valuation must be carried out on a set of methods and assumptions as specified by the regulatory authority. The regulatory authority has recently introduced a new set of methods and assumptions, and this is the first valuation carried out on the new set of methods and assumptions.

The results of the valuation show that the accrued liabilities are greater than existing assets giving a deficit, whereas the previous supervisory valuation showed a large surplus.

Describe the various factors and events that could explain this change from surplus to deficit. [13]

- 5** (i) Discuss the concept of risk from the perspective of a financial institution. Your answer should include how such an institution would take risk into account as part of its management processes. [12]
- (ii) Outline the actuarial activities a financial institution will need to undertake in order to assess, quantify, manage and monitor the risks inherent in its business. [6]
- [Total 18]

- 6** (i) Describe the main reasons why an insurance company holds capital. [7]

Company X is an investment bank that is in the process of acquiring a large listed life insurance company, Company Y, in order to form a group, XY. As the transaction is in its final stages, Company X has access to all Company Y's internal information. Company Y has an internal risk management policy that sets a capital buffer to ensure the overall capital held is significantly in excess of the minimum required by the regulator.

- (ii) Discuss the reasons for Company Y holding a level of capital significantly above the minimum regulatory requirements. [4]
- (iii) Discuss how Company X could reduce the overall capital requirements of the newly formed group, XY. [5]

In the general economy there has recently been both a restriction in the availability of finance and an increase in the cost of finance.

- (iv) (a) Discuss the potential effect of these changes on Company Y's capital requirements.
- (b) Describe how the possible changes in capital requirements could be assessed. [4]
- [Total 20]

**7** A company is considering purchasing a large office building located in a large city and is assessing the options available to manage the risks associated with the purchase.

- (i) Give six examples of risks that could lead to the loss of use of the entire building. [3]
- (ii) Discuss the management of these risks. [4]
- (iii) Discuss the requirements of a model to be used to assess these risks. [9]
- (iv) Outline the steps required to evaluate these risks using a model. [5]
- (v) Discuss the advantages and disadvantages of using the following techniques to create a model:
  - (a) Stochastic modelling
  - (b) Stress testing
  - (c) Scenario analysis

[6]

[Total 27]

**END OF PAPER**

**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.

R D Muckart  
Chairman of the Board of Examiners

December 2009

**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**