

# EXAMINATION

4 April 2005 (am)

## Subject CA1 — Core Applications Concepts

### Paper 1 (Assets)

*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** A prospective home buyer has been offered the following two options to finance the capital sum for the purchase of a property:
- an “interest-only” loan and an endowment assurance
  - a repayment mortgage
- (i) Describe the cashflows under the two options. [6]
- (ii) (a) State the main disadvantage of the repayment mortgage option.
- (b) Suggest a way to address this disadvantage, describing its effect on the cashflows. [3]
- [Total 9]
- 2** A scheme which provides benefits on retirement has 25% of its assets invested in overseas investments. A scheme member has asked why the fund has overseas investments when all the benefits are payable in the domestic currency.
- (i) Discuss possible reasons for this strategy. [4]
- (ii) List the problems which may be encountered when investing in overseas securities. [5]
- [Total 9]
- 3** Outline the points a charity should take into account when reviewing its investment strategy. [10]
- 4** The financial regulations for insurance companies are being changed and as a result a company needs to introduce a stochastic asset model.
- Describe the evaluation criteria for selecting a stochastic asset model. [11]
- 5** (i) Discuss the features of corporate debt that would make it a suitable investment for a scheme providing benefits on retirement. [5]
- (ii) List the factors that influence the difference in yield between government and corporate bonds. [3]
- (iii) Describe the possible features of a new corporate bond issue that would reduce the risks associated with it, and thus might make the bond more attractive to an investor. [4]
- [Total 12]

- 6** (i) Describe the two main types of dealing system in use in stock exchanges. [4]
- (ii) An investor wishes to trade a large amount of stock. Discuss the advantages and disadvantages of the two main types of dealing system that could be used for this. [9]
- [Total 13]

- 7** (i) List the uses of investment indices. [4]
- (ii) Describe the particular uses of government bond indices. [4]

An investment manager is considering setting up a new index-tracker fund to track UK equities.

- (iii) Compare the main features of the FTSE 100 Share Index and the FTSE All-Share Index. [4]
- (iv) Explain the factors to consider when deciding which of these indices to track. [4]
- [Total 16]

- 8** An investment company is considering selling a financial product in a developed overseas market. This will be its first international venture. The company has estimated the potential cashflows in today's monetary values under a number of different scenarios as follows.

Scenario	A	B	C
Year	\$000	\$000	\$000
1	−565	−565	−565
2	180	160	100
3	210	176	100
4	240	194	80
5	240	213	70
Probability of occurrence	30%	60%	10%

- (i) Explain how the real risk discount rate to be used when valuing this project should be chosen. [8]
- (ii) Calculate the net present value under each scenario and the expected net present value of the project. Use a real risk discount rate of 9% p.a. and assume that the cashflows occur midway through each year. State the formulae used. [6]
- (iii) Discuss the considerations which should be taken into account when deciding whether the project should proceed. [6]
- [Total 20]

**END OF PAPER**

# **EXAMINATION**

April 2005

**Subject CA1 — Core Applications Concepts**

**Paper 1 (Assets)**

**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 1 syllabus and reading is shorter and more straightforward than that for paper 2. As expected the standard of candidates' solutions was considerably better in this paper than in paper 2.*

*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** (i) **An endowment assurance** has the following cashflows:

A regular series of known premiums (amount certain) which cease on death;  
A lump sum paid on death guaranteed to repay the loan;  
A lump sum on survival to maturity.

The maturity amount may be certain if the policy is without profits and non-linked, otherwise it could be less than or more than the loan amount outstanding, so there may be a potential shortfall to be funded

It may be possible for the loan to be repaid early, but only if the policy has sufficient surrender value.

An “interest-only” loan has the following cashflows:

Initial capital sum received;  
A regular series of interest payments to service the loan - the interest rate need not be fixed so the interest payments may vary.

The timing of the final cash flow is uncertain.

**A repayment mortgage** has the following cashflows:

Initial capital sum received;  
A series of amounts each of which includes part repayment of the loan in addition to the interest payments.

The interest rate need not be fixed so the amounts may vary.

The repayment elements of each regular payment are planned to guarantee to repay the mortgage amount by the end of the term without the need for a final large cash flow.

It may be possible for the loan to be repaid early if the borrower makes greater payments than required to service the arrangement.

There is no provision to fund repayment of the loan on death, so there will be a shortfall to be funded on death.

- (ii) (a) The disadvantage of the repayment option is that there will be shortfall on death or critical illness.

(b) A term assurance (level or decreasing) would overcome the disadvantage.

The cash flows are a series of known premiums payable and a guaranteed lump sum payable on death, which will at least repay the outstanding loan amount.

*Part (i) was generally well answered but many candidates missed the point that the sum assured at the maturity of the endowment policy may not be sufficient to repay the loan. In part (ii), candidates who realised that the main disadvantage was a shortfall on death or critical illness scored very well.*

- 2** (i) The scheme would generally be looking for a higher return. Overseas investments can increase the expected return through investing in higher risk opportunities or taking advantage of inefficiencies in the global market such as changes in currency rates.

Overseas investments can also reduce risk through increasing the level of diversification by investing in different industries and companies, and investing in countries with a low degree of correlation to the domestic market.

There are other possible reasons to use overseas investments:

- There may not be enough suitable assets available in domestic economy;
- The tax situation may favour overseas investment;
- There is a risk of been out of line with other schemes.

- (ii) Changes in exchange rates;  
currency complications;  
irrecoverable taxes;  
different accounting practices;  
less information available than in the home market;  
language problems;  
time zone differences;  
poorer market regulation — may increase risks;  
risk of adverse political developments;  
liquidity — may be very low;  
restrictions on ownership of certain shares;

complex administration, for example a multi-currency accounting system; and the need for specific expertise

all add to overall costs

*This was well answered by most candidates.*

- 3** The investment strategy needs to be consistent with the charity's objectives; any statutory, legal or voluntary restrictions on how the fund may invest; and the amount of risk that the charity is prepared to take.

The primary aim of the investment strategy is to meet the liabilities of the charity as they fall due.

The strategy will need to reflect:

- the nature of the existing liabilities — fixed in monetary terms, real or varying in some other way;
- the currency or geographic location of the existing liabilities;
- the term of the existing liabilities;
- the level of uncertainty of the existing liabilities both in amount and timing.

Other issues need to be considered.

Liquidity — cash coming in due to appeals disasters etc  
and cash needed for short term net outgoings.

Tax — both the tax treatment of different investments and the tax position of the charity need to be considered.

The size of the assets, both in relation to the liabilities and in absolute terms.

The expected long term return from various asset classes.

Future accrual of liabilities.

The existing portfolio.

Whether to invest in ethical investments or to invest in a way consistent with the charity's aims.

Costs of investing - charities may have limited money to spend - and of switching investments if a large change is advised.

*Well prepared candidates, in particular those who thought more widely about the particular circumstances of the charity, scored well on this question but weaker candidates missed out many relevant points.*



**4** An appropriate model would have the following features:

Representativeness — The model should mimic the most important characteristics of real-world financial assets.

Economic interpretation — The behaviour of assets within the model should be consistent with generally accepted economic principles.

In particular, the generated results should be arbitrage-free. The model should also exhibit sensible joint behaviour of model variables.

Parsimony — Models should be as simple as possible, while retaining the most important features of the problem. A balance between realism and simplicity needs to be struck. It is important to avoid the impression that everything can be modelled.

Transparency — The workings of the basic model should be easy to appreciate and communicate. The results should be displayed clearly — graphic formats are often used.

Evolution — The model should be capable of development and refinement. Nothing complex can be successfully designed and built in a single attempt.

It should be fit for the purpose and consistent with the changed regulations.

It should be consistent/compatible with existing modelling.

Implementation tools — A range of methods of implementation should be available to facilitate testing, parameterisation and focus of results.

Cost must be considered - buy off the shelf with customisation cost, or develop internally.

*This was mainly bookwork but many candidates did not score as well as would normally be expected for this type of question.*

**5** (i) The scheme will wish to choose assets that are the most appropriate for its liabilities. In particular assets fixed in monetary terms such as corporate debt would be suitable to match liabilities expressed in monetary terms.

Maturing schemes (closed to new entrants) make bonds a suitable investment as liabilities can be matched.

The decision will be influenced by:

- the relative supply of government debt and corporate debt in the territory concerned;
- the range of terms available; and
- the relative supply of bonds and equity, as equity supply affects bond prices.

Corporate debt also provides diversification benefits:

- higher yield for additional credit risk;
- higher yield for reduced liquidity; and
- scope for active management.

Tax considerations need to be taken into account..

Some types of debt may have additional options to consider, for example convertible loan stock.

- (ii) Features that influence yield differences:  
marketability / liquidity  
supply and demand  
credit quality (of particular issue)  
corporate prospects (of issuing company)  
forecast strength of economy  
tax and restrictions on investors  
different terms
- (iii) Features that could be introduced to reduce risks, or the effect of risks, include:  
Floating charge over all or some assets of company  
Fixed charge over a given asset  
Collateral provided  
Financial covenants e.g. income cover  
Prior ranking debt  
Rights in a technical default  
Restrictions on further borrowing / equity distribution  
Parent company guarantees  
Third party guarantees  
Shortening the term  
Increasing size of issue

*Attempts at part (i) were disappointing. Most candidates picked up that corporate debt would be suitable for matching liabilities expressed in monetary terms and that a higher yield was available than on government debt, but most of the other points were missed. Parts (ii) and (iii) were well answered by the better candidates but many relevant points were missed by others. This question tested the wider thinking that is a feature of this subject.*

- 6** (i) Quote driven system — market makers quote both buying and selling prices at which they are prepared to deal, at least up to a certain volume of shares.

Order driven system — buyers and sellers are matched, usually electronically.

Stockbrokers can observe the prices at which deals are being made on the system and can make an offer to buy or sell at a certain price for their own account, or on instruction from their clients.

- (ii) Using a quote driven system the investor does not need to disclose the transaction he wants to do.

The investor can decide not to trade without revealing the trade they were considering.

Large trades can take a time to find a party to transact with and negotiate a sale, particularly if the trade is so large that there are a number of parties on the other side.

Confidentiality is required to obtain the best price.

Using a market maker under a quote driven system addresses these issues

Market makers are closer to the market than investors, and understand the underlying liquidity of a stock. Thus they have the experience to smooth through large trades reducing sharp price movements.

Using an order driven system the size and direction of the trade has to be revealed before a price is agreed. This is usually a disadvantage to the first investor to reveal the trade but can be an advantage to other investors who may deal at a good price.

An order driven system may have lower operational costs, as there are no market makers to take a turn.

For large trades revealing both the size and direction of a potential trade can result in the market moving before the trade is agreed and therefore a poorer price obtained.

*The solutions to this question were generally weak. Many candidates were confused between the two systems. In part (ii), many candidates failed to read the question and did not pick up on the fact that a large amount of stock was being traded. Very few candidates realised that the main advantage of the quote driven system was confidentiality; this enables the investor to gain a better price.*

- 7** (i) Investment indices can be used:

as a measure of short-term market movements;

to provide a history of market movements and levels;

as a tool for estimating future movements in the market, based on past trends;

as a benchmark against which to assess the investment performance of portfolios;

to value a notional portfolio;

to analyse sub-sectors of the market;

as a basis for index funds which track a particular market;

to provide the basis for the creation of derivative instruments relating to the market or a subsection of the market.

(ii) Government bond indices can be used:

As a standard against which yields on other fixed interest investments can be assessed;

For an approximate valuation of a fixed interest portfolio;

To provide a picture of general yield structures of fixed interest investments;

Yield indices allow comparison to be made with yields on ordinary shares as a measure of the yield gap between bonds and equities.

Comparison of yields on fixed interest and index-linked government bonds indicates the market's view of future inflation.

Comparison of short term yield and long term yield indicates the market's expectation of future interest rates.

(iii) FTSE 100 consists of the UK's 100 largest quoted companies by market capitalisation, accounts for about 80% of the total UK equity market capitalisation, and is the main indicator of short term movement in the UK equity market.

FTSE All-Share contains over 350 shares covering around 98% of the market, including small-cap stocks. It is more representative of the whole market.

Neither reflects reinvestment of dividends.

(iv) If the manager wants to manage fewer holdings within the fund then the FTSE 100 containing only 100 companies but representing over 80% of the market may be suitable.

It will in general have similar performance to the whole of the UK Equity market, but at times the performance of the small cap stocks excluded from this index is very different from the large cap stocks.

FTSE 100 is the most widely-known UK equity market indicator, and is the easiest point of reference for investors.

The All-Share index gives a more diversified portfolio, but because of the number of stocks, replicating its performance will be more expensive in terms of investment research and transaction costs.

If the FTSE 100 is used, there will be additional costs associated with trading whenever there is a reclassification of the index, which occurs frequently.

Some fund managers offer index trackers of FTSE 100 and others FTSE All-Share so the manager needs to decide which funds they want to compete with.

There will be practical and cost problems if the fund is small initially; to track the FTSE 100 a derivative strategy could be used, but tracking the FTSE All-Share would involve investing in representative stocks.

*Part (i) was well answered by nearly all candidates. Parts (ii) and (iii) were fairly well answered but few picked up all the relevant points. Only the better prepared candidates scored well on part (iv), which is where the application of the previous parts was tested.*

- 8** (i) The discount rate is the current cost of raising incremental capital in order to fund the project. This is the rate of return which needs to be earned on the capital if the existing shareholders are to be no better or worse off.

This should be the company's cost of raising capital, taking this as a weighted average where the weights are based on the optimum capital structure for the company as between equity and debt.

The cost of equity capital is the current expected total real return on index-linked bonds plus a suitable equity risk premium.

The cost of debt capital is the current expected total real return on index-linked bonds plus a suitable bond risk premium, having regard to the company's credit rating, and then multiplied by  $(1 - t)$  where  $t$  is the rate of tax.

As this is the company's first international venture, the discount rate used should be higher than that used for projects in the home territory.

Ideally the starting point should be the discount rate used by companies which habitually engage in such projects, adjusted upwards to account for the fact that it is this company's first such project. In practice it will be difficult to get this information, and the home project discount rate should be used with an adjustment to account for the riskiness of the venture. Care must be taken to avoid spurious accuracy.

Although the discount rate needs to be adjusted upwards to take account of the extra risk of this project, care should be taken not to make it too high, as the relative weights placed on short term and longer term will be distorted.

(ii) Scenario A:  $NPV = -565v^{0.5} + 180v^{1.5} + 210v^{2.5} + 240v^{3.5} + 240v^{4.5}$   
 $= \$127,000$

Scenario B:  $NPV = \$29,000$

Scenario C:  $NPV = -\$266,000$

Expected net present value of project:

$$0.3 \times 127,000 + 0.6 \times 29,000 + 0.1 \times -266,000 = \$29,000$$

- (iii) On average, this project is expected to make a profit.

On 90% of occasions, this project would show a profit but on 10% there would be a significant loss. The loss could be as high as \$266,000 or even more, if a scenario worse than C evolves.

The decision makers should also look at considerations outside the financial analysis, for example:

any bias or approximations in the estimates;

doubts about the feasibility of entering a relatively unknown market; and

any last minute developments.

They should also consider mitigation - insurance against worst outcome - and sensitivity to assumptions.

The decision makers should evaluate this project against other available opportunities and determine whether this fits with other activities of the company before deciding to proceed.

*Part (i) is well covered in the core reading but was not well answered. Many candidates realised that weighted average cost of capital was required but only the better solutions gave details. Very few candidates discussed the problems arising from using too high a discount rate.*

*Part (ii) was well answered by nearly all candidates although a surprising number did not provide the correct units in their solutions, and therefore lost marks. Mathematicians may think that the correct units are a side issue; clients tend to think differently if they are given an answer 1000 times too small, or in sterling when dollars are meant!*

*In part (iii), many candidates failed to comment on their results from part (ii). Most candidates discussed considering other available opportunities and how the project fitted with other activities but many of the other points were missed.*

# EXAMINATION

5 September 2005 (am)

## Subject CA1 — Core Applications Concepts

### Paper 1 (Assets)

*Time allowed: Three hours*

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- 1 Describe the circumstances under which money market investments may be temporarily unattractive to investors. [4]
- 2 Discuss the features of a corporate bond portfolio that would be taken into account in setting its investment performance benchmark. [6]
- 3 List the items that should be included in a project's written strategy. [7]
- 4 Discuss the steps that should be followed to determine the fair value of a large portfolio of bonds with low liquidity. [8]
- 5
  - (i) State how the expectations theory explains the shape of the yield curve. [2]
  - (ii) Describe three other theories that explain deviations from the expected shape of the yield curve. [6]
  - (iii) Explain why a corporate bond might have a significantly higher yield than a government bond of the same duration. [5]

[Total 13]
- 6 A charitable trust has a portfolio of assets, mainly invested in conventional government bonds and equities. The only liability of the trust is to pay an annual prize for the best new published book. The prize money has traditionally increased each year in line with inflation.
  - (i) Describe two methods of valuing the trust's assets and the implications of each for the valuation of the liabilities. [6]

The chairman of the trust has expressed an interest in moving assets from conventional bonds into index-linked bonds.

  - (ii) State the formula for deriving the expected return on conventional bonds from the return on index-linked bonds. Define any symbols used. [2]
  - (iii) Discuss the circumstances in which it would be appropriate for the trust to choose index-linked bonds over conventional bonds. [8]

[Total 16]

- 7** A city council is considering building a new tourist and leisure complex which it hopes will appeal to visitors to the city as well as to local residents.
- (i) Discuss the steps necessary to achieve an effective identification of the risks facing the project. [11]
  - (ii) State the major risks associated with this project. [3]
  - (iii) Discuss how each of the risks identified in part (ii) might be mitigated. [6]
- [Total 20]
- 
- 8** A developed country has moved into recession in the last year. In order to boost growth the central bank has lowered short-term interest rates substantially over the last few months.
- (i) Discuss how economic growth, the exchange rate, and inflation in this country might develop over the next two years. [15]
  - (ii) Discuss how these developments are likely to affect the level of equity and commercial property markets. [11]
- [Total 26]

**END OF PAPER**

# **EXAMINATION**

September 2005

**Subject CA1 — Core Applications Concepts**

**Paper 1 (Assets)**

## **EXAMINERS' REPORT**

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Chairman of the Board of Examiners

29 November 2005

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*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.*

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**1** Cash is less attractive:

- when generally falling interest rates result in strengthening in both bond and equity markets;
- at the end of a recession, if it is thought that equity markets will have high returns;
- When corporate bond prices are rising, either due to falling credit spreads or rising credit ratings;
- if the strength of the national currency makes cash investments in other currencies less attractive;
- if the investor has temporary low short term liquidity requirements;
- when inflation is higher than interest rates.

*This question asked for the reverse of a situation detailed in the core reading. Despite this, few candidates scored well.*

**2** Corporate bond portfolios are often constructed to meet specific constraints and the benchmark will need to reflect this.

The yield will be a key feature of the portfolio, as will the risk profile of the portfolio for risk adjusted returns. Portfolios may be set up with a particularly high yield, for a high income portfolio (or due to different tax treatment of income versus gains).

Credit rating is also important. Many portfolios will have a stated minimum credit rating.

Duration: depending on the purpose of the portfolio (e.g. pension scheme), the duration of the bonds may be short, medium, long or broad spectrum.

Size of issue/liquidity: some portfolios may specialise in small, unmarketable holdings under the belief that they will ultimately provide better returns.

Country of origin/currency: the benchmark will need to reflect the country of origin and the currency of the portfolio.

Nature fixed/index-linked/hybrid: portfolios may be fixed income or index-linked (less common with corporate bonds, or a hybrid of both).

*This question was not generally well answered. Most candidates gave some sensible points, but only the better candidates provided a broad range of features to be considered.*

- 3**
- A clear identification of the objectives of the project
  - Statements as to how these objectives will be met
  - The acceptable quality standards for meeting the objective
  - The project sponsor's role
  - The role of any third parties
  - The financial and economic objectives
  - Details of the expected cost of the project
  - The financing policy
  - The policy for arbitration/dealing with legal issues
  - The need for insurance or reinsurance
  - The technical policy
  - A structured breakdown of the work to be completed under the project
  - The key milestones and timeframe for reviewing the project
  - The risk management policy
  - The communications policy
  - The information technology policy

*This is a straightforward piece of bookwork and, as expected, was answered well by most candidates.*

- 4**
- This is a process and once you determine an acceptable price you stop.

Whilst the portfolio contains bonds with low liquidity, small volumes of some holdings may be regularly traded, so there may be some readily available market prices. Prices and timings of recent transactions should be checked.

If yield curves, credit spreads and firms' credit ratings have remained stable since recent transactions, the price may be acceptable. However, still need to consider whether it was a willing seller/willing buyer transaction.

Market makers / brokers may be able to provide indicative prices. Compare these with prices of other bonds with similar credit rating, maturity, liquidity and terms.

A stochastic economic model could be used to produce a market consistent price, i.e. to revalue the bond based on other bonds with similar credit rating, maturity and terms, but for some hybrid bonds, e.g. sinking funds and convertibles, the price may not be reliable.

The most recent price could be adjusted by the movement in an appropriate index — although it may be difficult to find such an index.

Failing this the most recent price might have to be used, but this will not give a fair value unless very recent.

*This question was very poorly answered. A clear, structured, logical approach was being looked for, which considered the sources of information available to arrive at a value and the potential problems with that information. A stochastic economic model is not a panacea as most candidates assumed.*

**5** (i) Expectations theory describes the shape of the yield curve as being determined by economic factors, which drive the market's expectations for future short-term interest rates.

(ii) Liquidity preference theory: Investors require a greater return to encourage them to commit funds for a longer period so yields should be higher than expected for long-dated stocks.

Inflation risk premium: Inflation risk is greater in the long term so yields should be higher than expected for long-dated stocks.

Market segmentation / Preferred habitat theory: Yields at each term are determined by supply and demand from investors with liabilities of that term, so yields on short and long bonds may therefore move somewhat independently.

(iii) The yield of any fixed interest security is a function of the price. The price will be influenced by the laws of supply and demand.

In a perfect market with purchasers who are not influenced by sentiment there are some objective reasons for yield differences.

In general, government bonds provide the most secure and marketable fixed interest investment in a particular currency, and in developed economies they are risk free.

Investors will require a higher yield on other forms of debt. The size of the yield margin depends on both the credit (default) risk and the marketability of the corporate bond issue.

A particular bond may have high credit risk: due to a low credit rating (specific risk) or due to high credit spreads in the relevant sector (systematic risk).

It may have low marketability due to small issue size or because it is infrequently traded.

The issue may have features that make it particularly desirable/undesirable to certain classes of investor, for example a high coupon might attract institutional investors.

Investors are concerned with post-tax returns, so different tax treatment between government and corporate bonds are reflected in the yield.

*Parts (i) and (ii) were answered well by most candidates. In part (iii), as in question 2, only the better candidates wrote a broad enough range of points. Other answers were somewhat superficial.*

- 6** (i) It is vital that the valuations of the trust's assets and liabilities are consistent.

Either the assets can be valued at market value and the liabilities valued at appropriate market-based discount rate, or both assets and liabilities could be valued using the same interest rate, which would normally be the long-term expected return on the assets. It will be necessary to allow for dividend growth on the equities.

Any market value will imply an expected rate of return that is linked to the riskiness of the asset. Because the portfolio contains both equities and bonds, using a single discount rate to value all assets may therefore be inappropriate because of the different extent of risk. Different discount rates could therefore be used depending on the riskiness, marketability and term of the assets.

It may be difficult or impractical to establish a market related valuation basis for liabilities

- (ii) The expected return on the conventional bonds can be taken to be the gross redemption yield (GRY).

$$\text{GRY} = \text{real yield on index-linked bonds} + \text{expected inflation} + \text{inflation risk premium}.$$

*To gain full marks all terms needed to be defined as well as a correct equation given.*

- (iii) The trust needs to decide whether it wants to plan for future prizes to be increased in line with inflation. If so, does it wish to anticipate the future increases by matching the liabilities on this basis.

One way of doing this would be a move to index-linked securities. This may not be a perfect match if the securities used a different inflation index to that used for the prize.

Conventional bond yields will rise (i.e. price will fall) relative to index-linked bonds if investors' expectations for future inflation rise or if the size of the

inflation risk premium rises. Under these circumstances, real yields and prices of index-linked bonds will not necessarily change.

Thus, if the trust's investment manager expects future inflation to be higher than that implied by the difference between nominal and real yields in the market, index-linked bonds would be more attractive than conventional bonds.

The investment manager may also have a different view of the inflation risk premium. If inflation is negative or very low he may prefer to keep the prize money unchanged and therefore conventional bonds would match the liabilities.

Index linked bonds need to be available in the country and currency concerned, and to have a spread of durations available for matching liabilities.

*Part (i) and (ii) was generally well answered. In part (iii), few candidates considered whether the trustees would continue the past practice of increasing the prize money annually in future or whether index linked bonds used an appropriate inflation index, although most candidates made the basic points.*

## **7**

**(i) Step 1**

Make a high-level preliminary risk analysis to confirm that the project does not obviously have such a high risk profile that it is not worth analysing further. For example, a clear risk is that the finance cannot be raised.

It is important to determine where the finance is likely to come from and who is managing the process of raising it.

### **Step 2**

Hold a brainstorming session of project experts and senior internal and external people who are used to thinking strategically about the long-term.

The aim is to identify project risks, both likely and unlikely; to discuss these risks and their interdependency; and to attempt to place a broad initial evaluation on each risk, both for frequency of occurrence and probable consequences if it does occur.

The session should also generate initial mitigation options and discuss them briefly.

### **Step 3**

Carry out a desktop analysis to supplement the results from the brainstorming session by identifying further risks and mitigation options, researching previous similar projects and the problems that were encountered.



Obtain the considered opinions of experts who are familiar with the details of the project and the outline plans for financing it.

#### **Step 4**

Set out all the identified risks in a risk register, with cross references to other risks where there is interdependency.

#### **Step 5**

Ensure that upside risks as well as downside risks are covered.

(ii) *Only six risks and the corresponding mitigations are needed to gain full marks*

- (a) Cost of project higher than expected
- (b) Time taken to complete project longer than expected
- (c) Complex does not appeal to local residents
- (d) Complex does not attract tourists
- (e) Running costs higher than expected
- (f) Planning permission not granted
- (g) Opposition to project
- (h) Construction problems
- (i) Insolvency of contractors
- (j) Problems obtaining finance
- (k) Problems obtaining further finance if costs overrun
- (l) Fraud/crime
- (m) Industrial relations problems
- (n) Natural disasters

(iii) Corresponding mitigation:

- (a) All areas of the project should be well planned and researched and costed at each stage.
- (b) Each part of the project should be planned in advance to ensure the project is completed on time and action should be taken at the first sign of overrun.
- (c) Carry out market research and give local residents a say in the process. Special discounts or passes to the centre could be used.
- (d) Compare with similar projects in different cities and make any suitable changes. Carry out market research on current tourists.
- (e) Investigate costs in all areas of similar complexes and consider the factors likely to increase these in future.
- (f) Find out whether planning permission has been granted to similar types of project locally and in other areas and adjust plans if necessary to increase likelihood of acceptance.

- (g) Carry out research to see whether any opposition exists and on what grounds and adjust plans if necessary.
- (h) Consider all aspects of the construction process and ensure they have all been used successfully in the past and that there are clear procedures on what to do in the event of any problems.
- (i) Research the financial backgrounds of contractors and do not rely on just one contractor.
- (j) Ensure finance is in place before starting the project.
- (k) Ensure there are agreements with providers of finance on procedures to follow.
- (l) Research the backgrounds of all companies and key personnel.
- (m) Maintain open communications channels with works and their representatives so that issues are raised and resolved.
- (n) Purchase insurance to protect against unforeseen natural disasters

*Marks were given for any other reasonable mitigation options.*

*All parts of this question were reasonably well answered, and candidates generally proposed sensible mitigation options for the risks they identified.*

## **8 (i) Economic growth**

Lowering short rates encourages investment spending by firms, and increases the level of consumer spending.

There can be a considerable lag between lowering interest rates and a pick-up in growth.

Capital investment spending by firms increases employment levels and therefore incomes, but it takes time for firms to plan and build new production facilities before they start producing goods.

To increase consumer spending you need to do one or more of:

- (a) Increase disposable income by reducing the cost of servicing existing debt — the effect will be more immediate if borrowing is generally at floating rather than fixed rates.
- (b) Discourage savings and / or encourage spending of savings — lower interest rates provide less reward for saving, however, consumers need

confidence (e.g. job security or prospects) before savings are turned to spending.

- (c) Encourage personal borrowing — lower interest rates make borrowing cheaper, however, consumers need confidence (e.g. job security or prospects) before borrowing to spend.

The return of consumer confidence will take time to emerge.

### **Exchange rate**

Initially the exchange rate should fall.

Lower interest rates reduce the demand for the domestic currency.

Lower exchange rates should increase the competitiveness of all exports. This is despite increasing the cost of imported materials used in production.

Lower exchange rates should increase the relative competitiveness and demand for domestically produced goods and services stimulating domestic growth in the next two years.

### **Inflation**

Lower exchange rates will increase the cost of imported goods and services leading to supply side inflation. The impact on the inflation rate will depend on whether these higher costs can be passed on to consumers. Weak demand and the presence of domestic alternatives are a limiting influence.

The use of forward currency contracts will create a longer lag.

Lower real interest rates mean an increased quantity of money is demanded which is met by an increase in the money supply. This can lead to inflation (demand side). Demand side inflation typically has a longer lag than economic growth.

### **(ii) Equity market**

The level of equity markets is primarily determined by expectations of future economic growth.

Real interest rates are more important than nominal ones so it is the real interest rates which should be considered.

Cutting interest rates should stimulate economic activity, increase corporate profitability and future dividends, and thus raise equity prices.

If investors are worried about inflationary pressure caused by the cut in rates, there may be a move away from fixed interest towards equity investment, as

equities provide a better hedge against future inflation. This would again push up the level of equity markets.

More competitive exports due to a weaker domestic currency should increase corporate profitability. The higher cost of imported raw materials will however decrease profitability to the extent that costs cannot be passed on to consumers.

The higher the proportion of corporate profits earned abroad, the greater the depreciation of the local currency and the bigger the boost for equities.

### **Commercial property market**

A starting point of recession will mean relatively low demand for commercial and industrial premises. A reduction in interest rates should increase demand.

As economic growth picks up, levels of employment in the service sector should increase and demand for offices will pick up substantially.

Property prices are highly dependent on supply. The time lag between an increase in demand for property and the development of new property can cause rapid increases in the price of property. By the time new properties are developed, the economy may well have slowed down again.

As expectations of future inflation rise, institutional investment in property may also rise, as property has traditionally provided a good hedge against inflation.

Where overseas investors are significant purchasers of property the exchange rate will have an effect on demand levels.

*In part (i) most candidates got the key points, however, very few candidates appreciated that for the interest rate reduction to be effective consumers and companies would need confidence, and that this may take a considerable time to emerge.*

## **END OF EXAMINERS' REPORT**

# EXAMINATION

27 March 2006 (am)

## Subject CA1 — Core Applications Concepts

### Paper 1 (Assets)

*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 9 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** A retired homeowner has no current debts but needs to release capital tied up within his main residence.
- State two ways in which this could be achieved and describe the cashflows involved. [4]
- 2** (i) State both the general formula and the simplified formula for the dividend discount model defining all the terms used. [4]
- (ii) List the assumptions underlying the simplified version of the model. [2]  
[Total 6]
- 3** A country with a developing economy wishes to encourage investment in its domestic equity market. It intends to introduce domestic equity market indices that can be used by index tracking funds.
- Describe the features to be taken into account when designing indices for this purpose. [6]
- 4** An investment management company operates a wide range of funds investing in different types of securities. In the last twelve months new investments into its corporate bond fund have increased rapidly compared with new investments into its other funds.
- Discuss possible reasons why this may have occurred. [7]
- 5** Outline reasons why the ordinary shares of two companies might trade at different price earnings ratios. [8]
- 6** A fund that only invests in overseas equities is expanding the range of countries in its portfolio. It is considering including developing countries.
- (i) Discuss possible reasons for including developing countries in its portfolio. [3]
- (ii) List the points it should consider before investing in a particular developing country. [5]
- (iii) State, with an example, one additional factor that it needs to take into account when investing in small economies. [2]  
[Total 10]

- 7**
- (i) Define the following terms:
    - (a) Arbitrage
    - (b) Spot interest rate [2]
  - (ii) Outline the following theories used to explain the shape of the yield curve:
    - (a) Expectations theory
    - (b) Liquidity preference theory
    - (c) Market segmentation theory [5]
- A provider offers a ten year single premium investment product where the investment return (before charges) credited at the end of each year is the higher of a fixed rate and the one-year zero-coupon bond yield at that time. The yield curve at the time the guarantee is priced is upward sloping.
- (iii) Discuss the implications of using this yield curve to predict the anticipated cost of the guaranteed investment return, using the theories in part (ii). [11]  
[Total 18]

- 8**
- (i) Outline the main factors to consider in developing a long term investment strategy. [5]
  - (ii) Comment on the specific issues likely to affect the investment strategy for the following investors:
    - (a) An individual who has recently received an inheritance of ten times his annual salary.
    - (b) A contributor to a personal pension policy.
    - (c) A life insurance company closed to new business, which has never written with profits business.
    - (d) A general insurance company.
    - (e) A charity. [15]
- [Total 20]

- 9**
- A food retailer is considering introducing an organic food range. It is carrying out an initial appraisal of the proposed project.
- (i) Discuss the appraisal methods the food retailer should use to determine whether to pursue this project. [7]
  - (ii) Identify the major risks involved with the project and suggest how they might be mitigated. [6]
  - (iii) Describe how the discount rate to be used in evaluating this project should be chosen. [8]
- [Total 21]

**END OF PAPER**

# EXAMINATION

April 2006

## Subject CA1 — Core Applications Concepts

### Paper 1 (Assets)

## 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 and after each part 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** (a) A lifetime mortgage with interest added to capital.

The mortgage amount (less any associated costs) will be received immediately and no capital or interest payments will be made.

On death, the estate will have the proceeds from the sale of the property, but will need to pay the capital cost of the mortgage along with all accrued interest.

(b) A lifetime mortgage with repayments each year (or other regular times).

The mortgage amount (less any associated costs) will be received immediately. Repayments, which may be fixed or variable, will be payable at regular times.

On death, the estate will have the proceeds from the sale of the property, but will need to pay the capital cost of the mortgage only.

(c) The home (or a proportion of it) could be sold to a company in return for a lump sum and the right to live in the property until he died.

The value less associated costs will be received immediately. The value received would be less than the open market value in view of the right of residence.

On death, nothing will be received if the entire home was sold. If a proportion were sold, then the estate would receive the value of the remaining proportion.

(d) The owner could sell the home and move to a cheaper property or rent.

The difference between the two property values after costs have been paid would be received on sale. Alternatively the net sale price is received, and regular rent (certain or uncertain) is paid out.

On death, there will be no monies due and the value of the new home (if there is one) would form part of the estate. If not, the new residence is not part of the estate.

**Comments on question 1:**

*Marks were given for any two sets of answers under (a) to (d) above. Equity release or home reversion plans generally address the need for additional income, and were not appropriate answers, unless the description of the cash flows clearly involved the homeowner receiving capital. Other methods that involved the homeowner gaining capital were also given credit.*

*The question was generally well answered. The better candidates included mention of the costs associated with the options they chose, and concentrated on describing the cash flows, rather than the plan in general.*

- 2 (i) The general formula is:

$$V = \sum_{t=1}^{\infty} D_t v(t)$$

where:

$V$  is the value of the share

$D_t$  is the amount of the  $t$ th dividend payment

$v(t)$  is the discount factor applied between time 0 and the time of the  $t$ th dividend payment

The simplified formula is:

$$V = \frac{D_0(1+g)}{(i-g)}$$

where:

$D_0$  is the most recent dividend received.

$i$  is the required rate of return

$g$  is dividend growth rate

*Credit was also given for defining  $D_0$  as the next dividend due provided that the  $(1+g)$  term was omitted.*

- (ii) Dividends are paid annually, and the next dividend is payable in one year's time.

Dividends grow at constant rate  $g$ .

The required rate of return is independent of the time at which payments are received.

Shares are held in perpetuity or are sold at a price consistent with the formula.

**Comments on question 2:** *Many candidates attempts at general formulae were not actually general; for example they assumed a constant discount rate  $i$ . Otherwise the question was generally well answered.*

- 3 The key features of indices that are suitable to be used with index tracking fund are:

The index should be representative of the equity market.

- It needs to be practical to be used as an index tracker, for example avoiding frequent changes in constituents or being calculated with reasonable frequency (real time pricing is best).

- Firms for inclusion should have sufficient liquidity so that full index replication is possible without causing prices for individual equities to be too volatile.
- All firms within the index should be subject to the same financial reporting/accounting and other standards as far as possible e.g. same market regulation standards, this is particularly important for investors from overseas where lack of information, language and poorer market regulation represent barriers to investment.

For all the above reasons the smallest firms and those firms with a low proportion of free-float shares are likely to need to be excluded.

A small number of firms may be very large. It may be necessary to restrict the weighting of these firms because their performance could dominate the whole index. The country is unlikely to achieve the implicit aim of encouraging investment in a wide range of firms.

Similarly it may be necessary to restrict weightings where there are large proportions of closely held holdings that are not traded as they could cause distortions to the index.

Restricting the representation of the largest firms and non-free float shares will increase the diversity within the index and therefore reduce the level of specific equity risk.

Having identified firms and the extent to which they are suitable for inclusion then the country needs to consider how many indices/sub-indices should be created. Initially the country is likely to restrict the number of indices to a few as it will be easier to create a domestic and international profile for the indices and therefore assist the encouraging domestic equity investment.

There may be a variety of tax bases applying to potential users of the index. The country may want to calculate indices that allow for these differences (e.g. withholding tax for overseas investors).

The index should try to reflect the actual accrual of dividend income in the market.

**Comments on question 3:** *This question was not well answered. The main problem was that many candidates gave a good list of what needed to be considered when constructing indices in general (coverage, weightings, calculation frequency, updating constituents, etc.), but then did not relate their answers to the specific circumstances of a developing economy. In the type of question that requires a general concept to be considered in specific circumstances it is necessary to give equal attention to the specific circumstances and to the general concept.*

- 4** Corporate bonds may have enjoyed very good performance relative to all other asset classes. This may have encouraged new investors.

There may be a general trend towards more secure assets, as there may be uncertainty in the political or economic climate. For example, it may be felt that the economy is moving towards recession and future returns on equities will be poor, or that investors are taking profits from other classes and reinvesting in corporate bonds.

There may have been an overall change in investors' liabilities, or recognition of such a change. For example, pension schemes may have come to realise that a greater proportion of their liabilities are guaranteed than they have thought guaranteed in the past, and may have moved into bonds.

There may have been an improvement in investor education so that bonds have been purchased as a better match for particular liabilities.

In the opinion of investors, the difference between returns on corporate bonds and government bonds may more than allow for the additional risks. This may have caused investors to accept the additional risks in exchange for the extra return. One reason for such a market distortion could be supply related (either oversupply of corporate or undersupply of government bonds)

There may have been a change in the regulatory regime. For example, the government may have forced benefit schemes to match their liabilities more closely by investing in bonds.

There may have been a change in the tax regime so that bonds are now treated more favourably relative to other assets.

It may be part of investor fashion. If bonds are seen to be popular, more and more investors may move into them. Being out of step with everyone else is a risk.

If this is not an industry trend, the fund may have had good past performance relative to competitors, which has attracted new investors. The fund may be managed by a highly rated fund manager.

There may have been improved marketing and publicity of this fund, for example an advertising campaign, new literature or a special offer.

**Comments on question 4:** Performance on this question was very variable. Many candidates seemed to find several different ways of saying "bonds looked cheap". The better candidates considered matching issues; looked at the yield differentials with other asset classes and argued risk versus return; and then picked up some of the softer points such as quality of manager.

- 5** The price of an equity that is regularly traded is a figure that equates the expectations of a willing buyer and a willing seller.

The key drivers of price are the current level of income, the growth in that level of income and the uncertainty over that growth. There are elements of subjectivity in assessing these items, and the further the amounts are in the future the greater the uncertainty.

There are also elements of sentiment that drive the precise price level, such as the market's view of the ability of the board and management team.

The price of shares will reflect the latest information including:

- announced post balance sheet events
- trading conditions affecting the market sector
- market speculation about unannounced events, such as mergers and takeovers

The company's earnings is a retrospective accounting measure. The level of retrospective earnings may not be representative of the future, for example they may include the effect of historical events such as exceptional items, or particularly good or poor past results. Different accounting policies may make comparison of quoted earnings tricky.

Earnings may result from a period where the company was fundamentally different, due, for example, to corporate restructuring.

The companies may be in completely different industries or market sectors, which traditionally trade at different P/E ratios. Some companies (e.g. property companies) are not valued on an earnings basis and P/E ratios are largely irrelevant to them.

The way in which earnings are distributed may distort P/E ratios.

P/E ratios of two firms may also differ due to a combination of all the factors outlined above.

***Comments on question 5:** Although "price earnings ratio" is not a defined term in the core reading, the concepts of market price and corporate earnings are both well covered. Sadly a number of candidates based their answers on dividend yield issues (i.e. price/dividend ratios) and scored few marks. Potential distorting effects were not well covered, but most candidates pointed out the effects of different industries or market sectors.*

- 6** (i) Stock markets in developing countries are more risky markets. They offer higher returns than developed markets to reflect the additional risk.

Due to rapid industrialisation the rate of economic growth is also expected to be high. In addition, possible market inefficiencies also generate opportunities for profitable investment.

The economies and markets of many smaller countries are less interdependent than those of the major economic powers. Therefore investment in emerging markets may provide diversification.

Competitor funds may be similarly invested, and this fund wants to be “in the pack”.

- (ii) Emerging markets will differ from each other in practice but points to consider will generally include the following:
- current market valuation
  - possibility of high or volatile economic growth rate
  - currency stability and strength
  - level of marketability
  - degree of political stability
  - market regulation
  - restrictions on foreign investment such as exchange controls
  - range of companies available
  - communication problems such as language or time delays
  - availability and quality of information and accounting standards.
  - withholding taxes could be more of an issue
  - expertise in these markets
  - extra costs such as custody fees
  - the extent of additional diversity generated.
- (iii) Markets in small economies can be affected by the enormous flows of money generated by changes in sentiment of international investors. For example, domestic factors in the US that cause investors to repatriate funds, can completely swamp economic fundamentals in determining the level of local markets.

*Marks were given for any sensible example that specifically related to small economies.*

**Comments on question 6:** *In part (i) many candidates spent too much time talking about overseas markets in general rather than concentrating on developing economies. Part (ii) was largely bookwork and was well answered. In part (iii) most candidates made the point about lack of liquidity, but often it was described in the context of a given investor moving the market or not being able to sell. The bigger issue of other investors moving the market a lot due to large cash flows was missed.*

- 7**
- (i)
    - (a) Arbitrage — The simultaneous buying and selling of two economically equivalent but differently priced portfolios so as to make a risk free profit.
    - (b) Spot interest rate — The n year spot interest rate is the geometric average of the interest rates that are expected to apply over the next n years. It is the redemption yield on an n year zero coupon bond.
  - (ii)
    - (a) Expectations theory — Expectations theory describes the shape of the yield curve as determined by economic factors which drive the market's expectations for future short-term interest rates.
    - (b) Liquidity preference theory — Investors require a greater return to encourage them to commit funds for a longer period so yields should be higher for long-dated stocks.
    - (c) Market segmentation theory — Yields at each term are determined by supply and demand from investors with liabilities of that term so yields on short and long bonds may therefore move somewhat independently.
  - (iii) To cost the guarantee, it is necessary to estimate future 1 year yields (using the above theories and the yield curve) and compare these rates to the possible guaranteed rate.

The yield curve is upward sloping so based on the expectations theory the market expectations for future short-term (1-year) interest rates is that the one-year rates will progressively increase.

Part of the upward slope of the yield curve relates to liquidity rather than the expectation of increases to short-term rates. Thus based on the liquidity preference theory using the yield curve to estimate future short-term rates risks overestimating future rates therefore understating the cost of the investment guarantee.

Market segmentation theory says that the yields on long and short bonds may move somewhat independently, so the yield curve does not necessarily predict the future short-rates so care should be exercised in using the yield curve to anticipate the future cost of investment guarantees.

Using the initial yield curve to anticipate the cost of investment guarantees risks mis-stating the anticipated cost, however, there may be no better objective information available.

If there is other market information indicating that future short-term yields will be different from those predicted from the initial yield curve then this suggests an arbitrage opportunity exists.

Initial market yield information should therefore be used carefully and with judgement when estimating the cost of investment guarantees.

The yield curve will vary over time. Uncertainty over predicting future yield curves will increase the further in the future the prediction is required — there is an expanding funnel of doubt. Therefore the actual cost of the investment guarantee may be considerably different from that anticipated at outset.

**Comments on question 7:** *This was the least well done question on the paper. Considering that part (i) was bookwork definitions, very few did well. Part (ii) was much better; definitions tended to be both tight and relevant. Very few candidates did well on part (iii). Many started by not understanding how the contract works — overestimating future zero-coupon yields results in underestimating the cost of the guarantee; inadequate reserves will be established and the company will be financially exposed. The question was designed to explore the effects of the three theories together on the overall approach, not each theory separately.*

- 8 (i) The main factors that will influence a long term investment strategy are:
- The nature of the existing liabilities — fixed in monetary terms, fixed in real terms, or varying in some other way.
  - The currency of the existing liabilities.
  - The term of the existing liabilities.
  - The level of uncertainty of the existing liabilities both in amount and timing.
  - The tax treatment of different investments and the tax position of the investor.
  - Statutory, legal or voluntary restrictions on how the fund may invest.
  - The size of the assets, both in relation to the liabilities and in absolute terms.
  - The expected long term return from various asset classes allowing for expenses.
  - Statutory valuation and solvency requirements.
  - Future accrual of liabilities.
  - The existing portfolio.
  - The strategy followed by other funds.
  - The amount of risk that the investor is prepared to take.
  - The investor's objectives.
  - Liquidity requirements.
  - Features of the available assets.
  - The risks associated with those assets either absolutely or relative to the liabilities.



- (ii) (a) The investor's need for income or capital (allowing for existing assets). In particular, a low risk investor may wish to repay any debt including mortgage and invest for retirement. A high risk investor will wish to choose investments with the highest expected return.

The inheritance could be viewed as a windfall so just spend it for fun.

Some assets may be precluded due to the amount of capital available to invest. A desire for a diversified portfolio may suggest collective investments.

Individuals will need to consider their tax position and will wish to invest in tax efficient products.

- (b) The investment objective is to create as large a fund or pension as possible on retirement, although as retirement approaches some defence against the possibility of falling interest rates is also desirable.

The likely strategy would involve investment in equities and possibly bonds as well for diversification, transferring more into bonds as retirement approaches.

The key issues should centre around finding the optimum time to begin transferring which, may be linked to the contributor's age, and how regularly to transfer and in what proportions of the fund.

- (c) The first priority must be to ensure all liabilities can be met.

The amount of risk that can be taken depends on the financial strength and on the uncertainty over liabilities. Funds with low financial strength will need to be invested in high quality bonds of appropriate terms. If a slightly higher risk can be taken with part of the fund then equities and property could be considered.

The position of the fund would need to be monitored carefully and investments changed as it matures.

Unit-linked funds would be invested in accordance with the fund descriptions issued to policyholders.

- (d) The first priority must be to ensure that all liabilities can be met, allowing for the length of time it might take to achieve settlement and uncertainty over amounts and timings of payments.

Competitive premiums may require the highest investment return using asset types permitted by regulations.

It may be important to stabilise profits.

Investment policy depends on size of free reserves, and reinsurance arrangements.

- (e) Investment policy may impact on the reputation of the charity, which will have broad objectives and constraints. The attitude to risk of trustees/management and contributors should be considered.

It will also be necessary to consider the specific purpose of charity, its operating considerations, need for investment income and capital.

Impact of the tax status on expected returns.

The amount and timing of contribution income will be relevant.

*Comments on question 8: This question was answered well by most candidates. In part (i) the command verb is "outline", indicating that a bit more than a list is required, but not much more, given the number of marks available. Most candidates tied the answer to part (i) to the different scenarios on part (ii) fairly well.*

- 9** (i) The main purpose of any initial appraisal is to ascertain whether the project is likely to satisfy the minimum criteria that have been established by the company for projects to proceed. A major consideration could be opportunity costs e.g. better use of resources might be possible in other projects.

Other possible criteria include achieving synergy or compatibility with other projects undertaken by the company, or satisfying political constraints, both within and exterior to the company.

The return on the project could be determined as the net present value (NPV) or the Internal Rate of Return (IRR) or the payback period for the project. As the IRR can give multiple solutions it is less popular than NPV. Alternatively, the project could be viewed in terms of an option, and option pricing techniques could be used

The NPV method would yield a satisfactory result if the answer were positive when an appropriate discount rate was used. The result of the IRR and the payback period would be regarded as satisfactory if they exceeded the pre-set requirement of the company.

Following this analysis a sensitivity analysis should be conducted in order to ascertain how sensitive the result is to varying the parameters around their most likely levels.

If the results proved very unsatisfactory then the new range should not be launched. If the results show a satisfactory outcome then a detailed risk analysis should be conducted.

- (ii) The capital cost of the project could be underestimated. All areas of the project should be well planned and researched and costed at each stage.

The time to be operational could be underestimated. Each part of the project should be planned in advance to ensure the project is completed on time. Action should be taken at the first sign of overrun.

Sales are overestimated. Market research should be carried out to determine demand for organic foods and sensitivity of sales to price.

Costs are underestimated. Thorough research will be needed for realistic estimate of costs. Could try to set up fixed price deals with suppliers so that they are bearing some of the risk.

Market issues could be a problem. For example there could be difficulties in quality and quantity of supplies or you may have to replace otherwise profitable lines with the organic range. The market should be researched initially and continue to be monitored for any potential problem areas.

Regulations relating to organic produce change. This may be very costly. Be aware of all regulations and ensure that company produces its range to the required standards at all times. Also research any likely changes and ensure company can meet these as soon as possible if required.

- (iii) The starting point is the current cost of raising incremental capital for the company in order to carry out the project. This is the rate of return that needs to be earned on the capital if the existing shareholders are to be no better off and no worse off.

This should be the company's normal cost of raising capital, taking this as a weighted average where the weights are based on the optimum capital structure for the company as between equity and debt. (If the company's capital structure is not currently optimum, it could be made optimum through a separate decision).

The cost of debt capital should be taken as the cost in real terms of new borrowing for the company, by taking an appropriate margin over the current expected total real return on index-linked bonds, having regard to the company's credit rating, and multiplying by  $(1 - t)$ , where  $t$  is the assumed rate of corporation tax.

The cost of equity capital should be taken as the current expected total real return on index-linked bonds plus a suitable margin to allow for the additional return that equity investors seek to compensate them for the risks they run.

This would generate a real discount rate, to be applied to cash flows expressed in present-day monetary values, or adjusted by the assumed future inflation rate and used with cash flows in nominal terms.

The project might be considered a slightly higher risk as this is a new area for the retailer. The project should be appraised on a slightly higher discount rate

than would be considered for projects exhibiting normal degrees of risk for the company.

A guide may be the discount rate used by other organic food businesses. In practice these rates may be hard to obtain and therefore an arbitrary addition to the discount rate the company normally uses may be the only solution.

Care should be taken to avoid spurious accuracy and to avoid the rate being too high and so distorting relative weights of short and long term values.

*Comments on question 9: In part (i), the better candidates grasped the scope of the initial appraisal and so kept their answers focused on relevant points. The weaker ones went overboard on risk or went into too great depth on the methods, in some cases writing down everything they could think of, relevant or not. In part (ii), most people said many sensible things and gave examples and justifications of mitigating options. Answers were generally well structured and easy to follow, without too much padding. Part (iii) was one of the best answered sections. The good answers fleshed out WACC and explained all terms, the rationale, and how it needs to be tweaked for this project. There were some good discussions on why it was riskier (but not hugely different/riskier). Candidates who did not hang their answer around WACC ended up rambling in circles.*

## **END OF EXAMINERS' REPORT**

# EXAMINATION

4 September 2006 (am)

## Subject CA1 — Core Applications Concepts

### Paper 1 (Assets)

*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.*

<p><i>In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator.</i></p>
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- 1** (i) Define the term *equity risk premium*. [1]
- (ii) Describe why a change in the equity risk premium will alter the valuation of equities using a discounted dividend model. [2]
- (iii) Explain the phrase *systematic equity risk premium* and give two examples of events that would change the systematic equity risk premium. [2]
- [Total 5]
- 2** (i) List the possible uses of investment market indices. [4]
- (ii) State with reasons the uses in part (i) for which the following US equity indices would be appropriate:
- (a) the Dow Jones Index
- (b) the Standard & Poor's Composite Index [4]
- [Total 8]
- 3** Describe the project management requirements necessary to ensure a project is successful, timely and cost effective. [10]
- 4** (i) Explain why market value is not always suitable to use when valuing an asset. [4]
- (ii) Describe the following methods of valuing an asset:
- (a) Book value
- (b) Smoothed market value
- (c) Discounted cash flow value
- (d) Value resulting from a stochastic model
- (e) Arbitrage value [7]
- (iii) Outline the circumstances in which each of the methods in (ii) could be used. [5]
- [Total 16]

- 5** A large benefit scheme includes pension benefits that are linked to the final salaries of members.

The assets of the scheme are invested in a range of equities, fixed interest and property investments without any formal regard to the matching of the assets to the liabilities.

- (i) Discuss the issues the scheme would need to consider if it wished to match the value and timing of its asset proceeds with the value and timing of its liability outgo. [5]
- (ii) Outline the difficulties the scheme might experience in trying to implement the strategy in part (i). [5]

For the past few years the scheme's investment objective has been to achieve an investment return in any given calendar year that is in the top quartile of returns earned by comparable benefit schemes. The scheme's investment managers have met this objective in four out of the past five years. There are no restrictions on the investment managers' choice of investments.

- (iii) Explain why this investment objective might not be appropriate. [3]
  - (iv) Discuss changes that could be made to the scheme's investment objective in order to address the issues raised in part (iii). [5]
- [Total 18]

- 6**
- (i) List the principal issuers of bonds. [2]
  - (ii) List the features of an individual corporate bond that affect its price. [6]
  - (iii) Describe the risks that need to be considered in corporate bond investment. [13]
- [Total 21]

- 7** A company is designing a stochastic asset model to be used for:

- evaluating investment management policies
  - calculating fair values; and
  - setting capital requirements
- (i) Describe the features required by such a stochastic asset model, in particular those that make it suitable for each of the required purposes. [12]
  - (ii) Discuss the difficulties in designing one asset model for all these purposes using a single set of parameters. [10]
- [Total 22]

**END OF PAPER**

# EXAMINATION

September 2006

## Subject CA1 — Core Applications Concepts

### Paper 1 (Assets)

## 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 after each part 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** (i) The equity risk premium is the additional return that investors require from equity investment to compensate for the risks relative to risk free rates of return.

- (ii) The simplified equity valuation formula is:

$$V = \frac{D_0(1+g)}{(i-g)}$$

Where:  $D_0$  is the most recent dividend received  
 $i$  is the required rate of return  
 $g$  is the dividend growth rate

*Credit was also given for defining  $D_0$  as the next dividend provided that the  $(1+g)$  term was omitted.*

The point to note is that  $i$  features only in the denominator.

*If this point was made, there was no need to state the formula, as long as there was a satisfactory verbal argument.*

Changing the risk premium changes the  $i$  term in the above formula. Increasing the risk premium increases the  $i$  term increasing the divisor and therefore reducing the valuation of equities, and vice versa.

- (iii) The systematic risk premium, i.e. for a diversified portfolio, fluctuates over time and depends on the overall level of confidence of investors in equity markets, and their view of risks associated with equities in general. Examples are changes in interest rates, changes in oil prices, onset of recession.

*Any two events that will affect equities in general or a particular sector were acceptable. No marks were given for events that affect only individual stocks and therefore the specific risk premium.*

**Comments on question 1:** *This was well answered by most candidates although many omitted to mention that the additional return was relative to the risk free rate.*

- 2** (i) The uses to which indices can be put include:
- (a) A measure of short-term market movements.
  - (b) Providing a history of market movements and levels.
  - (c) As a tool for estimating future movements in the market, based on past trends.
  - (d) As a benchmark against which to assess the investment performance of portfolios.
  - (e) Valuing a notional portfolio.
  - (f) Analysing sub-sectors of the market.
  - (g) As a basis for index funds which track the particular market.

- (h) To provide the basis for the creation of derivative instruments relating to the market or a sub-section of the market.
- (ii) The Dow Jones Index is made up of 30 shares. Although commonly quoted, the small number of companies does not make it a good indicator of overall market performance.

Suitable for (a) and (e), could have some use for (g) and (h).

However the Dow Jones has a very long history, so despite the disadvantage above it might also be used for (b) if a long time period is involved.

The Standard & Poor's Composite Index is made up of the 500 leading companies in the USA representing a broad cross-section of all sectors of the market. It is often suitable to use for performance measurement of a fund's portfolio of USA equities.

Suitable for all uses in part (i).

**Comments on question 2:** Part (i) was bookwork and was well answered by the majority of candidates, although a number did not appreciate the restricted sector coverage of the Dow Jones index. Part (ii) was disappointing with only the stronger candidates linking the features of the two indices to all the points they had considered in (i).

- 3** Projects need to be led by strong experienced people who can drive them forward. Such individuals should be able to establish direction, decide on action, organise resources and motivate the project team. However, there should be checks and balances on the enthusiasm of the project's champions.

A key element of any sizable project is to have a comprehensive master schedule for the project which ensures that the right people do the right things at the right time to ensure the project moves at an appropriate pace. Tools such as critical path analysis will aid this. The right people include both those internal to the project and external suppliers.

It is vital that setting the standards of performance required from the parties involved is undertaken early in the life of the project, as these will have a major impact on the whole project.

Once the strategy and objectives have been written and the objectives of the project have been set a development schedule is needed setting out how and when the project will be undertaken.

The written strategy should be shared with the key individuals who will bear the responsibility for implementation of the project. It will be necessary to review the development schedule at regular intervals and particularly when the key milestones in the schedule are reached. Good communications between all parties at all stages will be essential.

The budget must be set and performance measured against this regularly at appropriate intervals.

A thorough risk analysis should be carried out.

Technical and design changes should be avoided once implementation has begun. Design parameters should be broad enough to give the developers some freedom of approach and to avoid the need for subsequent changes. Strict change control management should be implemented.

Any new technology should be fully tested before being released for use.

A competent team should be in place from the outset. Where appropriate the end users of the project's output should be involved from the start. It is important that all the team members are committed to the success of the project and that the project leaders provide support.

The distinction between the project owner as the sponsor and future operator of the project outcome and the project management team as the designers and builders of the project is a particularly important one. A successful project outcome requires the right balance to be struck between project sponsor and the project implementation specialists.

Project owners should concentrate on the key points in the project's development schedule that should be reached at certain times to ensure that they are properly scheduled and that the project is fully reviewed each time it reaches a milestone review point. At these milestone review points, critical questions on all aspects of the project should be raised by all those involved in the project. Project managers will need to have conflict management skills.

**Comments on question 3:** Most candidates had a reasonable attempt at this question but only the well prepared candidates scored very well by considering how the project would be successful, timely and cost effective as well as mentioning the general project management points. The distinct role of project owners and their relationship with the project management team) was not always appreciated.

- 4 (i) Frequently assets may be valued alongside liabilities. It is necessary to adopt a method that values assets and liabilities on a consistent basis. Depending on the method used to value the liabilities, market value will not be suitable for this purpose. For example, volatility of market values may be an issue.

*No marks were given for volatility without an explanation.*

The market value depends on the circumstances surrounding the transaction. A market value requires a willing buyer and a willing seller. When either the buyer or the seller is not willing the market price will be distorted, for example when there is the forced sale of a large volume of assets.

There may be no market in the assets concerned, and thus no market value may be available.

The market value equates buyers and sellers at the margin, normally of a small part of any stock issued. These circumstances may not give a good value for a large holding.

Accounting or other regulations may require another value e.g. book value or amortised book value to be used.

- (ii) (a) Book value: historic book value the price originally paid for the asset. Written up or written down book value is historic book value adjusted periodically for movements in value.
- (b) Smoothed market value: where market values are available they can be smoothed (for example by taking some form of moving average over a specified period) to remove daily fluctuations. Smoothing would be over a short period — days or weeks.
- (c) Discounted cash flow: this method involves discounting the expected future cashflows from an investment. It has the advantage of being easily made consistent with the basis used to value an investor's liabilities.

However, it relies on the assessment of a suitable discount rate, which is straightforward where the assets are government guaranteed fixed interest stocks but is less so otherwise. Assumptions are needed for default rates.

Where cash flows are uncertain, such as for equities, property and inflation linked securities, further assumptions have to be made.

- (d) Stochastic models: these are an extension of the discounted cash flow method in which the future cash flows, interest rates or both are treated as random variables.

The results from a stochastic model are a distribution of values from which the expected value or other statistic can be determined. In

practice, computer simulation would usually be used to perform the calculations.

- (e) Arbitrage value: arbitrage value is a means of obtaining a proxy market value and is calculated by replicating the investment with a combination of other investments and applying the condition that in an efficient market the values must be equal.
- (iii) (a) Book value is often used for fixed assets in published accounts. Companies other than financial product providers often use book value (written down if necessary) for all accounting purposes.
- (b) Smoothed market value: This method can be used where markets are volatile, in particular where values are driven by sentiment rather than underlying fundamentals. This may be suitable if the objection to market value is its volatility.
- (c) Discounted cash flow: this method is most commonly used when the cash flows from assets and liabilities are certain and they can be discounted at the same interest rate. It is the most straightforward tool where it is necessary to compare asset and liability values.
- (d) Stochastic models are particularly appropriate in complicated cases where future cash flows are dependent on the exercise of options, for example the option to wind up an investment trust in certain financial circumstances. Options can exist in either assets or liabilities.
- (e) Arbitrage value is often used in the valuation of derivatives.

**Comments on question 4:** In part (i) most candidates realised that assets and liabilities needed to be valued consistently and that market values did not always exist. Only the stronger candidates picked up the additional points. Many candidates omitted the 'marginal' nature of market prices as well as the need for a willing buyer and willing seller. Part (ii) was bookwork and was answered fairly well by most candidates and so it was disappointing that its application in part (iii) was much weaker with very few candidates scoring well.

- 5** (i) The liabilities are extremely long term. The actual timing of the payments is unknown. Further the in-service liabilities increase as salaries increase and the pensions in payment are likely to also be increasing to some degree in line with inflation. The amounts of the future liabilities are therefore unknown.

Some liabilities may crystallise on discretionary events — for example a highly paid, long serving member leaving service or electing to take early retirement.

The total contributions may be volatile. If members contributions are fixed then the company's contribution will be geared and thus more volatile.

While the returns from fixed interest stocks are known, there may be a default risk. The returns from equity and property investment are unknown, and assumptions will need to be made.

- (ii) Because of the uncertainties in amount and timing of both asset proceeds and liability outgo, full matching of cash flows will not be possible. One reason is that there may not be assets available of sufficiently long duration.

Over the long term shares are generally considered to be the most appropriate asset to meet long-term real liabilities. Indexed linked bonds would also be appropriate. For fixed liabilities such as pensions in payment, a substantial proportion of fixed or index linked bonds would be appropriate.

Most asset types have uncertain returns.

If the changes are not managed over time then there would be large trading costs associated with one-off changes. The costs of trading to adjust the portfolio frequently to achieve full matching may be prohibitive.

Given infinite resources, it is possible to try to meet outgoings by buying excessive amounts of securities. In practice, the matching portfolio is the portfolio which costs the least and which still provides the required certainty of meeting the liabilities. The scheme may have to alter its investment guidelines to allow this.

- (iii) The current investment objective does not take any regard of the risk the investment manager may have taken. This may lead to volatile returns and lead to volatile contributions being needed.

The scheme may wish to reduce the relative risk of the investment strategy probably at the expense of some future returns.

The objective may not be a fair comparison if other schemes are required to operate under more restrictive conditions. For example other schemes may be required to match pensioner liabilities with fixed interest stock, even if full cash flow matching is not required.

The definition of “comparable benefit schemes” is not precise and is potentially easy to manipulate to achieve a top quartile return.

- (iv) The scheme could establish an asset allocation benchmark that reflects the proportion of pensioner liabilities to liabilities relating to current employees.

The part of the benchmark relating to fixed liabilities could have a high proportion of fixed interest and index linked securities. The portion relating to “real” liabilities could be heavily weighted to equities and property.

Investment could be restricted to companies with a minimum credit rating. High risk investments such as speculative use of derivatives could be prohibited. Requiring a minimum number of individual holdings in certain

categories (e.g. domestic equities) would increase diversification and reduce risk, but might require the manager to hold stock that he did not consider appropriate, merely to have sufficient lines.

The scheme could require that the market value of individual holdings remains within a pre-agreed range. As market values change and these ranges are exceeded steps would be taken to rebalance the portfolio within a reasonable time frame given costs and market opportunities.

Further, if the scheme's liabilities are solely domestic then it may be reasonable to constrain the fund to limit investment in foreign shares and fixed interest investments. The benefits of further diversification may not outweigh the currency risks. This constraint would be expected to reduce both the risk and returns from the fund.

**Comments on question 5:** This question was poorly answered by most candidates. In part (i) very few candidates considered volatility of contributions or returns from assets. In part (iii) most candidates appreciated that there was no regard of the risk taken and many realised that the objective may not be fair but these ideas were not developed further. Part (iv) was badly answered by nearly all candidates with few mentioning any points beyond an asset allocation benchmark.

- 6**
- (i) National governments  
Local authorities  
Large companies  
Supra-national organisations  
Overseas governments
  - (ii) Term/duration  
Currency  
Coupon level  
Size of issue  
Credit rating  
Income cover  
Asset cover  
Seniority/ ability to issue further debt  
Security backing issue  
Parental guarantees  
Repayment options e.g. variable redemption dates  
Option features (e.g. callable and puttable bonds)  
Type, Fixed or Index Linked  
Country of origin

(iii) **Default risk**

This is the risk that a borrower will be unable or unwilling to make the payments required under the agreements.

**Liquidity risk**

This is where a market does not have the capacity to handle (at least, without significant adverse impact on the price) the volume of an asset that an investor wishes to buy or sell at the time when the deal is required.

In the context of an individual or a company rather than a market the term is also used to refer to an inability to meet debts when they fall due because of inadequate cash or other liquid assets. The company or individual may still be solvent were they able to realise illiquid assets.

**Counterparty risk**

This is the risk that a counterparty will not honour its obligations. A counterparty might be a custodian, a bond broker, a party involved in transmitting money, etc. (settlement risk). If the default occurs before the date when settlement of the underlying transaction is due, the party who has been let down is exposed to the risk of having to bear any costs of replacing or cancelling the deal. Counterparty risk increases as the time between a deal being transacted and settled increases.

**Concentration risk**

This is the exposure to a high level of risk on any instrument or in any sector. An extension of concentration risk is where a market is dominated by a small number of firms. Concentration can be within an industry, currency or geographical region. Most of these factors are considered by rating agencies in evaluating a firm's credit rating.

**Credit risk**

The term credit risk is sometimes also used to describe the risk associated with any kind of credit-linked event. This could include:

- changes to credit quality (up or down)
- variations in credit spreads in the market

as well as the default events described above.

**Correlation risk**

The risk that the behaviour two or more bonds is correlated. This is because factors affecting one company within an industry are likely to be relevant to other companies. This means the benefits of diversification are not fully realised.



## Economic risk

Risks due to variation in interest rates, inflation and reinvestment risks.

*Comments on question 6: Parts (i) and (ii) were well answered by well prepared candidates. Most candidates picked up some of the relevant points in part (iii) but few scored very well.*

### 7 (i) Good asset models should possess the following characteristics:

They should incorporate simulation techniques to generate the distributions of key outputs.

Representative — the model should mimic the most important characteristics for real-world financial assets

Economic interpretation — the behaviour of assets in the model should be consistent with generally accepted economic principles. In particular, the results should be arbitrage-free. The model should also exhibit sensible joint behaviour of model variables.

Parsimony — models should be as simple as possible, while retaining the most important features of the problem.

Transparency — the workings of the model should be easy to appreciate and communicate. The results should be displayed clearly — graphic formats are often used.

The model should be well documented and the results should be verifiable.

Evolution — the model should be capable of development and refinement nothing complex can be successfully designed and built in a single attempt.

For evaluating investment policies the following features are particularly important including:

- The key focus is on the central range of outcomes in terms of magnitude and probability, there is less emphasis on the extremes as it is recognised these are heavily influenced by personal judgement.
- The central range of outcomes should reflect the reasonable expectation of the market, this is heavily influenced by recent historical experience e.g. up to the last 30 years.
- There is a balance to be struck in using a long enough recent history and that history being relevant.
- For investment decisions sensible joint behaviour of variables is as important as the relative behaviour.

- For investment decisions it is important to reflect behaviour up to the time horizon for investment decisions.

For evaluating fair values the following characteristics are important:

- The ability of the model to replicate market prices in particular scenarios and conditions.
- The replication of market prices is effectively the average outcome; therefore there is greater emphasis on the average outcome, including joint behaviour of linked variables, than on replicating a particular distribution.

For setting capital requirements the following characteristic are important:

- Capital requirements are based on adverse outcomes. Adverse outcomes are represented by the tails of the distributions.
- It is important that the model replicates adverse outcomes in terms of probability and magnitude. It may be necessary to forgo accuracy in the central part of the distribution in order to model the tail.
- Similarly the joint behaviour of variables in adverse outcomes is more important than the joint behaviour in other parts of the distribution of outcomes.
- For capital requirements it is the capital determining time horizon that is important. There is a greater emphasis on the behaviour to this time horizon with compromises possible at other time horizons in order to achieve this.

- (ii) Asset modelling requires a balance to be struck between realism (and hence complexity) and simplicity (for ease of application, verification and interpretation of results).

Having a single model that is suitable for all three uses does not alter the requirements in relation to being representative, economic interpretation and parsimony it just places additional constraints. Using a single set of parameters means there will need to be a compromise – this is not ideal.

Within investment markets there are areas where arbitrages exist to various extents, e.g. liquidity constraints can create arbitrages. Asset models suitable for all three uses should be arbitrage free. This is an additional constraint to that which exists in actual investment markets. The complications that this causes should not be underestimated.

In particular there are the following additional constraints:

- Need to replicate the outcomes in terms of probability and magnitude over the entire range of the distribution. There are no areas where compromises are possible.

- There is a need to replicate the required behaviour over a much wider range of time horizons than for an individual model.
- There is a requirement to replicate prices for a wide range of potential assets rather than the actual assets held.
- The areas where compromises can be made are considerably restricted.

Increasing the number of constraints that have to be satisfied can only be achieved by increasing complexity, which significantly increases the development and maintenance requirements.

The additional complexity makes the calibration progress more difficult and time consuming. The additional computational requirements also need to be considered. Additional complexity does not help transparency of the model.

*Comments on question 7: This question was poorly answered by most candidates. Most provided a satisfactory general explanation of a good asset model in part (i) but very few candidates considered the particular features needed for the three purposes given in the question. In part (ii) many candidates realised that there would need to be a compromise and that the model would be more complex, but there was little reference to arbitrage issues, the conflict between the focus on central and outlying results and the problems of addressing a wide range of time horizons.*

## **END OF EXAMINERS' REPORT**

# EXAMINATION

11 April 2007 (am)

## Subject CA1 — Core Applications Concepts

### Paper 1

*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.*

<p><i>In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator.</i></p>
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**1** Describe the aim and main features of catastrophe reinsurance from the point of view of a ceding general insurance company. [5]

**2** (i) Explain the following terms in the context of individual assets:

- (a) marketability
- (b) liquidity [2]

(ii) Describe the liquidity and marketability features of the assets that the following would normally expect to hold:

- (a) A fund that takes large stakes in small unquoted companies with the aim of achieving high future growth.
- (b) A fund that guarantees to return the capital invested plus interest after 5 years. The interest rate is fixed at the outset.
- (c) A fund that aims to make profits by trading in bonds.
- (d) A motor insurer. [8]

[Total 10]

**3** (i) Describe the interests of leaseholders and freeholders in the context of property investment. [3]

An investor owns a freehold property that is leased to a commercial tenant.

(ii) Give a general formula for valuing this freehold property stating the assumptions made. [3]

An investor has been offered the opportunity to purchase a number of short fixed term leases on high quality residential properties located close to the financial centre of a large city.

(iii) Explain how the investor would determine the discount rate to be used to put a value on each lease. [5]

[Total 11]

**4** The three yearly valuation of a defined benefit scheme has just been completed. A large surplus has emerged, which has arisen from two sources:

- A large increase in the market value of the scheme's equity investments during the period since the last valuation, considerably in excess of the assumption used in the previous valuation.
- A reduction in the active membership a year ago, when the sponsoring employer reorganised the business and made a reduction in staff numbers. The benefits for early leavers in the scheme are such that significant withdrawal surpluses arise.

These two features have had approximately equal impact.

The scheme's actuary has advised that two changes can be made without detriment to the scheme's long term financial position:

- The employer's contribution rate can be halved from 8% to 4% of scheme salaries for each of the next three years.
- The rate of pension increases in payment can be changed from a fixed 3% per annum to the rate of inflation. This change to the pension increase would apply to pensioners and deferred pensioners as well as current contributing members.

These two changes have the same expected cost, and implementing both of them is affordable.

The employer has proposed that it will implement the contribution reduction, but that there will be no changes to the pension increases. The balance of the surplus will be retained in the scheme.

Discuss this proposal for using the surplus. [15]

*You need not assume that the scheme is written under UK legislation, or that of any other state.*

- 5** (i) State the characteristics of good design for a financial product. [5]

An insurance company is considering entering the market for long-term care contracts. These cover the costs for an elderly person of home or nursing-home care.

- (ii) Discuss the factors that will influence the design of the following areas of the new contract:
- (a) The circumstances under which the benefit is payable.
  - (b) The form of the benefit. [10]
- (iii) Describe with an example how two of the various design characteristics in part (i) can conflict when designing this long-term care contract. [2]  
[Total 17]

- 6** A consortium is planning to construct a new national sports stadium on behalf of the owner of the site. The consortium will receive a proportion of the income from events to be held in the stadium during the first 15 years following completion of the stadium, after which all rights will revert to the site owner.

- (i) Outline the ways in which the consortium can identify and control the operational risks on this project. [6]
- (ii) Describe four significant risks for the consortium, and for each suggest a method to mitigate it. [8]

The consortium has asked a bank to lend it money to finance the construction.

- (iii) Outline the terms and conditions for the loan that the bank might seek in order to control its risks. [4]  
[Total 18]

- 7** An insurance company writes all types of life assurance and pension business.

- (i) List the company's main expense items. [4]
- (ii) Describe how the company's direct and indirect expenses could be allocated and analysed between functions and product lines. [6]

The company is considering using a model that only allows for expenses to be expressed as a percentage of premium.

- (iii) Discuss this approach to allowing for expenses. [14]  
[Total 24]

**END OF PAPER**

# EXAMINATION

April 2007

## Subject CA1 — Core Applications Concepts

### Paper 1

## 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 aim of catastrophe reinsurance is to reduce the potential loss to the ceding company due to any non-independence of the risks insured.

It smoothes the results and lowers the probability of ruin in most future scenarios that might be tested. It reduces volatility and avoids possible deteriorations in the solvency position.

It is non-proportional reinsurance; typically only available on a yearly basis and has to be renegotiated each year.

The reinsuring company will agree to payout if a “catastrophe”, as defined in the reinsurance contract, occurs. There is no standard definition of a catastrophe but, typically, there needs to be a minimum number of claims arising from a single incident occurring within a specified time of that incident. The cover would usually exclude war risks, terrorism, epidemics and nuclear risks.

The reinsurance treaty will also specify how much the reinsurer will pay. This might be the excess of the total claim amount over the ceding company's catastrophe retention limit. The total claim amount would be net of any amounts reinsured on an original terms or risk premium basis.

The reinsurer's liability in respect of a single catastrophe would be limited to a maximum amount. Any amount above that would fall back to the ceding company or to the next layer.

*This was a fairly standard bookwork question where most candidates scored well. Most candidates noted the main features though not many covered the exclusions. Too many candidates discussed reinsurance in general, especially the benefits of like reinsurance, without focusing specifically on catastrophe. With only five marks available the examiners were looking for specifics rather than generalities.*

- 2** (i) Marketability is the ability to trade an asset at a given price in given volumes. It essentially relates to the ease of trading. For example how long it takes to deal and at what cost.

Liquidity is about how close to cash an asset is. It measures how soon the asset will turn into cash without being marketed. For example a seven-day fixed term deposit at a clearing bank might be completely un-marketable, because the deposit cannot be transferred or assigned. It is however extremely liquid. If market conditions change, liquidity is a measure of how the capital value moves. Liquid assets tend to have stable market values.

- (ii) (a) **Growth fund**

The fund will hold unquoted shares, which will by their nature have low marketability. The capital values of the shares will probably be volatile given the nature of the companies. Hence there will be low liquidity.

There will be no quoted market value and the values used for many purposes could be quite stable, which means the fund appears to have lower volatility. Any actual transactions, especially large trades, will lead to a revaluation. The new value could differ a lot from the previous revaluation, which means that the fund could be very volatile.

**(b) Guaranteed return fund**

The investment is short term with a guarantee and so the assets held should have low volatility i.e. be liquid. A combination of assets could achieve this aim.

There is no guarantee in respect of early redemption (or possibly any option of early redemption). Hence assets do not need to be marketable (early redemption penalties could apply to cover any risk). Having assets with lower marketability implies that a higher guaranteed return can be offered.

**(c) Bond fund**

The fund aims to generate profits by trading and so it will hold marketable assets (in general). It could deal in large blocks of bonds, particularly as an intermediary between a seller and an ultimate buyer.

One of the ways to make profits is to switch between bonds that have different volatilities. So at any given time, the bonds held will have varying liquidity features and this makeup could vary over time.

**(d) Motor insurer**

The bulk of the liabilities will be short term and cash-like in nature. The assets to match will therefore need to be liquid and if outgo is uncertain, marketability will be needed to provide reliable cash flows.

There could be some longer term more real liabilities for personal injury claims. Assets to back these liabilities could have less marketability and liquidity to hopefully provide higher returns.

If the insurer has strong positive cashflow from premium income or large free reserves, it could hold assets with lower marketability and liquidity.

*Part (i) was generally very poorly answered. Most candidates thought marketability and liquidity were synonyms, and struggled to find any difference between the two definitions. The example given above clearly explains the difference.*

*In part (ii), the poor start from part (i) meant that many candidates concentrated on describing appropriate assets for the various entities, and why they were appropriate using asset/liability matching arguments, and without discussing the marketability and liquidity of the assets. This approach generated some marks, but did not answer the question the examiners were asking.*

- 3** (i) The freeholder owns the site on which the property stands. He is entitled to all proceeds from the property both income and capital gains. He can sell part of the rights to a leaseholder. At the end of the lease ownership will revert to the freeholder.

A leaseholder is entitled to rent from the users of the property for a given term. An agreement will set out the level of rent and the procedures for rent reviews (normally upward only) and the obligations of each party. At the end of the lease, the leaseholder will not receive any capital. Normally the leaseholder pays rent to the freeholder – this will be different from the rent it receives. Leases can be traded but they are not very marketable.

- (ii) 
$$\text{Price} = \text{Rent1} * a_{n1} + v^{n1} * \text{Rent2} * a_{(n2-n1)} + v^{n2} * \text{Rent3} * a_{(n3-n2)} + \dots$$

The initial rent is level at Rent1. There will be rent reviews at times  $n1, n2, \dots$ . Rent is assumed to increase at these points to Rent2, Rent3,...

*25% was given for the very general  $a_n$  at (i-g) type formula, 50% was given for a general  $\sum$  formula*

Rent should be net of expenses and tax.

It is assumed that the rent is received in perpetuity.

No allowance is made for refurbishment or modernisation. This should be consistent with the level of rent  $R1, R2$  etc.

Rents are discounted at an appropriate discount rate, which should allow for risks in the property, particularly of void periods.

- (iii) Essentially the investment is a short term fixed interest bond with no capital redemption at the end of the term. So the starting point is the return on short term government bonds — on income strips, or a series of zero coupon bonds if they exist.

There is a risk premium on the investment relative to similar government bonds. This risk premium may vary with individual properties. So a margin needs to be added to allow for the risks.

Risks relate to the tenant and particularly the chance of a void where no rent is received. If the tenant is a corporate body the covenant will be more secure and so voids are less likely. However there is the risk of a downturn in financial markets or business. This could reduce demand for the property.

There is a risk that the location of the financial centre could change or the area becomes unfashionable for a particular reason. These tenants could be fickle.

A margin will need to be added to allow for the lack of marketability relative to government bonds.

The discount rate may include an allowance for administrative expenses or they might be valued explicitly.

*Part (i) was reasonably well answered by most candidates, although some wasted time describing the attributes that increase the value of a freehold or leasehold or the features of property investment in general. In part (ii) it was disappointing that so many candidates could not set out a simple discounted cash flow formula, and made silly errors even when they understood the principles. The examiners were particularly looking for acknowledgement of the step nature of rent increases. In part (iii) most candidates appreciated that a risk premium needed to be added but few added it to the correct short-term bond return. Only the better candidates commented on the impact of the quality of the tenant.*

- 4** Consider the nature of the surpluses. The equity surplus is not realised, at least to the extent that the assets have not been sold, and may be reversed if markets fall. There is no indication that there will be future surpluses from this source. The withdrawal surplus is realised, and is one-off.

Consider the nature of the benefit improvements. The temporary contribution reduction is also a one-off benefit. The improved pension escalation rate is an ongoing benefit, as it will apply to future accruals of service (and possibly also salary in a final salary scheme), as well as to past service for both current and former employees.

It is therefore difficult to see how the actuary can state that this improvement can be made without detriment to the scheme's long term financial position. The employer needs to seek further information on this point. It may be that the actuary means that the additional benefit is affordable for the expected future membership of current scheme members, and new members will have to pay more or not be eligible for the benefit.

Consider the employer's contribution requirement. It is accepted that the employees contribute to the scheme, but if the employer fully sponsors the scheme, then he will be agreeing to be responsible for the balance of cost of the scheme benefits over the employee contributions.

In such a scheme, if the employer is required to pay additional contributions when strains arise, then it is highly reasonable for the employer to benefit from surpluses. This is particularly the case when surpluses are unrealised and reversible, such as the equity market surplus.

Whether the employer leaves the surplus in the scheme against future strains, or withdraws it, accepting the need for future additional contributions, is not significant. The former increases members' security should the employer have financial difficulties.

Equity investments are a good match for benefits in deferment; particularly for active members with salary increases matching inflation. Thus distributing the equity surplus to pensioners and deferred pensioners is a clear mismatch.

There is an argument, on grounds of fairness, that the withdrawal surplus might be distributed to those members involved in the staff reductions. Although these deferred pensioners would benefit from the pension increases, their benefit would be diluted among all members.

It would be necessary to consider the perceived value of the pension increases. Although the long term inflation proofing guarantee is valuable, it may be that in the short term pension increases may even be expected to be below 3%.

The termination payments in the staff reductions may have been generous, and designed to compensate for the poor scheme early leaver benefits that gave rise to the surplus. The employer may have made these payments in expectation of a partial recovery from the withdrawal surplus that would result. The employer may feel no duty of care to former employees, and reject any proposal to improve their benefits.

Employee representatives may question this proposal. Employees also contribute to the scheme and so may consider it is unfair for there to be no benefit improvements, especially when the actuary has advised that the changes in pension increases together with the contribution reduction are both affordable.

A reduction in the employer's contributions should increase the strength of the company and this should improve employment prospects. This may be an important factor to staff concerned about any further reduction in staff numbers.

Past decisions on distribution of surplus will influence expectations of employees. It will also be necessary to consider scheme rules, legislation and regulation, and the scheme's investment strategy.

*This was the longest single part question on the paper, and thus needed the greatest concentration on ordering a logical response rather than writing down random ideas. The best answers were concise, relevant, logically argued and structured and they answered the question. This question was the place to spend the bulk of the reading time. Performance on this question was a good indicator of performance on the paper as a whole: the better candidates did well here, the poorer ones did not.*

*Too many candidates "overcooked" the issue of Legislation/Trust-Deed/Scheme Rules even though the wording of the question was designed to circumvent this. Some candidates gave and justified alternative distributions for the surplus, rather than commenting on the proposal given, as required. However, in general, the balance of cost argument and that the employer ultimately covers risk (shy of a collapse of the scheme) were grasped and well explained.*

**5** (i) Good design for a product requires that the product

- is simple to understand
- is transparent in its structure and charges.
- provides benefits that demonstrably meet the identified needs of the client/customer.
- is profitable.
- provides benefits on discontinuance which are fair.
- is marketable.
- is competitive.
- is capital efficient.
- meets regulatory requirements.
- is simple to administer.
- is consistent with the provider's risk profile and risk appetite.
- must allow for costs of any options and guarantees.
- avoids cross-subsidies and anti-selection.

(ii) **Design factors to consider concerning the circumstances under which the benefit is payable:**

The more conditions that need to be fulfilled before the benefit is paid, the lower the cost leading to lower premiums. However, any conditions must not be so onerous that it makes the contract impossible to sell in the market or lead to adverse publicity in the future because claims have not been paid when some policyholders think they ought to have been.

A novel definition of the insured event (e.g. ability to pay part of the benefit in certain circumstances) may even differentiate the contract sufficiently in the market so that competitiveness on price is less significant, though this is dependent on the sales channel and the size of the market.

If the definition of the insured event is too loose, the company may either have to pay benefits that were not anticipated when the contract was written, or incur additional costs in disputing claims, and thus may also find it difficult to obtain reinsurance.

**Design factors to consider concerning the form of the benefit:**

The provider will want to ensure that the product meets the needs of its prospective customers in providing insurance for the long-term care services they may wish to use.

If benefits are defined as “meeting the costs of care” then the company must assess the costs of care to be covered. Alternatively, benefits may be defined

in cash terms to contribute towards the cost of care, but this may generate a marketing risk in that the benefits may not be enough to cover the eventual cost of care.

A cash benefit may be paid as a lump sum or an annuity. A benefit paid as a lump sum will reduce risk for the provider by avoiding longevity risk and the risk of the cost of care increasing, which may be significant for long term care

Consideration will have to be given to the reduction in benefits that would be provided if fewer premiums were paid than expected or the surrender value available if the policy were terminated. The extent to which early termination values are guaranteed will influence both the overall cost and the market perception of the contract.

Benefits may need to dovetail with any State social benefit schemes, and will need to take account of tax and legislation.

- (iii) *Marks were given for any appropriate pair of features, not just the examples below.*

**The desire for simplicity may conflict with the company's risk appetite**

To gain a marketing advantage the provider will want to make the contract as simple as possible for the customers to understand, which may involve cross-subsidies (for example, between large and small policies); or simple scales of benefits that would be provided if fewer premiums were paid than were expected, or if the policy were terminated.

These may create associated risks of anti-selection which are undesirable.

**The desire for profitability may conflict with marketability:**

In order to make adequate profit, premium rates must be adequate to cover benefits and expenses in most foreseeable circumstances.

However, the contract needs to be attractive to the distribution channels open to the company as well as the market in which it is intended to operate, which may distinguish on premium rates.

*Part (i) was standard bookwork and was answered very well. In part (ii) answers tended to be at too fine a level, some almost reproducing a policy document, rather than looking in more broad terms at the needs and risk of the provider and client, and using these to deduce the issues around the form of the benefit. Part (iii) was generally answered well, although quite a number of candidates wasted time describing two conflicts, when the question asked for one pair of items that were in conflict.*

- 6 (i) Thorough due diligence and appraisal of the project to establish what risks exist.

Decide how to measure the risks and which risks are most important.

Investigate correlations between the risks.

Decide on reasonable adverse scenarios to consider and model the effects of these.

Compare the outcomes against the risk tolerance of the consortium, allowing for risk exposures that the consortium may have on other business projects.

Investigate how risks can be mitigated, by reducing the risk of occurrence or by reducing the financial impact of occurrence.

Identify the costs of risk mitigation.

Implement the chosen risk mitigation techniques.

Establish procedures for monitoring, reviewing and controlling the risks as the project develops

- (ii) Risk: construction takes longer than expected, so deferral of income.

Mitigation: insurance against delay-causing events

*More than just "insurance" was required. Any sensible example gained the full marks.*

Risk: construction costs more than expected, so need for more finance.

Mitigation: transfer risk to sub-contractors.

Risk: fewer events in new stadium than expected, so lower income flow.

Mitigation: contracts with sporting bodies committing them to holding events.

Risk: lower income per event than expected.

Mitigation: sell tickets/debentures in advance.

*Marks were given for any other sensible risk*

- (iii) Covenants requiring the consortium to maintain appropriate insurance and other risk mitigation.

Covenants restricting the consortium from carrying out actions adverse to the bank's interests, for example further borrowing.



Control over how/when the consortium can draw on the loan.

The repayment schedule may be linked to the 15 year term during which the consortium will receive income. The bank may set the schedule as fast as the profitability would permit, and may also seek to prevent early repayment, in order to protect its interest margin.

The bank may take a guarantee or fixed charge, for example over the assets of the consortium, and will set the interest rate to take account of the risk.

*In part (i) almost all candidates restricted themselves to reproducing the core reading. The examiners were looking for an approach to risk management at a higher level than given in most of the scripts.*

*In part (ii) the risks chosen needed to be both significant and have suitable mitigation. The weaker candidates did not consider the features of the project as described in the question, and gave answers that were too general. Candidates who applied common sense to the specific problem rather than try to think of some core reading to reproduce did well.*

*In part (iii) most candidates came up with a number of sensible ideas, although some made suggestions that were beyond the terms that could be imposed on the loan, such as the bank approving operational plans. This part was generally answered well.*

- 7**
- (i) salaries and salary-related expenses  
commission to brokers  
property costs (rent, heating, lighting and cleaning)  
computer costs  
External fees (audit, regulatory, consultancy)  
investment costs (stamp duty, commission, custodian, etc.)  
capital costs  
office sundries e.g. stationery
  - (ii) Some expenses can be identified directly as belonging to a particular class of business, while others do not have a direct relationship to any one class of business. These need to be apportioned between the appropriate classes.

If direct expenses arise from areas dealing with more than one class of business then time sheets can be kept (either for a period or permanently) to help split costs between classes.

The indirect expenses are harder to allocate as the departments concerned are not related directly to any particular class of business, but form a support function for the provider. In this case, it is necessary to find a sensible apportionment of the expenses across direct activities.

For some costs a charging out basis could be used. Computer time and resources could be charged to the direct function departments according to the use made of them. Premises costs can be allocated by floor space.

For other costs such as statutory fees or senior management costs a more arbitrary basis may be required. These costs could simply be added at the end of the analysis as a percentage loading to all the other attributed costs.

As well as apportioning expenses to a line of business, costs need to be apportioned by function, so that they can be allowed for in determining product pricing or the provisions for existing future liabilities.

For most types of business the high level division is into the costs of:

- securing new business;
- maintaining existing business (renewal and investment)
- terminating business (including claims).

These items may be sub-divided. For example new business costs might be split into marketing; sales and commissions; processing and policy issue; and underwriting.

Investment expenses would normally be expressed as a percentage of funds under management. This enables them to be expressed as a reduction in the assumed investment return in product pricing or provisioning.

- (iii) It is important to consider the purpose of the model and the extent it will be used.

An important element of any product pricing process will be the inclusion of loadings for expenses.

These are required to ensure that sufficient premiums are charged to cover not only the expected claim costs, but also the costs of expenses related to administration and claims handling for the business written on these rates, and provide a contribution to the general fixed costs of the provider.

The loading for expenses could be allowed for as follows:

- as a fixed amount per contract;
- as a percentage of the premium charged;
- as a percentage of the sum insured/assured;
- as a combination of the above.

Some expenses are directly related to the size of the premium, e.g. renewal commission payments, and it may also be decided that overheads should be shared in proportion to premium size. A model using premium related expenses would deal with these well.

However, many expenses are independent of the size of the policy, for example premium collection costs and the costs of communicating with policyholders. If these are loaded in proportion to premium rather than on a

per policy basis, then the modelled expenses will be incorrect if the average size of policy is not as assumed.

It is very unlikely that the company does not sell single premium products, or has no paid-up contracts. These products do have an ongoing maintenance costs and should also contribute to overheads. Thus the company will need a loading for single premium product maintenance costs, even though there is no premium paid.

The combination of a percentage of premium and a per policy expense loading for contracts with no premiums payable will complicate both the model and the process of setting the assumptions. This will increase costs.

Alternatively the company could load all expenses onto regular premium policies. However, this approach will increase the exposure to the risk of the lapse rate being greater than assumed, and to lapses, deaths and surrenders not being of the assumed average size.

Because of this effect, sensitivity runs of the model will need to be interpreted with great care.

Future premiums are unlikely to increase in line with expense inflation. Some policies will have automatic indexation or voluntary increments. Group contracts with premiums linked to salaries will also have an element of inflation built into the premiums.

While initially the aggregate expense loadings will be set in order to meet current expenses, in future years the premium loadings will not keep pace with the inflationary increase in expenses incurred. To get round this the percentage of premiums will have to increase with duration. Hence the original simplistic approach will need to be made more complicated, and thus more costly to develop.

Termination expenses are best reflected as a per policy amount, whereas investment expenses are usually expressed as a percentage of fund.

*Overall parts (i) and (ii) were answered well. A number of candidates were confused about what constituted items of expense, for example putting both salaries and administration expenses in the list. Part (iii) was another question looking for the higher order skills; many candidates recalled a part of the core reading that was vaguely relevant and reproduced it, scoring few marks. In summary, an unusual proposal has been made as to a method of modelling expenses, and candidates were asked to comment on it, not just set out the obvious approach. The method has some advantages, particularly simplicity and hence run time, which almost no one pointed out,*

## **END OF EXAMINERS' REPORT**

# EXAMINATION

24 September 2007 (am)

## Subject CA1 — Core Applications Concepts

### Paper 1

*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.*

<p><i>In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator.</i></p>
---

- 1** (i) State the principles of investment. [2]
- (ii) Outline how the regulatory framework may limit investment freedom. [5]  
[Total 7]
- 2** Evidence suggests that a significant proportion of the price movements of many shares traded in a domestic equity market can be attributed to overall market movements rather than features of the specific companies.
- (i) Explain why this may be the case. [4]
- (ii) Give four examples of types of companies whose share price movements may be significantly influenced by conditions in overseas economies. [2]  
[Total 6]
- 3** A life insurance company is setting up a new line of business.
- (i) Describe the modelling necessary to assess the capital required. [5]
- (ii) List the principal experience assumptions that may be needed for the model in part (i). [3]  
[Total 8]
- 4** Outline the reasons why the following companies hold capital:
- (i) A general insurance company. [5]
- (ii) An international pharmaceutical company. [5]  
[Total 10]

**5** A long-established company operates in a country with a developed economy. The country has no established standards on how companies account for employee benefit costs.

- (i) Explain how the four widely used accounting concepts can be applied when disclosing employee benefit costs in a company's accounts. [4]

The company's chief executive officer is currently aged 50 and has been promised a pension benefit on retirement at age 60. This benefit will be provided directly by the company, not through a separate pension scheme.

- (ii) Outline the main information about this benefit promise that could be disclosed in the company's accounts. [2]

A large overseas multinational corporation is considering acquiring the company and is carrying out the appropriate financial assessment.

- (iii) Describe how the multinational might use the information about the benefit promise to the chief executive in its assessment. [6]  
[Total 12]

**6** A local authority is considering supporting the reopening of a railway station on an existing commercial working line.

- (i) List the stakeholders in the project. [3]
- (ii) Outline the criteria that the local authority may wish to see satisfied before giving its support to the project. [6]
- (iii) State the potential risks associated with this project and consider how each could be mitigated. [9]  
[Total 18]

**7** A life insurance company launched a conventional without profits critical illness term assurance contract ten years ago. After low sales in the early years, the volume of new business sold has risen significantly in the last three years. Under the contract no benefit is payable on death or lapse. The company is about to review the profitability of the contract.

- (i) Explain how the company would analyse the critical illness claims experience since the product was launched. [9]
- (ii) Describe how the company would use the results of this analysis to set assumptions for assessing the profitability of the contract. [3]
- (iii) Explain why the results of this analysis may not be indicative of future experience. [7]  
[Total 19]

- 8**
- (i) State the information an actuary would need when undertaking a professional task for a new client. [2]
- (ii) Describe what a written agreement between an actuary and a new client would cover. [3]

An actuary has recently been appointed as the adviser to an established final salary pension scheme. On reviewing the documentation, the actuary discovers the following:

- The scheme pays high investment expenses to a company controlled by the sponsoring employer.
  - The scheme pays a service charge for administration to the sponsoring employer.
  - The scheme owns a large number of unquoted shares in companies based in developing countries.
  - The scheme shows loans to companies linked to the sponsoring employer as assets of the scheme.
  - Over recent years, the scheme has reported lower than average investment returns.
  - The employer pays lower contributions than are paid by employers with similar schemes.
- (iii) Explain whether the above features give cause for concern. [4]
- (iv) Discuss the issues the actuary may wish to investigate for each feature. [8]
- (v) Outline the initial actions that the actuary could take in response to any concerns. [3]

[Total 20]

**END OF PAPER**

# EXAMINATION

September 2007

## Subject CA1 — Core Applications Concepts

### Paper 1

## EXAMINERS' REPORT

### Introduction

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M A Stocker  
Chairman of the Board of Examiners

December 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** (i) An investor should select investments that are appropriate to the nature, term and currency of the liabilities allowing for the investor's appetite for risk.

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

- (ii) The following controls might be implemented:
- Restrictions on the types of assets that an investor can invest in. For example no self investment.
  - Restrictions on the amount of any particular type of asset (or the method used to value assets) that can be taken into account for the purpose of demonstrating solvency.
  - A requirement to match assets and liabilities by currency.
  - Restrictions on the maximum exposure to a single counterparty.
  - Custodianship of assets.
  - A requirement to hold a certain proportion (minimum or maximum) of total assets in a particular class — for example government stock.
  - A requirement to hold a mismatching reserve.
  - A limit on the extent to which mismatching is allowed at all.
  - Where a mismatching reserve is required, the regulations are usually framed so that the more an investor decides to invest in riskier assets with a higher expected return, the higher is any resulting reserve. This increases the value of the liabilities and reduces the available free assets/surplus.

*Part (i) is standard bookwork that is normally asked once a year. The question and answer are always the same! Part (ii) was answered well with most candidates getting most of the items in the list. The command verb "outline" suggests that more than a list is required, hence there were some additional marks for some amplification, for example the additional comments on the mismatching reserve and some of the examples noted above.*

- 2 (i) Important macro economic factors e.g. interest rates, growth, inflation etc will affect most companies in similar ways, as will the general political climate, which will influence uncertainty and market risks.

Most companies' costs will be affected by similar factors e.g. tax rates, labour markets, access to and cost of finance and fuel.

Many investors choose to invest in an equity market in general terms rather than choosing specific stocks or sectors. Individual investors in particular may invest in collective investment schemes with a broad mandate across the whole market.

The local market may look attractive (or unattractive) compared to say bond markets or overseas equity markets.

Investors may have liabilities that are suitable for equity investment.

There may be a general feeling that the costs of active management are not compensated for by sufficient extra returns. This would suggest investment in tracking instruments or a broad portfolio across all sectors and stocks.

Regulations or tax breaks may encourage investment in domestic equities.

- (ii) Conditions in overseas economies might affect the following types of company:

Companies with extensive overseas trade or business links.

Multinational companies with operations in many countries.

Companies that have outsourced manufacturing or other services to developing countries. For example motor manufacturers or banks.

Collective investment vehicles or trading funds whose objectives are to invest in specific overseas markets or assets.

Companies that exploit natural resources eg mining, agricultural or oil companies.

Companies that are listed on a market for tax or political reasons but whose operations are mainly overseas.

*In part (i), answers tended to be too limited in scope, concentrating on the macro-economic factors. The question was asking why there is systemic risk in this situation, not what systemic risk is. Comments about domestic companies having similar resource costs were often made at a sector-specific level which missed the point of the question. Few candidates got to grips with the issues leading to a block demand for equities, irrespective of individual company or sector performance. Many answers suffered from lack of clarity and structure, which led to much repetition and hence wasted time.*

*Part (ii) was answered better, although the examples given were not always sufficiently diverse. Credit was given for any sensible example, although credit was not given for saying “companies that are major exporters” and “companies that are major importers” as separate items.*

- 3** (i) The capital required to finance the office's business activities is the new business strain expected to arise for each contract multiplied by the expected volume of business, less repayments of capital from business in force.

In determining the new business strain for a contract, allowance needs to be made for setting up reserves including the solvency margins being created and any other capital requirements. Hence the assumptions used to determine statutory solvency margins need to be taken into account.

In determining the reserves required allowance should be made for any options or guarantees.

The future tax position should also be considered.

Capital requirements for each year are then assessed from the cash flows arising i.e. premiums plus investment returns less claims, expenses, tax and changes in reserves, including solvency margin.

Experience assumptions must be consistent; it is not sufficient to project these independently.

Development costs need to be allowed for. These could include marketing, systems improvements and additional staff and administration costs.

- (ii) The following principal experience assumptions may be required:

- Expense assumptions
- Mortality assumptions
- Morbidity assumptions
- Persistency assumptions
- Investment return assumptions
- Inflation assumptions
- Tax assumptions
- Volumes of new business assumptions

*In part (i) many candidates saw the word “modelling” and went onto autopilot, reproducing the standard bookwork on the features of a model and the alternative benefits of stochastic and deterministic models. The question was seeking what needed to be modelled, not the modelling process. Part (ii) was answered well by most candidates.*

- 4 (i) A general insurance company requires capital to:
- Meet statutory or regulatory requirements to hold capital.
  - Support the uncertainty surrounding the amount of liability outgo.
  - Support the uncertainty surrounding the timing of liability outgo eg due to any long-tailed business.
  - Support more aggressive pricing (or investment) strategies.
  - Smooth any fluctuations in the cost of claims (for example, claims equalisation reserves).
  - Smooth returns (dividends) arising for example from high (or low) investment returns to any shareholders.
  - Meet new business strain due to the administration and management expenses, commission and any statutory requirements involved.
  - Demonstrate financial strength to individuals and investors.
  - Meet marketing costs.
  - Develop new products.
  - Invest in business efficiency projects.
  - Enable mergers and acquisitions.
- (ii) An international pharmaceutical company requires capital to:
- Finance long term research and design of new drugs.
  - Support stock and manufacturing work in progress.
  - Provide start up capital for new manufacturing operations.
  - Meet marketing costs.
  - Provide funds for expansion into new markets and territories.
  - Provide a cushion against costs arising from fluctuating trade volumes, due to the risk of drugs being withdrawn, lengthy litigation or the patents expiring, especially as a significant amount of the patent's lifetime may be spent getting the drug approved.
  - Cover adverse currency movements or other international events affecting overseas sales/revenues.
  - Enable mergers and acquisitions.
  - Invest in business efficiency projects.

*Part (i) involved the application of standard principles to a situation that most actuaries would be familiar with – an insurance company. This part was generally answered well.*

*Part (ii) was seeking the application of the bookwork to a non-standard situation (for actuaries), and required application of general knowledge and common sense. Many candidates tried to fit the items that apply to a financial services company to a trading company, and made irrelevant points. It was surprising that so few candidates mentioned*

*financing stock and work in progress, and covering trade debtors. This is the fundamental difference between insurance companies, where there is no policy until a premium has been paid, and trading companies, who have high costs of manufacture before the goods are sold.*

**5** (i) The four widely used accounting concepts are:

Going concern: assumes that the company will continue its operations, so looks at the benefit that will be payable when employees leave/retire in the future.

Accruals: recognises costs as they accrue, and so allocates the total benefit appropriately across employees' total period of service.

Consistency in approach from year to year. In particular in respect of the basis used to value accrued and accruing benefits. If the basis does change, for example due to regulation, the impact of the change should be disclosed.

Prudence: makes provision for future benefit costs even if the amounts/values are uncertain. It is necessary to establish how cautious to be in this provision, given the uncertainties about future benefit costs.

(ii) The following might be disclosed:

Details of the benefit promise.

The value of the benefit that has accrued, and the value of the benefit that is accruing each year.

The actuarial assumptions and method adopted for these calculations.

(iii) This may enable the multinational to understand:

- whether the benefit is competitive, allowing for other elements of the remuneration package.
- how it fits into the multinational's remuneration strategy
- the value of the benefit that has accrued, bearing in mind that the executive may choose to leave or be made redundant, and that special benefit provisions may trigger on acquisition.
- the value of the benefit that is accruing each year.

It is therefore necessary to understand how the actuarial method allocates benefit costs over service. This enables the multinational to assess how prudent or realistic are the actuarial assumptions adopted for these calculations.

This will enable them to adjust the figures onto a different basis if they wish, and understand how they would be incorporated into the multinational's own accounts.

It is necessary to bear in mind the materiality of these figures at this stage of the deal.

*Part (i) was straightforward bookwork, which candidates either knew or didn't. Part (ii) was also intended to be a straightforward application, but many candidates did not find it so. Many candidates failed to state the simple and obvious – which is what would appear in company accounts – such as what the benefit promise actually is.*

*Answers to part (iii) were disappointing. Most candidates commented on the possibility of the executive leaving early but failed to state how the accounts could be used by the multinational to enable it to gain an understanding of the benefit then payable. Although many made a reference to the multinational possibly wanting to calculate the value of the accrued on its own basis, few related this back to the original basis. The staff and other practical issues were generally overlooked.*

- 6** (i) Local authority  
Railway and/or station operator  
Rail track owner  
Government or regulator  
Potential passengers  
Local residents or businesses  
Local tax payers  
Any other provider of capital  
Competitors eg bus companies  
Employers of potential passengers

*Credit was also given for any other sensible suggestions.*

- (ii) The criteria will typically be expressed in terms of the financial results expected e.g. IRR or NPV.

In this case the financial benefits will be the money saved from reduced congestion and accidents, reduced pollution and health improvements. There could also be the prospect of boosting local tax revenues from more local economic activity.

Criteria may also be related to overall risk. In particular the chance that the project is unsuccessful and the expected financial returns don't arise.

However, there will be political or environmental factors that can't be quantified in financial terms. For example achieving synergy or compatibility with other projects such as other transport plans.

Satisfying targets for reduced transport on roads and increasing the use of public transport.

Increasing labour mobility and providing cheaper transport for less well off people e.g. in rural areas.

Boosting the local economy or making the area more attractive to commuters. This may have implications for other services such as schools.

Having the broad support of local residents or other stakeholders.

Using scarce financial, human or other resources in the best way.

- (iii) The cost of land for station buildings, car parks, etc. is greater than estimated. An accurate initial valuation of the cost must be used when initially considering the project and the time between this valuation and acquiring the land must be kept to a minimum.

The cost of construction is greater than estimated. All areas of the project should be well planned and researched and thoroughly costed at each stage. Some of this risk can be passed to the contractor.

Service arrangements or the timetable are unsatisfactory. This must be negotiated and agreed upon before commencing with the project. This includes commitments to maintain the service for a minimum period and on levels of fares.

Investment from other parties is not forthcoming or is less than expected. Must ensure finance agreements are in place before beginning the project and that there are satisfactory arrangements in case of any cost overrun.

The project is not completed on time. Each part of the project should be planned in advance to ensure the project is completed on time and action must be taken at the first sign of overrun.

Planning permission is not granted. Find out whether permission has been granted to similar projects locally or in other areas and adjust plans if necessary to increase likelihood of acceptance.

There are construction problems e.g. delays due to weather. Consider all aspects of the construction process and ensure they have all been used successfully in the past. Ensure there are clear procedures to be followed in the event of any problems.

Lease agreement with station operator is not completed before start of project. A satisfactory agreement must be arranged before beginning the project.

Passenger numbers are lower than anticipated. Carry out market research to anticipate demand. Can also compare with any similar stations and make any necessary adjustments.

*Credit was given for other sensible and relevant examples. For each example, it was necessary to specify a risk, give a mitigating action and explain the link between them.*

*In part (i), the possible types of stakeholders were vast, and most candidates scored well despite some repetition.*

*In part (ii), candidates tended to reproduce too much bookwork. Those who thought about the specific issues to the case at hand scored well. The better candidates realised that the local authority's objectives may only be partly financial, as it needs to serve the local community too, and, in turn, gave good examples of how this could be achieved.*

*Generally part (iii) was well answered although sometimes the range of risks given was not sufficiently broad bearing in mind the large scope possible and marks available.*

- 7** (i) The extent of the analysis will depend on the volume of business written. The aim is to split the data into homogeneous groups whilst keeping the volume of data within each group credible.

The investigation may be carried out on an amounts basis as well as a lives basis and also net and gross of reinsurance. Only business accepted at standard rates would be included.

The experience is calculated as the claims divided by the exposed to risk. It is important that the claim data and the exposed to risk data correspond. The exposed to risk will normally be the average of the in force policies at the year start and the year-end.

The analysis would be performed to cover the experience for each year since commencement, but as significant volumes have only been sold for the last three years, it may be necessary to group the experience for some calendar years together.

A decision must be made either to analyse all claims or only accepted claims.

The most important levels at which to carry out the investigation are:

- Sex
- Age (grouped as required)
- Smoker Status
- Duration since outset (grouped for longer durations)
- (Experience will be lighter at early durations due to underwriting)
- Sales Channel (this is an indicator of target market)
- Type of illness
- Medical/non-medical cases
- Occupation
- Sum assured
- Premium size
- Premium payment method
- Claim decline rate

As there may be a delay between the date of a claim and when it is admitted,



care needs to be taken to include the claim within the calendar year and duration to which it relates. Allowance should also be made for any incurred but not yet reported claims in the more recent years.

- (ii) Assumptions are required for both the current level of critical illness experience and the expected future changes in this over the duration of the contract.

In interpreting the experience, care needs to be taken to allow for any features that may have impacted on the experience over the period of the investigation that may make it an unreliable guide for future experience.

The more recent years' experience would be used to help make an assumption about the current level of critical illness experience. This might be expressed as a percentage of reinsurer's rates, of a standard table if one exists, or of the pricing basis if different.

The trend in experience for recent years would be used to help make an assumption about the expected future trend in critical illness experience. If the volume of data were sufficient this trend would be considered separately for each type of illness to understand better the causes of the experience.

- (iii) Underwriting standards may have changed over the period of the investigation.

The experience for durations greater than three is based on small volumes of data so may not be credible. Similarly the trend in experience is only based on significant volumes of data for the last three years. This is unlikely to be sufficient to give an indication of likely future trends.

Changes in the sales process or the target market over the period of the investigation may affect experience.

The average premium size may have changed over the period of the investigation. This will affect the results if the analysis is not split by premium size.

The company may have reduced its premiums or there could have been reductions in market premium rates over the period of investigation. This may have led to selective lapses and worse experience. Alternatively, changes in the volume or mix of business may have arisen because of a change in relative premium rates.

Changes in the definition of a critical illness or the critical illness covered over the period of the investigation will distort results, as will changes in claims admittance standards. Consumerist pressure may lead to more pressure in future to admit claims that do not meet the strict definition. Social or economic trends (greater affluence, less reliance on state provision or fashion) may make past trends less relevant to future experience.

Future medical advances may lead to earlier detections of critical illnesses or more routine operations in future such that past trends are not indicative of the future. Particular medical advances that are not expected to continue in future may have caused past trends in experience.

*Part (i) was intended to be a straightforward process question: “set out what you do”. Candidates who approached it from this viewpoint scored well. Some candidates wasted time by going beyond the scope of the question, for example talking about why external data may be necessary.*

*In part (ii) many candidates seem to misunderstand the question, for example discussing how to perform a discounted cash flow with sensitivity testing. The question was merely focussing on the claims assumptions needed for the purpose in hand, and so basic issues, such as future claims assumptions being based on the most recent data, were missed. Some candidates wasted time talking about other items of experience e.g. investment, expenses. The question said “use the results of **this analysis**”, and only offered three marks for doing so.*

*(iii) Most candidates made a number of relevant points. Few mentioned that the actual data on which to base the rates is not amenable to providing either good credibility or a good indicator of trends. Some mentioned “because of future medical advances” as if no allowance had already been made for this. The important point is why future medical advances may be different to those projected from past experience.*

- 8** (i) The actuary would need to have sufficient background about the client to put the task into context, and to know for whom in the client firm the work is being performed.

Are there any conflicts within the client firm — is the actuary advising for one side of an argument.

What complaints procedures will be in place.

What is the specific task.

- (ii) Client agreements set out in writing the terms of reference or the scope for a particular task and outline the output to be delivered to the client, the timescale in which the output will be required, and the actuary's charging basis. They may also cover the relevant regulatory environment governing the work.

The terms of reference will be agreed with the client.

The agreement is likely to cover issues surrounding client confidentiality.

The agreement will cover legal issues such as ownership of the work product, and what happens if the relationship is cancelled or the project terminates before completion.

There may be restrictions on the use of the actuary's work by the client — particularly the extent to which it can be placed in the public domain.

- (iii) Each feature could have valid reasons or it could give rise for concern. For example, the reasons to keep admin or investment services in house may be due to convenience or control rather than ulterior motives. However, given that there are many suspicious looking items, there may be reason to worry (one or two items may be more understandable).

To take a view, the actuary needs to know what is strictly allowed and what is within the spirit of any legislation.

The state of the company may be a guide. If it is struggling there may be motivation for sailing close to the wind. A detailed analysis may be needed since the company may be trying to hide things.

Reasons for the actions could be to transfer surplus from the scheme to the employer, to reduce tax liability, to improve the reported profitability or enhance the balance sheet or to pay shareholders in the way that they prefer. None of these reasons is necessarily suspect.

Alternatively, the company may be trying to paint a false picture of its financial position and/or reward owners (boost the share price) and managers in inappropriate ways.

- (iv) The investment expenses may be a result of profit-related fees from good performance. The low reported investment returns would suggest not. It is necessary to consider how much the investment manager charges other schemes.

The actuary should review what administration services are provided and by whom. There may be a formal contract setting out details of the arrangement and how charges are calculated. Charges for other services (e.g. legal) may be included

It would help to have information on the unquoted companies e.g. profitability, assets, dividends paid and other shareholders.

It is necessary to form a view as to whether the values shown for the unquoted shares are realistic and compare these with the prices paid for them. Need to determine from whom the shares were bought.

The loans could be viewed as self-investment and so be unwise in principle. The actuary needs to investigate whether they are on commercial terms.

The actuary needs to investigate whether the values shown for the loans represent realistic values of the likely proceeds. This includes analysis of the security charged (if any) and whether the loans will have value if the employer gets into difficulties.

The actuary needs to form a view on the reason for the low investment returns. In particular were investment guidelines inappropriate or were they broken. Either the unquoted shares or the loans could be a factor explaining the low

investments returns. Poor relative performance may have been due to poor allocations between types of investment, or poor individual stock selection.

Employer contributions could be low if there was a large surplus in the scheme. The employees may pay relatively high contributions.

The actuary needs to review the method and assumptions used for funding the scheme. The basis used may not be realistic. The assumptions need to be credible and internally consistent.

- (v) As Actuary to the scheme, it is likely that the client responsibility is to the members and Trustees (or other managers of the scheme).

The actuary should discuss any concerns with the client and to the extent that the client can exercise control, seek assurances. This will depend on the explicit or implicit control exerted by the employer who is probably not the client.

The actuary should consult the previous actuarial advisors. They may be obliged to disclose any concerns that caused them to cease being advisors.

The actuary might approach any regulatory authorities (this may be an obligation).

The actuary might seek professional guidance from senior actuaries in his firm, or from the actuarial profession.

The actuary may decline to accept the work.

*Parts (i) and (ii) were largely bookwork and answered well by those who knew it, but there was a lot of repetition. It seemed that candidates were unsure which part of the question the point they wanted to make was answering, and so wrote it down twice. This is always unnecessary as the examiners give marks for valid points, even if written in the "wrong" part of the answer.*

*Candidates would have benefited from reading the whole question first before starting to answer part (iii). Many candidates gave piece-meal answers to each bullet point that they went on to repeat in part (iv). This part was an opportunity to look at the scene collectively from a high vantage point, for example could the employer be trying to hide something; is it significant all these apparently odd things are happening at once. Many candidates were dogmatic about there being definitely cause for concern - failing to consider the other possibility that there are innocent actions or coincidental issues. Most wrote far too much, ignoring that fact that there were only four marks available.*

*In general in part (iv), too much was said on the problems each bullet point may cause to the scheme (e.g. lack of security or diversification), rather than the actual issues the actuary would need to investigate. The better candidates kept an open mind on whether each bullet point was indeed suspect. Most candidates drew comparison with arm's length market practice where relevant. Many candidates repeated "allowed by legislation" for each bullet*

*point, although one blanket comment in part (iii) would have been sufficient to gain all the available marks.*

*Some candidates scored well in part (v), but too many failed to change the approach from part (iv) and discuss the initial actions the actuary could take against the background of his/her professional responsibilities.*

## **END OF EXAMINERS' REPORT**

# EXAMINATION

7 April 2008 (am)

## Subject CA1 — Core Applications Concepts

### Paper One

*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 6 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.*

<p><i>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.</i></p>
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- 1** A life insurance company is considering offering an immediate annuity product. Rather than paying cash to purchase the annuity, the policyholder would give the company an interest in a residential property belonging to the policyholder.

The terms are that the policyholder would continue to live rent free in the property until his or her death, and meanwhile receive an annuity. On death, the property would belong to the life insurance company.

The annuity would be payable throughout life and could be either level or linked to an inflation index. It could be written on a single or joint life last survivor basis.

An elderly homeowner with no current mortgage wishes to release the equity in their home.

- (i) Describe the cashflows involved if the homeowner were to:
- (a) sell their home and move to a smaller, cheaper residence;
  - (b) take out this policy in respect of their existing home. [5]
- (ii) Discuss the disadvantages to the homeowner of taking out this policy, compared to selling their home and moving to a smaller, cheaper residence. [5]
- [Total 10]

- 2** (i) List the items that an insurance company would consider when determining the assumption for future expense inflation in its financial modelling. [2]

A life insurance company has estimated the unit costs for the following year based on its expense and new business volume budgets for the following year. Unit costs are:

- the per policy cost of maintaining each in force policy
- the expected cost per claim processed
- the cost per unit of new business written
- the cost of investment management as a proportion of funds under management

The unit costs vary with the type of contract, depending on the complexity and level of activity involved in various aspects of administration. Unit costs include allowances for overheads and other indirect costs.

- (ii) Describe how the company would use these expected unit costs to allow for future expenses in:
- (a) the valuation of liabilities at the coming year end;
  - (b) re-pricing its major product lines.

You do not need to describe how the unit costs are derived. [10]

[Total 12]

- 3** A large developed economy has a domestic equity market which is commonly divided into 20 sectors. Each sector contains at least 20 stocks.

A university in that country has a substantial portfolio of investments. Various committees made up of members of the academic staff determine the investment strategy.

The committee responsible for investment in domestic equities holds an annual strategy meeting. Prior to the meeting the return on each stock in the whole market over the previous year is obtained. At each meeting the committee decide to invest in 16 stocks. These stocks are selected from the whole market as follows:

The fourth, fifth, sixth and seventh best performing stocks in the fourth, fifth, sixth and seventh worst performing sectors are identified. The whole fund is then divided equally between these stocks. No changes are made to these investments until the next strategy meeting. No specialist investment managers are used and the committee wishes to make as few active investment decisions as possible.

- (i) Outline why the committee might use a passive investment approach. [3]
  - (ii) Explain the rationale behind the approach to stock selection described above. [4]
  - (iii) Describe situations or events where decisions may need to be taken by the committee between strategy meetings. [6]
  - (iv) Discuss the types of indices the committee should use to assess the performance of this domestic equity fund. [4]
- [Total 17]

- 4**
- (i) Outline the main factors to be considered by an individual in developing a personal investment strategy. [10]
  - (ii) State the additional factors a financial institution will need to consider when developing an investment strategy for the funds it offers to individual customers. [3]

Three members of a family have each inherited a sum of money.

- A single 23 year old in full time employment (but not in a pension scheme) living in rented accommodation. His inheritance is five times his annual income.
- A married 50 year old in full time employment (in a pension scheme), with two children in full time education, living in his own home, which is mortgaged. His inheritance is twice his annual income.
- A widowed 75 year old living in her own home. Her inheritance is ten times her annual income.

- (iii) Outline how each family member could use their inheritance. [9]
- [Total 22]



- 5** The regulatory regime in a certain country requires each life insurance company to appoint a Pricing Actuary. The Pricing Actuary may be an employee of the company. The function of the Pricing Actuary is to certify that the company's premium rates are sufficient to provide for the risks that the company expects to take on in the next twelve months. A new certificate has to be given whenever there is a change in premium rates, or annually if no rates have changed. The certification is based on the whole portfolio of business. The regulations do not preclude particular product lines being written as loss leaders, provided that the certificate can be given for the whole expected portfolio of business. A Pricing Actuary who is unable to give a certificate must make a report to the Regulator.

A life insurance company has a Pricing Actuary who is an employee. The company writes a wide range of products, but 50% of its new business arises from annuities written on retirement of members of pension schemes. This market is becoming increasingly competitive, and in order to maintain market share the profitability of the annuity rates has been steadily reducing.

Fixed interest yields have recently reduced significantly, but the company has decided to leave annuity rates unchanged in the hope of increasing new business. The Pricing Actuary has some concerns about whether he can give the necessary certificate. The Chief Executive points out that as there is no change in premium rates, a new certificate is not required, and in any event the regulations permit products to be sold as loss leaders.

Outline the technical and professional issues that the Pricing Actuary should raise in his discussions with the company before deciding whether or not to give the certificate. [16]

- 6** A government is following a policy of transferring some of its operations and employees to the private sector. As part of the transfer agreements, the new employers are required to make a commitment to provide pension benefits for future service that, overall, are at least as good as those that would have accrued under the government's defined benefit scheme. The government scheme currently links increases to pensions in payment to an inflation index and provides relatively generous benefits on early or ill health retirement.
- (i) Describe the various ways of interpreting and assessing the pensions commitment. [7]
  - (ii) State any significant problems that a new employer could encounter in trying to meet its commitment. [3]
  - (iii) Outline the actions a new employer could take to make up the shortfall in benefits if they are unable to satisfy the pensions commitment fully. [5]
  - (iv) Discuss how any benefits accrued in the government scheme prior to the transfer of employment could be accommodated under the new arrangements. [8]
- [Total 23]

**END OF PAPER**

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

### **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) (a) When selling the home and moving to a smaller residence there will be initial cash outflow of legal fees, expenses and possibly holding deposits.

The homeowner will then have a lump sum cash inflow of the selling price of the existing property followed by a smaller lump sum cash outflow of the purchase price of the new property, plus cash outflow of any other outstanding expenses.

The timing of the cashflows will be short term but unknown and will depend upon the time taken to find a buyer for the existing property and a property to buy, and that taken to agree the sale of the existing property and the purchase of the new property.

All cashflow amounts related to house prices would be unknown prior to agreement of the sale and the purchase.

On death, the house becomes part of the estate and may be sold.

- (b) When taking out this policy the homeowner has a regular cash inflow with known regular timing. The amount may either be level and known, or unknown and linked to an inflation index.

This regular cashflow ceases on death either of the policyholder or the last survivor, at which point the house reverts to the insurance company. The insurance company may then sell it to achieve a cash inflow, which is unknown in both amount and timing, including timing relative to the point of death.

The insurer will have expenses related to selling and maintaining the policy.

- (ii) The main disadvantages to the homeowner in taking out this product are:

The homeowner may not want to release the whole of the equity in the home, and may prefer a lump sum rather than an annuity or they may prefer exposure to the property market than to inflation.

Moving to a smaller home may be more suitable and may have lower associated costs. The homeowner may also wish to release cash for other purposes.

The policy may be perceived to be poor value, especially in the event of early death, and because when calculating the annuity rate the company will have to reflect the risks of matching a stream of annuity payments with a reversion on the house, which yields no income. Any house valuation is likely to include a margin for risk and may not reflect the value on a competitive open market.

There may be tax disadvantages to the homeowner in taking out this policy compared to buying/selling their main residence.

The policy may impact any state benefits currently received or due to be received.

The homeowner may wish to move house in future, or may wish to modify the home in some way, for example making the property more accessible or extending it for a live in carer. This may not be possible under the terms of the tenancy.

The homeowner may wish to leave an inheritance (or a whole property) to their children.

There is a risk that after taking out the policy the homeowner's circumstances will change (through marriage or divorce, say) and the type of annuity would no longer be suitable. Admission into long term care may also mean that the annuity is no longer suitable.

If the level annuity option is taken, the homeowner will be exposed to inflation risk.

The policy may be difficult for the policyholder to understand and additional legal advice may be required.

There may be additional risk if these policies are not regulated.

*Marks were given for other valid flexibility points as alternatives to the above.*

*Comments: This was well answered by most candidates but only the well prepared candidates mentioned that the exact cashflows and timings in (i)(a) would be unknown in advance. In part (ii) candidates were asked to discuss disadvantages so there were no marks available for stating the advantages.*

**2** (i) Current rates of inflation, both of prices and earnings.

Expected future rates of inflation.

The difference between the gross redemption yields on government fixed interest and index-linked securities.

Recent expense experience of the company or, if available the industry as a whole.

It is important that the inflation assumption is consistent with other assumptions.

(ii) The company will need to price for the long term. The starting point for its pricing and valuation unit costs will be next year's estimated figures.

The company needs to check that the unit costs are representative of future experience, ignoring inflation, which will be added as a specific assumption.

Review the calculations to check that one-off expenses are spread over the appropriate term.

Review projected policy volumes. Will need to consider new business, in force business and claims as well as the mix of business. If these are declining, it may be necessary to allow for additional unit cost inflation in addition to normal inflationary increases to ensure that overhead costs are covered.

Review new business projections but beware of allowing for economies of scale from large projected increases in new business, in case this doesn't materialise.

After these adjustments, long term best estimate unit costs will result.

**(a) Valuation**

New business unit costs would not be used.

Renewal and claim unit costs would be loaded as a specific allowance in the valuation basis, applied to each policy and each claim. Unit costs might also be used in the calculation of general additional reserves, such as provisions for closure to new business.

It might be decided to merge renewal and claims costs into a single per policy in force figure. However this would generate distortions if the volume of business changed.

Investment costs would be allowed for by a deduction from the valuation interest rate. For unit linked policies it would also be necessary to make a specific allowance in the cash flows.

All the unit costs used would be increased by a margin for prudence. The extent of this would depend on the regulatory regime and solvency capital requirements in the country concerned.

If there is a high explicit solvency capital calculation required, then prudential margins in each element of the basis may be little more than rounding in the cautious direction.

If the explicit solvency capital calculation leads to a low result, then it will be necessary to hold a much larger prudential margin in the basis elements.

**(b) Product pricing**

New business unit costs would be included.

Other unit costs would be applied to the model in the same manner as above, without any margins, but with the following differences.

The company would expect its premium rates to apply for a period. This might be only a few months for a competitive commodity product such as term assurance or annuities, but might be several years for savings products.

For the expense loadings to be robust, all the monetary amounts need to be inflated to the mid-point of the period the premium rates are assumed to apply. It is unlikely to be necessary to inflate the investment expense unit cost.

It will be necessary to allow a margin for uncertainty and risk in the pricing basis. This might be achieved by loading each item with a specific margin, as in the valuation basis. The size of this margin may be driven by competitive or other factors.

More commonly the company will determine a risk discount rate at which all the cash flows will be discounted when profitability is determined. If this approach is followed, the best estimate unit costs should be used in the pricing model without further adjustment.

*Comments: Part (i) was reasonably well answered by many candidates but only the better prepared candidates picked up all the marks. Given that the command verb was "list", and that there were only two marks available the key was to be high-level and straightforward. Part (ii) was poorly done. Most candidates didn't appear to have read the question, in particular the preamble, which stated that unit costs had been calculated and allocated. The examiners were seeking comments on how the unit costs might be used in the two scenarios. Many candidates considered some valid general points but did not bring out the differences between (a) and (b) and consequently did not score well.*

**3** (i) There are 2 broad reasons: lower costs or higher returns.

The committee may take the view that the costs associated with active management are too high compared to the extra returns that could be generated.

Their approach means that there will be no trading expenses, fees or commissions, but conversely it will not be possible to take into account investment opportunities that arise mid-year.

There will be no need for the research provided by brokers or consultants that an active strategy would need. Similarly, advice on suitable strategies or modelling exercises wouldn't be needed. There will also be an opportunity cost saving as less time will be needed to run the portfolio so giving committee members more time to do their normal jobs.

However, expenses will be incurred at the annual re-arranging of the portfolio and in monitoring returns. These expenses are likely to be relatively small.

Given the make up of the committee, there could be an element of elitism and a "we know best" attitude.

The approach is easy to communicate and understand.

- (ii) The rationale could be based on the view that markets are cyclical and that, for a given sector, relatively good periods are followed by relatively bad periods and vice-versa.

The view could be that due to fear and greed markets over react both in good and bad times. This could mean that shares and sectors are over bought or over sold. This could lead to some prices being too high or too low relative to fundamentals.

This could mean that sectors that have recently performed relatively badly are now relatively cheap. The worst sectors are avoided as their performance could reflect serious long- term problems not just market inefficiency.

The view could be that good stocks in relatively bad sectors represent the best value. However, the best stocks are avoided, as they could be relatively expensive within the sector. The relatively good recent performance may not be repeated as it could be due to factors that have been more than fully discounted e.g. takeover speculation.

The fund will be comprised 16 of stocks in 4 sectors. This is designed to give some diversification but not so much as to dilute the impact of focusing on a narrow, hopefully, cheap area of the market.

This approach is an example of technical analysis as opposed to fundamental analysis.

- (iii) New money either from dividends or other injections (e.g. from a higher-level reallocation) will arise. The committee will need to decide whether or not to reinvest this income, and if so, in which shares.

Some of the companies in the portfolio may be subject to a takeover bid or merger. The committee will need to decide whether or not to accept the terms offered. If they do or if the bid is ultimately successful, new money may arise as above.

Some companies may have a rights issue. The committee will need to decide whether or not to subscribe. If they do, they have to decide where the money will come from. The implication in the question is that they will not subscribe.

The directors of some of the companies may propose a share buy back plan. If the committee decides to sell (again unlikely) new money will arise.

Some companies may get into difficulties. This could lead to proposals to reconstruct the balance sheet. The committee could be asked to approve these plans.

Ultimately, some companies may wind-up. If anything is payable on the wind-up, new money will arise. In this case a decision will be needed as to whether new companies should be invested in so as to keep the number at 16.

There will be routine (or extra ordinary) shareholder meetings. The committee will need to decide whether or not to attend and on how (if) to vote on each resolution.

There may be more substantive resolutions for example concerning issues of new capital. A decision will be needed, as new capital will affect the circumstances of the shareholding.

There may be circumstances where money is needed e.g. for projects in other areas of the university or to pay tax or to be transferred to other funds. A decision may be needed if some shares have to be sold. Alternatively, unallocated new money could be used.

- (iv) A benchmark index will be needed to compare the performance of the fund against the general domestic equity market. The benchmark will need to take into account any constraints or restrictions imposed on the portfolio the committee can choose.

The index will need to be appropriate for the purpose of assessing performance e.g. weighted by market capitalisation. It is likely that an index covering the whole domestic equity market will be needed e.g. an S&P 500 type rather than Dow Jones30 type.

If possible, the profit or loss against the market overall should be split between that due to the choice of sectors and that due to the choice of stocks within each sector. To do this, an appropriate index for each sector of the equity market will be needed. The question implies that these indices exist.

In order to assess performance, allowance needs to be made for both income and capital gains from the benchmark portfolio. The indices used should therefore give total returns directly or be easily adapted to provide them (e.g. with xd adjustments).

The choice of indices may depend on targets (if any) set for the fund. For example if the target is set relative to other funds, the indices used should reflect the assets that these other funds can invest in.

*Comments: This question was a good discriminator enabling the better candidates - those that read the question carefully - to be identified. Parts (i) and (ii) were reasonably well answered with most candidates grasping the main points. The candidates who understood the point of part (iii) scored well, but others focused on general market related points rather than stock specific factors for which there were few marks. In part (iv) some candidates were too specific in the requirements of the index in terms of matching the fund. If the index composition perfectly matched the actual fund, the index would be pointless. The better candidates realised that an index covering the whole domestic market was needed along with appropriate indices for each sector but only the better prepared candidates picked up the other points.*



- 4** (i) An individual's assets consist of current wealth and future income. Liabilities consist of future spending, including any debt repayments. Both the term and nature of future spending will need to be considered as well as the expected level.

The sophistication of the planning process used by individuals will vary greatly, but most will take some account of the pattern of their expected future income and major likely expenditure, such as a house purchase, in making their plans.

Individuals may also have personal reasons for investing or not investing in certain types of asset. For example they might want to invest in residential property to provide a home to live in, or might have particular religious or ethical views that override normal investment considerations.

Most of an individual's liabilities will be real in nature, although the relevant index measure may not be the RPI. Occupational income can be considered as a real income stream, but pensioners may be on a fixed income.

Because liabilities will generally be real, assets for long term investment should usually be real although monetary assets may be chosen for short term investments, diversification or because they appear good value.

Most investors will have liabilities and hence assets in their domestic currency, although there may be special reasons for holding other currencies.

Individuals may be constrained in their choice of investments by the size of their liabilities relative to their assets. They will often not be in a position to accept very much risk. Attitude to risk is partly a personal matter as well as being dependent on an investor's financial position.

Risk can be reduced by diversifying assets both between and within asset classes.

A major constraint is uncertainty. Individuals may lose much of their income for a variety of reasons, such as redundancy or ill health. Similarly unexpected expenditure requirements can easily occur. Therefore it will be desirable to keep some assets in a reasonably liquid form.

Insurance can also be used to mitigate the effect of some types of uncertainty.

In addition to the considerations of matching liabilities and allowing for uncertainty, individuals will wish to maximise their expected return. This means selecting assets that are good value after allowing for the expenses of dealing in the asset and the individual's tax situation.

Differences in taxation can mean that an investment, which is good value to one person, can be unsuitable for another. Some investments are particularly efficient for taxpayers.

The individual will wish to be aware of the impact of their investment on any state benefits.

Individuals usually face practical constraints. These can include:

- not enough assets for direct investment in some asset classes.
- high relative expenses when investing small amounts.
- lack of information and/or expertise.

Many individual investors, particularly the retired, rely on the income from their investments to live on. In this situation it is necessary to find a strategy which will provide a high enough current income while allowing for sufficient growth of capital and income to maintain the level of income in real terms.

A different situation is faced by investors who are investing for the long term, and don't require a current income from their investments, possibly because they are still working. They will be freer to concentrate on maximising total return.

Individuals investing for the long term may not be concerned about short term variations in the market value of their investments. However, in practice, most people dislike volatility, particularly if their liabilities are uncertain or are short term. A suitable strategy is often to switch to less volatile assets as the time at which the investments need to be realised draws near.

(ii) An investing institution will also need to consider the following factors:

- Statutory, legal or voluntary (e.g. meeting the expectations of policyholders) restrictions on how the fund may invest.
- Statutory valuation and solvency requirements.
- The strategy followed by other funds. They will not want to risk underperforming compared with their competitors.
- What the market wants.

(iii) Most people would use an inheritance to cover the gap between assets and liabilities. The use of the inheritance will depend on the size of the assets and liabilities.

23 year-old

Assets: future income, any savings

Liabilities: accrued debt, living expenses

Suggestions for use of inheritance:

- pay off debt
- deposit on home
- non-investment spending/ satisfying emotional needs
- long term investment
- including pension provision

50 year-old

Assets: pension scheme, savings, home, future income

Liabilities: mortgage, living expenses, any debt, education costs

Suggestions for use of inheritance:

- money towards education costs
- pay off all or part of mortgage, particularly if not covered at maturity
- possibly small non-investment spending / satisfying emotional needs
- balance to long term investment probably linked to retirement (depending on existing provision)

75 year-old

Assets: pension, savings, home

Liabilities: living expenses, possible future care costs

Suggestions for use of inheritance:

- invest to provide increased income
- consider moving to a retirement home or adapting current home
- provide for long term care costs/funeral expenses
- non-investment spending/ satisfying emotional needs
- gifts to other members of the family or used to increase their inheritance

*Other well reasoned valid points also gained marks.*

*Comments: Most candidates scored well on parts (i) and (iii) with many candidates achieving high marks. Part (ii) was not so well answered – some candidates struggled to find the key points.*

**5** There are two strands to address – technical issues and professional issues.

**Technical issues**

A reduction in fixed interest yields will mean a reduction in annuity rates. As single premium contracts the investment return that can be earned on the premium is a major factor.

The profitability of the business is the product of the profit per policy and the number of policies written.

If more business is written, then there are more policies over which to spread overheads and other fixed costs. The costs per policy will reduce, and it is therefore entirely appropriate to reflect the lower unit costs in the premium rates.

At the extreme, if other product lines can support all the overhead costs, then one product can be priced on marginal costs only. It could be that the shareholders agree to support some of the overhead costs in order to grow the business, but this is likely to be only for a limited period, and the issue will only be deferred.

However pricing a product using lower than marginal costs will result in increasing losses if business volumes grow.

Marginal costing one product line might enhance sales of more profitable products as well as the marginally costed one.

The Pricing Actuary needs to be aware of detailed sales and expense forecasts for the whole of the company's business, following the decision not to reduce rates. If there are none, the company needs to be asked to provide them. This will enable him to review the profitability of the annuity rates in the light of the fall in interest yields and projected growth in volumes.

He also needs to review the profitability of other lines of business written. It may be that the Pricing Actuary actually heads the actuarial pricing team (as he is an employee) in which case he will have ready access to the information. If not it needs to be requested formally from the company.

It may be appropriate to review other aspects of the pricing bases for any of the contracts, such as the mortality assumption.

If the premium rates are insufficient to support the new projected volumes of business, then further discussions with the company are necessary – see later.

It may be that the premium rates are adequate, but only if the projected increases in business or the projected changes in the mix of business occur. The Pricing Actuary needs to establish with the company appropriate reporting and review mechanisms, and agree trigger points for action on premium rates, should the expected business volumes not materialise.

With these safeguards in place, it will be appropriate to give the necessary certificate.

### **Professional issues**

The Pricing Actuary has all the professional duties of an actuary. As an employee he has two duties. He has the normal responsibilities of any professional employee to act in the best interests of the company's business, and to follow reasonable instructions given. He also has the statutory duty to act on behalf of the regulator and to report if necessary. These duties can conflict, and the Pricing Actuary needs to make the employer aware of the potential for conflict.

Most aspects of product pricing involve an assessment of likely future experience. This involves professional judgement. It is possible that different actuaries will have different views on most items. Hence the Pricing Actuary should make the company aware that there is a range of premium rates that he would consider acceptable, not a single correct answer.

If the Pricing Actuary has had regular discussions with management they should be aware of the deteriorating profitability of annuity rates, and be aware of the limits of the Pricing Actuary's acceptable range.

The Pricing Actuary must ensure the company is aware of the difference between marginal costing, and writing business on terms that doesn't cover even marginal expenses.

The fact that premium rates are not going to change does not absolve the Pricing Actuary of his statutory duties. This must be stressed to the company. A positive decision not to change rates when a change is justified should be treated in exactly the same way as a change. The proposal to evade statutory requirements by such a technicality is unacceptable.

If the Pricing Actuary feels he cannot give the certificate he should work with the company to clarify the changes necessary to bring the position back into the acceptable range. There is a clear duty to the employer to try and achieve an acceptable position before reporting to the regulator.

However if such a position cannot be reached a report to the regulator should be made. In doing so the Pricing Actuary must keep the company fully informed of his actions. If possible he should advise the company of the possible regulatory actions as a result of any report.

*Comments: The type of question that is not divided into parts and has a lengthy paragraph setting the scene is normally the most difficult on the paper. The better candidates recognised this (we have made the point in past reports) and spent their reading time planning how to answer the question. The question gave a clue that separate consideration of technical and professional issues would be needed.*

*Annuity rates are commonly expressed as the amount of annuity that can be purchased for a fixed lump sum. Hence if annuity rates reduce, the customer gets a poorer return. Candidates who treated an annuity rate as the cost of buying a fixed annuity were not penalised if their argument was clear. Very few candidates understood that it is whether marginal costs are covered or not that is the trigger for exposure to losses from large volumes of new business.*

*On the professional issues, most candidates realised there was a potential conflict of interest but few considered how it could be dealt with. Few candidates pointed out that not reducing rates when a reduction is justified is actually the same as improving them.*

- 6** (i) The commitment can be considered both in relation to different groups of employees (male, female, young, old, short service, long service etc.) and in relation to different benefits (normal retirement, early or ill health retirement, death in service, withdrawal etc.).

The strictest interpretation would be that all benefits for all members would be at least as good. The most practical way to do this would be to provide a scheme, which replicates the government scheme.

The less strict interpretations could be:

- All members are better off in most cases. This would mean that some benefits aren't, in general, as good as those under the government scheme.
- Most members are better off in all cases. This would mean that certain groups of individuals are, in general, worse off under the new arrangements.
- The benefits pre and post transfer should be actuarially neutral. The justification for this is that circumstances where some members are worse off are compensated by circumstances in which the same or other members are better off. Hence the overall commitment is met.

In order to assess the suitability of the new arrangements, the relative levels of benefits under various scenarios could be considered. This could be a complex exercise and the results could be difficult to interpret.

Alternatively, the expected value of future benefits (allowing for the probability of each benefit arising) could be calculated for a representative sample of employees. These values could be compared to the value of future benefits under the government scheme. Problem groups and the reasons why problems arise could then be identified.

Pension benefits for the transferred employees could either be based on the government scheme or on any existing scheme used for existing employees of the new employer – assuming that the two schemes differ in material ways.

- (ii) The major problems the new employer could face are:

The government scheme could be very generous hence any attempt to provide corresponding benefits could be unaffordable.

The government scheme contains guarantees such as the inflation link for pensions in payment. The new employer may consider that the risks associated with these guarantees (e.g. volatile contribution rates or large deficits) are too great.

Having different schemes for different groups of employees would increase administration and other costs. If there is no existing scheme, a scheme will need to be set up.

The existing data will need to be transferred.

If the new arrangements differ significantly from the government scheme, it may be difficult to convince transferring employees that they are no worse off. It will be easy to find examples where an employee could be worse off.

If the new arrangements are similar to the government scheme, existing employees may feel aggrieved if transferring employees appear to be receiving more generous pension benefits.

To meet the commitment, lots of special rules, caveats or guarantees could be needed. These will be messy and difficult to implement.

- (iii) It may be possible to improve other elements of the remuneration package to compensate for worse pension terms. Pension benefits under the government scheme may have been relatively generous because other elements of remuneration weren't.

Such increases in other remuneration may not be a significant cost if existing employees enjoy better terms than the government employees (i.e. overall the cost of the transferring employees is similar to that of existing employees). This may be unlikely as the major way private companies can reduce costs is to have lower staff costs than the government.

It may be possible to offer:

- a pay rise or a one-off payment to buy out future service rights
- bonuses if employees hit certain targets
- increased holiday entitlement
- reduced working hours and/or more generous overtime pay
- improved additional benefits e.g. share-option, other savings schemes, childcare vouchers or discounts on certain goods
- improved ancillary benefits e.g. sickness or maternity/paternity pay

Generous benefits in the government scheme could have required relatively high employee contributions. Employee contributions to the new scheme could be lower.

It may be possible to get transferring employees to accept slightly worse pension terms if the alternatives were redundancies, cuts in pay or job insecurity.

- (iv) The first decision will be what benefits are to be provided. The broad alternatives are either standard leaving service benefits or benefits based on the value of the accrued benefits (allowing for future salary and pension increases) held in the government scheme for each member.

Given the context, it is likely that a value of accrued benefits basis will be appropriate. This may be a legal obligation. Benefits could be retained in the government scheme, transferred to the new scheme or transferred to a third party.

Again the context may imply a transfer out of the government scheme. Alternatively, employees may be given a choice.

Any benefits retained in the government scheme are likely to be expressed in terms of deferred pensions payable on the same terms as other deferred pensions under the scheme.

If benefits are to be transferred, a basis to calculate the value of these benefits (and the benefits to be purchased by the transfer values) will need to be agreed between the actuaries advising the relevant parties. This could entail protracted negotiation. The government scheme won't want to pay too much relative to its funding assumptions. The receiving scheme will want to receive enough to ensure that deficits don't arise on its funding basis.

These transfer values will be used to purchase benefits in the receiving scheme. These benefits could be expressed in terms of deferred pensions payable under the same terms as other deferred pensions in the scheme. More likely, they will be used to buy added years of service in the new scheme. In this way, benefits for past and future service will be paid on the same terms. Alternatively, a broad-brush approach could be used where transferring members are granted X years service in the new scheme for each year of service in the government scheme.

Third parties could be insurance companies or other providers of personal pensions. They could offer benefits in the form of guaranteed deferred pensions (with or without profit) – though the inflation link is unlikely to be retained. Alternatively they could project the pension that could be purchased at retirement if the transfer value was invested in a unit-linked fund.

If a large number of employees were to transfer, the provider could offer preferential terms e.g. lower expense loadings or less strict underwriting.

*Comments: Question 6 was generally not answered well. In part (i) many candidates interpreted the question as a discussion of the various methods of funding, or how the future benefits could be valued by means of a discounted cash flow. Although the question clearly referred to future service benefits, many candidates discussed past service benefits. Part (ii) was answered better, although some candidates gave all the risks of defined benefit schemes in general without focusing on the specific risks created by the incoming members. In part (iii) few candidates mentioned how non-pension scheme benefits could be used to offset the loss of future pension rights. Many candidates simply listed various ways future pension benefits could be reduced. In part (iv) most candidates made the basic points, but few gave these enough substance to gain all the marks available.*

## **END OF EXAMINERS' REPORT**



# EXAMINATION

15 September 2008 (am)

## Subject CA1 — Core Applications Concepts

### Paper One

*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 6 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.*

<p><i>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.</i></p>
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- 1** (i) Describe the three different types of advice that an actuary could provide. [3]
- (ii) Discuss the professional considerations an actuary should take into account when providing advice to an insurance company regarding the implementation of a new accounting standard. [4]
- [Total 7]
- 2** (i) State the formula used for explaining the total return that investors require on an asset. [2]
- (ii) Explain how this formula can be used to analyse the difference between the quoted redemption yields available on an index-linked government bond and a fixed-interest non-government bond, which have the same outstanding term to redemption. Both bonds are issued in the same currency. [6]
- [Total 8]
- 3** A small company specialises in manufacturing medical equipment. Approximately 75% of its business relates to a single high value product, for which it has a market share of around 60%. The company operates from a single site.
- The shareholders of the company have agreed to accept an offer for their shares from a large multinational conglomerate. The multinational does not manufacture the company's main product line, but it does manufacture some of the company's other products. The multinational intends to continue to operate the existing plant and premises.
- (i) Discuss how the change in ownership could affect the operations of the small company and hence the attitude towards obtaining insurance cover for the risks that it faces. [3]
- (ii) List the types of insurance cover that the small company is likely to have had in place prior to its acquisition. [4]
- (iii) Discuss how and why the existing insurance arrangements might change following the acquisition. [6]
- [Total 13]
- 4** An individual aged 50 has been told that he will be made redundant from his job in one month's time. He has been offered an immediate early retirement pension from his employer's pension scheme and a redundancy cash payment. An actuary has been asked to give advice on how the individual could use the redundancy cash payment.
- (i) Describe the further information that the actuary may need to gather. [8]
- (ii) Discuss the features of the cash flow projections the actuary would carry out when giving advice. [8]
- [Total 16]

**5** A general insurance company writes a range of business.

- (i) Specify the levers that management can use to try to increase the amount of profit or reduce potential losses. [6]
- (ii) Outline the main reasons for monitoring the actual experience of the business. [3]

The company intends to carry out an analysis of its expense experience for the purpose of product pricing.

- (iii) Describe the factors the company should consider when using the results of this analysis. [6]

Rather than carrying out a new, full analysis, the directors are considering using the results of the previous analysis. They suggest taking the previous expense figures and adjusting them to allow for inflation.

- (iv) Discuss this approach. [6]
- [Total 21]

**6** (i) State reasons why overseas property may be attractive to institutional investors. [3]

- (ii) List practical problems an investor in overseas property may face. [3]

A large financial institution has been asked by a consortium to provide significant debt finance for a major project. The consortium proposes to construct and then manage a number of new hotels in a range of developing countries. The target customers for the hotels would be affluent tourists from developed countries.

- (iii) Outline the social and economic factors that could make the project an attractive proposition. [3]
- (iv) Describe significant risks to the consortium's revenues once construction has been completed. For each risk, explain the actions that could be taken to reduce the chance of the risk occurring. [12]

As an alternative to lending money to the consortium, the financial institution is considering purchasing blocks of shares in a number of domestic property companies whose portfolios contain overseas hotels.

- (v) Explain how the financial institution's risk profile would differ between the two alternatives. [8]
  - (vi) Describe the benchmarks the financial institution could use to assess the performance of each of the two alternative investment options. [6]
- [Total 35]

**END OF PAPER**

# **Subject CA1 — Core Applications Concepts**

## **Paper One**

### **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 three types of advice are:

Indicative advice – Giving an opinion without fully investigating the issues, for example in response to an oral question.

Factual advice – Advice based on research of the facts for example interpretation of legislation.

Recommendations – Advice based on fully researching the requirements and weighing up the potential alternatives, for example specific advice about decisions to be taken.

(ii) Before providing advice the actuary should consider whether he has the necessary experience to provide the advice. The actuary may need to consult other actuaries, for example from within their firm, who have the relevant experience. Alternatively the actuary may have his work peer reviewed.

At all times the actuary should be aware of any conflict of interests. Conflicts could arise if the actuary is advising more than one associated party or from within the insurance company.

There may be professional guidance notes or other relevant legislation that must be complied with.

The implementation of an accounting standard requires interpretation of legislation and accounting requirements.

Whilst an actuary may be able to provide input for the implementation of the accounting standard, it is unlikely that they have the necessary experience and qualifications to act without involving other professionals such as accountants and lawyers.

*Most candidates remembered the bookwork for part (i). In part (ii) the better candidates read the whole question and so tailored their answers to show that they knew what really mattered here. In particular it is necessary to emphasise competence – and in this case the actuary may not have the expertise – the need to consult other professionals, and the specific conflicts that may arise and why. Simply stating “avoid conflicts” was not enough.*

**2** (i) Required total return = Required risk free real return + expected inflation + inflation risk premium (if relevant) + asset risk premium.

*Credit was given if a candidate gave only one risk premium but explained correctly what it covered. Marks were also given to candidates who covered inflation risk premium correctly in their answer to part (ii).*

(ii) The term to redemption is the same for each bond. But the coupon and redemption patterns will be different so durations are not identical, which matters more if the yield curve is not flat.

Hence part of the difference in yields can be explained by a risk premium (part of the asset risk premium in the formula) relating to differing volatilities arising from the different discounted mean terms.

Index-linked (IL) government bonds give a real return that can be taken as risk-free in most territories if held to redemption, subject to any delay between the reference dates for calculating coupon/redemption amounts and payment.

From part (i), the formula for the required return on the fixed-interest non-government bond is required risk free real return + expected inflation + inflation risk premium + bond risk premium.

Hence, from the formula, the difference between the yields can be expressed as expected inflation + inflation risk premium (IRP) + bond risk premium.

The yield on a fixed interest (FI) government bond of the same duration would be an intermediate step because:

FI government bond yield = IL government bond yield + expected inflation + IRP.

The difference in yields between government FI and IL bonds of similar terms reflects expected inflation + IRP.

The bond risk premium can then be approximated as the difference between the yields on the non-government bond and an FI government bond of the same duration.

This risk premium will incorporate margins for any differences in:

- Credit/security. Depending on the issuer (and the government), the corporate bond will suffer from a greater risk of default (in general).
- Marketability. It is likely that the corporate bond will be more difficult or expensive to deal in. This depends on relative issue sizes and also the extent to which institutions have a “buy and hold” mandate. Some IL government stock is held as a match and is not traded whereas blue chip corporate bonds have large and liquid markets.
- Other features of the bonds such as options, guarantees or conversion terms and dates

The difference is between quoted market yields and so the above reflects the views and conditions of the “average market investor”.

Individual investors will have different views on suitable risk premiums and expected inflation.

However, there may be circumstances where the formula cannot explain the yield gap. That is the market is pricing on other issues apart from relative risk. For example supply and demand constraints could distort the relative yields – some territories may require certain investors to hold government stock.

*Part (i) was generally answered correctly. Some candidates failed to break down the risk premium into its two components, though credit was given if their understanding of the two components was clear from part (ii). The quality of the answers to part (ii) varied, with many candidates showing a very good understanding. Some candidates lost needless marks by giving the difference between the two bonds on a (nominal – nominal) basis whereas the quoted redemption yield on index-linked bonds is always in real terms. There was some misunderstanding of the inflation risk premium, with candidates attaching this to the index-linked return rather than the fixed interest return. Answers were penalised if acronyms were not defined and then used ambiguously.*

- 3** (i) One of the reasons for the acquisition would be for the multinational to gain entry to a market that is dominated by one supplier.

Thus it is likely to continue to manufacture the main line of business at the existing site. Hence insurance will still be needed in some form. Minor products might be reorganised, which might mean more or less production from this site. Hence the scope of cover may change.

The multinational is larger, operates from more territories, and has more diverse business. Thus it can benefit from pooling risks internally, rather than needing an insurance company to effect the pooling among many different companies.

Insurance company premiums will include profit loadings. Thus if the multinational retains risk, profits should increase.

But some risks will be too large for the multinational to retain, and it will look to insurance companies to cover them.

Some of the risks currently covered by the small company's insurance arrangements may be transferred to any existing insurance arrangements that the multinational has. This may result in lower overall premiums.

Some insured risks will be specific to the small company, and may not fit well in the multinational's insurance arrangements. The small company may continue to insure these specialist risks.

- (ii) Employer's liability  
Product liability  
Public liability  
Business interruption (consequential loss)  
Pecuniary loss  
Fidelity guarantee  
Commercial Property – fire, theft, explosion, storm, flood, escape of water

Damage to plant and machinery  
Motor vehicle (if the company has its own distribution fleet or if cars are provided to staff)  
Patent protection (e.g. covering legal costs)  
Key person insurance  
Sickness and/or critical illness insurance cover for staff  
Life assurance for staff

(iii) The likely changes are:

Employer's liability. Liability from accidents can be very high, as can be the cost of litigation. Hence insurance cover is likely to continue, but with a much higher excess point (deductible) so that the smaller risks are retained within the group.

Product Liability. The risks in this area may be high for a manufacturer of medical equipment as claims could have a very high cost. Hence it is likely that the main line product liability cover will be unchanged. Minor product lines may be less significant and so they may be covered under the multinational's existing arrangements. However, as they are also medical products, cover will still be needed because claims could be high.

Pecuniary loss/fidelity guarantees. There will be less need due to the increased scale of operations. Possibly excess limits might increase.

Business interruption. If the minor product lines are manufactured elsewhere in the group, insurance cover under the existing policy might be restricted to events that affect the production of the main product line.

Commercial property. This depends on the premises involved. If the company can operate from standard industrial units, it is likely that the risk can be pooled within the group.

Damage to plant and machinery. Most damage risks are likely to be retained within the group. Insurance with a high excess point may be used as a backstop.

Public liability. As the potential for claims is unlimited it is likely that the cover will be unchanged. Claims are rare and thus premiums are low anyway.

Motor vehicle. It is likely that the new group will only insure the liability risks relating to motor vehicles and will retain the vehicle damage risks.

Patent protection. Greater group resources will probably remove the need for this cover.

Key Person. A much larger group is unlikely to be reliant on key individuals, so cover will probably not be needed unless very specialised skills are required to run the small company's main product line. Possibly retain for a limited period.



Sickness/critical illness insurance and life assurance. The multinational will probably have arrangements in place for its existing staff e.g. benefits provided from a pension scheme. Employees of the small company could now be covered by these arrangements and existing policies may lapse.

*Credit was given for other answers provided that the result stated was a logical consequence of the argument.*

*Part (i) had only 3 marks for a "Discuss" question so the examiners were seeking clarity and precision. Many candidates spent a lot of time discussing changes in operations that were irrelevant in the context of insurance arrangements. "Hence" was the key word in the question. Weaker candidates chose to ignore it and were not selective about the changes considered.*

*In part (ii), the command verb "List" means precisely that. The more that is said often reveals a lack of understanding and so devalues otherwise valid points. Part (iii) was not well answered. Few candidates thought of methodically working through the list to see how each type may change.*

- 4** (i) The actuary would need information on the assets and liabilities as a whole given the size of the cash sum, the level of the pension, and the terms attaching to it (increases, spouse's benefits).

Assets could include:

- The individual's house or other property
- Any other investments/savings e.g. other pension or insurance arrangements.
- Any contingent or uncertain assets e.g. an inheritance.
- Any income expected e.g. from possible future employment or the state.

Liabilities could include:

- Outstanding mortgages on property.
- Any other debts – credit cards etc.
- Tax due on income or redundancy payments.
- Living expenses and their anticipated changes e.g. healthcare costs, leisure expenses.
- Any short term costs such as retraining or holidays.

The individual's tax status will be important in choosing appropriate assets.

The actuary should also consider the assets, liabilities and tax status of other members of the individual's household, including provisions necessary for any children or others who may be dependant on the individual for an unknown future period and any special provision that the individual might wish to make (e.g. future care costs for relatives or legacies).

He should also consider any penalties that might apply on early repayment of any mortgages.

The time horizon of investment may be affected by the individual's state of health.

Advice will be based on the individual's broad outlook in respect of risk.

For example strategies could be:

- Cautious – focusing on debt reduction.
- Long term – focusing on savings or investment.
- Short term – focusing on consumption.

The individual may impose specific constraints based on ethical considerations or may have particular preferences for certain assets or sectors.

- (ii) For each strategy, an asset-liability model could be constructed. This would involve projecting expected outgoings from liabilities and proceeds (income and capital) from possible assets. Allowance would be made for future increases in such cash flows.

In order to make such projections, an assumption will be needed in respect of expected future inflation.

Each projection would consider the extent to which assets and liabilities are matched. Mismatching means that there is a risk of running out of assets in the long term or having excess assets on death.

One basis for projections could be net assets on death in order to obtain full, timely benefit from the overall assets.

The models could be rerun to illustrate the sensitivity of the outcome due to uncertainty in a number of key areas such as:

- How long the individual will live.
- How income and outgo might be affected by ill-health.
- The net returns achievable on assets.
- Interest payments on debts.
- Volatility in net income from employment or lifestyle changes.
- Variations in uncertain assets or liabilities (unforeseen income or outgo).

Within each broad strategy, there will be scope to choose different assets, so the models could be rerun with different asset allocations. In particular, the cash sum may affect how existing assets are invested (changed). The models can vary the amount of assets held as cash (or otherwise liquid) as opposed to being actively invested.

Consideration should also be given to the extent to which any risks can be mitigated (allowing for the costs of mitigation) by adjusting outgo or using

savings to meet future events, or by taking out insurance such as additional annuity, life assurance, healthcare, household cover, etc.

*Part (i) was generally well done with most candidates scoring plenty of valid points. There was a tendency to list random points in a disjointed fashion as and when they were thought of. The better candidates set out groups of points in a logical order, which demonstrated that they knew what mattered most and why.*

*Part (ii) was answered poorly. The question was carefully worded to stress the type of projection needed. Even so many chose to answer a question that wasn't actually asked and discussed the modelling process in general, rather than what needed to be modelled here. Many candidates talked about a stochastic model as a viable possibility, though this would be spuriously accurate for a single individual where there is so much future uncertainty requiring, at best only broad advice.*

- 5** (i) The levers that can control the amount of profit/losses are the factors that the company can affect through management to increase value. This insurance company could try to:
- Reduce the number of contracts that lapse.
  - Follow an investment policy that matches assets and liabilities.
  - Use any free capital to follow a strategy that tries to increase investment returns subject to an acceptable level of risk.
  - Control expenses both in terms of amounts and incidence - try to match expense outgo with premium income or introduce cheaper sales channels.
  - Adopt an effective tax management policy.
  - Review reinsurance or other risk management tools to limit claim amounts and volatility for the optimum cost.
  - Reduce the likelihood of actual claims differing from the expected through good underwriting of new business.
  - Underwrite claims for validity and amount.
  - Correctly price and provision for any guarantees that it offers.
  - Price products competitively, so as to avoid writing loss making business or producing policies that cannot be sold (premiums not too high or too low).
  - Develop new products or areas of business e.g. to diversify type and location of exposure.
  - Adapt existing products to reflect changes in market conditions e.g. NCD or excess levels.
  - Increase marketing spending to boost sales.
  - Use capital to purchase competitors so reducing competition.

- (ii) Regular monitoring of the experience is a fundamental part of the actuarial control cycle.

The actual experience of the company should be monitored to check whether the method and assumptions adopted for pricing and financing the business continue to be appropriate.

This will enable the company to:

- Update assumptions on future experience.
- Identify any adverse trends in experience so as to take corrective actions.
- Provide management or regulatory information.

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

The period under investigation may have been affected by abnormal events e.g. costs relating to new systems. Many elements of expense experience are affected by economic cycles e.g. levels of wages.

It is also possible that there is a gradual change in the experience from period to period. Before using the results of the investigation, it is therefore necessary to consider whether there is any reason why any past trends may continue into the future. Technological or managerial improvements may lead to steady falls in unit costs.

It is possible that some classes of business may not have been large enough to provide credible data for a full analysis. These lines may have been grouped with other business in the analysis. It will be necessary to check that any groups are and will remain relatively homogeneous.

Alternatively, such classes may be allocated expenses in an arbitrary way with an eye on consistency with market premium rates.

In addition it is possible that, overall, there was a lack of data so that the whole exercise lacks credibility.

The volume of new business will affect future expenses. The impact on costs of any expected growth or contraction of business should be allowed for.

If the results are to be used as a base for calculating future expenses, some allowance for inflation will be needed.

Different lines of business will have different levels of expenses. Allowance for expected changes in the mix of business or the development of new products may be necessary when allocating indirect expenses.

It may be appropriate to make an adjustment to any results to give prudent assumptions as opposed to using best estimates. This may allow for any

uncertainty as to the validity of the results of the analysis. However, given that the analysis is to be used for pricing, large margins may not be appropriate.

- (iv) This approach would have much lower costs and be quicker and easier to implement. If the business written and processes involved have not changed significantly since the previous analysis it may be appropriate.

This will also depend on when the last full analysis was carried out. Clearly, the longer ago it was, the less appropriate is this approach.

A new analysis could be used for many other purposes, for instances in setting provisions for existing business, and so would be more useful.

It is possible that a full analysis is required, say for calculating statutory reserves.

It is likely that there have been changes in business mix and overall level of business since the last investigation that would invalidate this approach.

Technological or other improvements may mean that unit costs are lower.

Different sales channels e.g. the internet or overseas call centres may have been introduced. This could have lowered unit costs.

New products would have no past figures to apply inflation to (though an analysis may have been done when the product was launched).

Need to consider the rate of inflation to apply to these expenses, and whether different rates would apply to different expenses (some may be price linked others wage linked).

It will not be possible to analyse future profit if the accurate expense figures are not used.

A more accurate expense analysis may lead to more competitive premiums. The suggested approach may lead to an increase in unprofitable business.

*Part (i) was answered well with most candidates getting a good range of points. The examiners were looking for more than the obvious answer of increasing premiums, although many candidates seemed to say “increase premiums in several different ways in their answers. Part (ii) was well answered, though many missed the linkage to the Actuarial Control Cycle. A question on this topic comes up at least once a year, and there is a “free” mark for recognising it. Some answers went beyond the requirements of the question, for example discussing types of corrective action.*

*A lot of thought went into carefully wording the question for part (iii) but many candidates chose to see what they wanted to see and not what was written. These candidates described at great length how an expense investigation would be carried out. Several candidates said that*

*the uses of the investigation depended on the purpose, ignoring the fact that the purpose was given in the question.*

*In part (iv) some good points were made, and many candidates gave a balanced argument. However many easy marks were missed. Few candidates were able embellish “inflation” to cover its many sub-issues. A surprising number failed to mention the time elapsing since the previous analysis, other reasons why a full analysis may be necessary, and the effect on the premiums and its consequences.*

- 6** (i) Investors may have overseas liabilities. Overseas property could be a suitable match for general currency exposure or for more specific real liabilities.

The investment could increase diversification both in terms of exposure to different economies and different asset types e.g. properties not available domestically.

Some overseas economies may experience high growth and/or currency appreciation, which could give high returns on assets in those countries.

The property markets in some countries could be buoyant. For example large - scale developments and/or local inefficiencies or supply constraints could boost local property returns.

- (ii) Information will be hard to obtain and interpret particularly if there are language difficulties.

Regulations in particular, those concerning tenure, planning and ownership rights may be unfamiliar.

There may be many restrictions on what can be owned by overseas investors.

Administration will be difficult, for example in terms of:

- Collecting rent
- Monitoring the condition of properties
- Carrying out repairs and maintenance
- Negotiating with tenants and authorities

Local agents will be needed – can they be trusted?

*In this section full credit was only given for points that are directly applicable to overseas property and day to day practical problems. General topics were given limited credit.*

- (iii) Essentially the main reason will be demand for the hotels.

Growing affluence in developed countries has left many people with large disposable incomes.

The availability and affordability of long haul flights has increased.

Many developing countries have improved infrastructure to make tourism more feasible.

Many people are seeking alternatives to traditional holiday destinations.

Many developing countries can provide attractions (cultural and geographical) not available with traditional holidays.

Economic improvements in developing countries mean that tourists feel more comfortable about visiting.

Costs may be low in developing countries enabling high profit margins.

Governments in developing countries may grant assistance and subsidies to encourage development.

The existing supply of hotels may be low implying high prices could be charged.

The project may be a useful way of establishing a presence and contacts in these markets with a view to exploiting future possibilities.

- (iv) *The points given below are not exhaustive. Credit was given for any valid example which included a risk, an avoidance strategy, and a description or justification of the action. The emphasis is on avoiding occurrence not on mitigating the consequences – though often the distinction is blurred in practice.*

A downturn in the general world economy could lead to people cutting back on luxury holidays. There is very little anyone can do to prevent such global economic fluctuations.

Terrorism or the fear of terrorism could lead to less overseas travel. Governments and others could improve security arrangements or the consortium could build hotels in countries less prone to unrest.

Political instability in particular countries could deter visitors. The consortium could focus on countries that have demonstrated a history of stability.

Changes in governments could lead to regimes less friendly to first world tourists. This could increase costs through taxes or general hassles such as planning or employment law. If possible, the consortium should cultivate relationships with the major political players.

As developing countries grow, local costs for labour, services etc. could rise unexpectedly putting pressure on margins. The consortium could negotiate long term deals with unions or suppliers so that they can effectively plan for costs.

Another consequence of growth could be a strengthening of developing countries' currencies. This may put tourists off and it will increase effective

local currency costs. The consortium could hedge currency or pay local employees in first world currencies but the impact on tourists' purchasing power is harder to prevent.

Competitors may open hotels putting pressure on margins. The consortium may be able to negotiate exclusive rights to develop certain areas or encourage local politicians to restrict the supply of new hotels.

Infrastructure such as airports and roads could be poor or poorly maintained causing a drop in visitors. The consortium should only build where suitable infrastructure exists and/or where they believe that the authorities will provide suitable facilities. The consortium may be able to win contracts to build or maintain infrastructure.

The service or overall experience tourists receive could be poor leading to poor publicity. Sufficient staff with appropriate training should be employed. The target market will expect comfortable conditions and so costs should not be skimmed in this area.

Management may be poor with a lack of financial control leading to losses or inefficiency. The consortium should employ managers with proven, relevant track records and monitor, assess and reward them appropriately.

Some areas may not prove attractive to visitors. Market research should be undertaken to gauge demand. Advertising in conjunction with local tourist authorities will help.

Construction could have been sloppy leading to a need for refurbishment or renovation. The construction phase must be properly planned and monitored. The budget should be sufficient to provide hotels of the desired standard.

Green concerns may lead to drop in demand or punitive taxation on long distance air travel or fuel. The consortium should where possible adopt environmentally friendly policies. This may make travellers feel less guilty or persuade politicians to let profitable developments go ahead.

The hotels may be situated in areas prone to bad weather or natural disasters. Research should be carried out so that the site chosen is practical. These risks can be localised (e.g. flood plains) so access to the relevant area can still be achieved.

The area chosen may be subject to diseases or other dangers. The hotels should be able to provide some protection e.g. against mosquitoes. Access to good local medical facilities or the employment of doctors would help.

Revenue received in local currency is vulnerable to currency depreciation or problems with repatriation. The consortium could try to receive as much revenue as possible in first world currencies pre travel. Alternatively local currency revenue could be used to cover local currency outgo.



- (v) The alternative involves buying equity as opposed to giving a loan. The characteristics of debt and equity vary. Debt is a cost to the borrower and must be paid as set out in the terms of the loan. Equity proceeds reflect residual profits and so are likely to be volatile and are not guaranteed.

Debt repayments take precedence over payments to shareholders and hence can be viewed as more secure. Debt payments tend to be fixed or otherwise defined and so are vulnerable to unexpected inflation. Equity dividends and hence prices provide real returns and so offer some hedge against unexpected inflation.

The property companies are likely to have borrowings. This debt will increase gearing and hence the volatility of returns.

Should the enterprise fail, debt takes preference over equity for example it may be secured on specific assets.

In general, property company shares will be more marketable than the loan, which implies lower risk (in this respect).

The loan is to a consortium that will build new properties. However, the term of the loan is likely to extend beyond the construction phase so that the consortium can generate income to repay the loan. Even so, the institution will still be exposed to significant risks related to construction and development. In particular, there may be a period with low or no income at the start of the project.

A portfolio of property shares is unlikely to have such exposure to developments. The risks will also be related to existing properties. This depends on the particular shares held and it may be difficult to determine the underlying properties.

The consortium is investing in a specific type of property in specific locations. There is some diversity between countries but there is still high specific risk as the exposure is concentrated. In addition, there is only one counter-party implying a further concentration of risk.

The property companies will probably not have as much exposure to hotels or developing countries. There will be a much greater diversity in terms of the underlying properties held. There will also be some exposure to the domestic market and the spread between shares means less “manager” risk.

(vi) **LOAN**

The loan to the consortium will probably have a fixed term and defined repayments and is similar in nature to a corporate bond. The significant difference could be in relation to interest repayments, which may be deferred and/or variable but linked to a widely used rate.

The appropriate benchmark would therefore be some form of international bond index. Such indices are not generally publicised. However, it is possible that suitable indices are produced by brokers or others.

To obtain a valid comparison, an index should be chosen that covers bonds with features similar to those under the loan in terms of duration, credit rating, marketability and nature of repayments. It may be difficult to find an index that meets all these criteria.

It is likely that the loan will be denominated in a first world currency say \$US. International bond indices should be available in the relevant currency.

## SHARES

The starting point for the property share investments would be an index of property companies listed on the domestic stock exchange. This may not be appropriate if the institution is concentrating on shares with international exposure. Shares in the index may be heavily weighted towards domestic properties.

It is possible that different property share indices are produced depending on the nature of the property company but this is unlikely.

As with bonds, it is possible that brokers could produce indices of international property company shares.

The choice will depend on the terms of reference for the investment. The aim may be to invest solely in overseas property, possibly in specific countries or types or to just have a certain level of overseas exposure.

Any benchmark should reflect these criteria this could be achieved by, for example, combining an international index with a domestic index.

It is likely that the available indices will be calculated in the same currency as the investments.

*Part (i) was answered well on the whole. Some candidates mentioned the possibility of higher return without adequately explaining why. In part (ii) there was a tendency to discuss property investment in general rather than overseas property in particular. This gained some marks, but wasn't what the examiners were seeking. The key to success in questions where general subjects are set in a specific context is to tailor answers to the context, but not to omit the basic points.*

*In part (iii), candidates tended to rehash the answers given to part (i). A surprisingly large number of candidates misinterpreted the question and gave economic and social benefits. Investors aren't charities and improving conditions in the third world isn't their goal, although it may be a beneficial side-effect. "Attractive" in the question means attractive to investors.*

*Part (iv) was generally answered well. The question did state "actions.... to reduce the chance of the risk occurring" so repeated reference to Insurance against the risk gained no*

*credit. A few candidates ignored the instruction to discuss the post construction risks only. This part required wide thinking and general knowledge, rather than particular actuarial skills.*

*In general answers to part (v) were too superficial, although most candidates realised this was essentially a debt v equity comparison. Candidates failed to explain why the security of income and capital redemption would be better under the debt. Most candidates commented on the greater diversification of the property shares, but few made an in-depth comparison of the features of the underlying properties under the two alternatives.*

*Part (vi) was very poorly answered. A large number of candidates seemed to answer a question about how to construct a property index, which wasn't what was asked. Few candidates seemed to understand that the purpose of a benchmark is to assess relative performance.*

## **END OF EXAMINERS' REPORT**

# EXAMINATION

20 April 2009 (am)

## Subject CA1 — Actuarial Risk Management

### Paper One

*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 six 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.*

<p><i>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.</i></p>
--

- 1** Outline with reasons the principles that a defined benefit scheme should follow in setting an investment strategy. [7]
- 2** A well-funded benefits scheme is investigating the possibility of providing a loan to a manufacturing company. Interest will be paid on the loan at a fixed rate over ten years, with full repayment at the end of the term.
- Outline the factors that the scheme should take into consideration when determining whether to make this loan. [10]
- 3** A life insurance company launched a single premium unit-linked bond product five years ago. The terms of the contract were as follows:
- Annual Management Charge of 1% of the accumulated fund each year
  - early exit charges to apply in first year at 3% of the accumulated fund, second year at 2% and in third year at 1%
  - guaranteed return of premium on death
- The policyholders have the choice of three funds to invest in:
- an equity fund
  - a fixed interest fund
  - a fund that guarantees at least the return of premium on every anniversary of the policy
- (i) Describe the approach that the company would have used to project its expected profits when it launched the product. [6]
- Having reviewed the policies' actual performance it is seen that the product has made losses every year since its launch.
- (ii) Discuss reasons why the losses may be occurring. [7]
- (iii) Outline the actions that management can take to reduce the losses on this product. [4]
- [Total 17]

**4** A general insurance company specialises in domestic property insurance covering both buildings and contents. The company is considering various methods of controlling risks.

- (i) Discuss the factors that the company should consider before deciding on an appropriate risk transfer programme. [7]
- (ii) Discuss methods other than reinsurance which the company could use to control risks. [6]
- (iii) List the advantages that these methods have compared to a reinsurance programme. [4]

The company is part of a large multinational organisation that has a number of business units that are either similar general insurance companies, life insurance companies or investment companies.

- (iv) Discuss two approaches to managing the aggregation of risk arising from the multinational organisation's various enterprises. [4]
- [Total 21]

**5** A large multinational corporation runs chains of fast food restaurants. Currently the corporation only operates in developed countries.

The corporation is considering expanding its operations by setting up in a large developing country.

- (i) Outline the options that the corporation should consider in deciding how to enter this developing market. [4]
- (ii) Discuss the factors that need to be considered to assess the viability of the expansion project and to identify and analyse the significant risks involved. You do not need to consider any issues relating to financing the project. [12]
- (iii) (a) List the main approaches for mitigating the major risks of a project; and  
(b) Give one example of how each approach could be applied in this project. [6]

[Total 22]

**6** The central bank of a developed country has reduced short term interest rates.

(i) Explain why the central bank may have taken this course of action. [9]

(ii) Discuss how a reduction in short term interest rates would affect the following types of investments that are domestic to the developed country:

- Government bonds
- Corporate bonds
- Equities
- Property

[14]

[Total 23]

**END OF PAPER**

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

**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** The defined benefit scheme should select investments that are appropriate to the:

- Nature of the liabilities, usually pension on retirement with other benefits, and liabilities are generally guaranteed in terms of an index but may be related to salary and/or inflation.
- Term of the liabilities, generally long term, particularly for deferred pensions.
- Currency of the liabilities (normally domestic).
- Uncertainty of liabilities: linked to longevity for pensions in payment and future pensions.
- Liquidity requirements of the scheme.
- Sponsor's appetite for risk: generally driven by company's desire to secure benefits and manage liability; trustees may have low appetite for risk.

Subject to the considerations above, the fund should aim to maximise the overall return on the assets (considering both income and capital gains): higher returns may enable higher benefits to be paid, or lower contributions from the sponsoring employer.

It will also need to take into account the size of the scheme, its funding position, its taxation position and its rules/regulations.

*Most recognised the core bookwork and so scored quite well. However not that many developed it properly. Given the relatively high number of marks and a specific context of a defined benefit scheme, candidates should have realised elaboration was needed on the basic issues. Many just repeated the general point e.g. term is important without being specific.*

*Too many went away from strategy to look at tactical issues i.e. stock or sector selection and relative return, which was looking at it from the wrong perspective. It was fine to use particular assets to briefly illustrate the point but not as the focus of a discussion.*

**2** The fund will need to consider the following factors:

- Do they have the cash to loan?
- Is the loan appropriate to the fund's investment objectives?
- The rate of return being offered compared to the return from government and corporate bonds of similar term.
- Existing capital structure of the company.
- Whether the debt will be secured on specific assets.

- Whether this debt will be subordinate to other debt owed by the company.
- The purpose of the loan.
- The tax treatment of the loan.
- Any supervisory or regulatory issues (and whether this is allowed under the trust deed/rules) surrounding a loan of this nature. For example, is it allowed for a pension fund to lend money directly? Will the loan be admissible as an asset for regulatory purposes? Any ethical issues?
- Marketability of the loan.
- Existing holdings of corporate debt within the fund and whether this will cause a concentration of risk.
- Whether the term of the loan matches the liabilities of the fund.
- Whether fixed repayments match the liabilities or whether inflation-proofing is required.
- Cost of administering debt.
- Is it the sponsoring employer that the loan is to be made to?

A detailed analysis of the company will need to be carried out, looking at information both in the public arena such as financial statements, and also:

- Business plans
- Management/character of the company
- Product
- Outlook for the sector and the market
- Competitive position

The fund should consider whether better terms could be obtained through negotiation.

If the fund managers have insufficient knowledge, consultants should be employed to perform the analysis and negotiation. The costs of this should be considered.

*There is a section in the core reading about what to consider when making a loan – linked to the canons of lending. However, this is a situation with a specific context. Many candidates failed to tailor the general bookwork to this example and so scored relatively poorly. Some aspects of the bookwork were valid but many weren't.*

*Most candidates mentioned the management and character of the company but few considered any of the other factors involved in analysis of the company. For example, while “ability to repay” is very relevant, the real consideration is how to assess it - ability is not a fact that you could look up.*

- 3** (i) It is necessary to project items such as the revenue account and balance sheet to see the expected profits.

The results of the initial product pricing models can be combined to build a complete model of the provider's future revenue accounts. It is important in building such a model to ensure that the elements of the revenue account are self-consistent in their own right. Assumptions will be required relating to premiums, investment income, death claims, lapses etc, although it is not sufficient to project these independently. One needs to build in expense allowances, both per policy and global, depending on levels of business.

One will also need to have assumptions around the likelihood of the guarantees biting — a stochastic model may be required for this.

The model will be developed by multiplying the profit test results by the expected number of bonds to be sold in each fund in each future year. Then for each future year the number of bonds still in force from previous years needs to be added. This will then give a model that can be used to build up the expected future progress of the business as shown by the revenue accounts.

Assess the sensitivity of the outcomes to the assumptions made.

- (ii) Commission — the commission that was needed to sell the business was higher than expected.

Persistency — the lapses of the bond have been greater than expected, particularly after the 3<sup>rd</sup> year anniversary as the early exit charges are no longer applicable; this is a particular concern if the commission terms are high as the business will not have recouped its outgoings in the first 5 years  
Withdrawals — regular or partial withdrawals may have been taken which would reduce the amount of AMC that the business would have received  
Investment Returns — the risks of poor investment primarily lie with the policyholder for the equity and fixed interest fund and therefore will not have contributed to the deficit. However if the returns are lower than expected this will affect the AMC.

Mortality — this will only be an issue if the fund value at the time of death is lower than the original premium; if this is the case then higher than expected mortality would be a problem.

Guarantees biting on the guaranteed fund — if investment returns have been poor then if people have left on the anniversary the provider will have to pay the difference.

Expenses — the expense of setting up the policy was greater than expected.

Ongoing Expenses — the expense of administering the policy was greater than expected.

Inflation — if inflation is greater than expected then real returns on the AMC will be lower, and expenses higher.

Levels of business — if this is lower than expected or a different mix then the fixed cost base may not have been covered and hence contributed to the loss

- (iii) Could try and control expenses — particularly the ongoing expenses — perhaps automating processes.

Reduce the commission levels for the new business — however this may reduce the new business coming through.

Look into the lapse experience and try to retain more policies — this is particularly important as the AMC is the only way the business makes money and therefore need the policyholders to stay as long as possible.

Increase the AMC or introduce initial charge — this is likely to reduce the level of business.

Charge more AMC for the guaranteed fund or just give the guarantees on particular anniversary dates (say 5<sup>th</sup> or 10<sup>th</sup> anniversary) to pay for the extra costs of running this fund.

The guaranteed fund could invest in less risky assets (cash and fixed interest) to ensure it is always greater than the original premium paid.

Extend the early exit charges to ensure that commission and extra allocation charges are recouped.

Consider selling through different channels where lower commission could be paid to sell the business.

Stop selling the product or reduce the number of funds available.

Increase sales (perhaps by changing design) to cover fixed costs  
All of these changes need to be done with the competition in mind

*In part (i), as usual with modelling questions, most candidates did reasonably well by looking at core bookwork but not many developed the specific nuances – a description of the cashflows and the significant issues a model would need to cover in this example. The better candidates did recognise the implications of guarantees in the context of stochastic analysis, and highlighted what matters most, such as expenses.*

*Part (ii) generally was done pretty well with good discussions on expenses and withdrawals. Mortality and investment return was handled less well, the link with profit was often not made: for example, many commented that the provider carried an investment risk but didn't explain why (e.g. could be a reason for poor sales).*

*There was a wide range of marks on part (iii). The better candidates focused on specific charges, expenses and guarantees, and considered proposals for reducing lapses and*

*increasing sales (and their implications). Others just talked in generalities (review, analyse or study) or stated aspirations (improve investment management). Too many candidates talked about increasing premiums – the implication being that the benefit was being undercharged – whereas of course there is no benefit being “purchased”, just accumulated premiums.*

*Many suggested that losses were arising because the model was wrong (perhaps true). But then to say “change the model and everything will be fine” misses the point that real world actions are needed to increase revenue or reduce costs.*

- 4** (i) Stability of profits: more excess of loss protection may result in more stable results and stability of profits will affect ability to pay stable dividends

Management and shareholders' attitude to risk: the size of the company's free reserves and the extent to which these can withstand adverse large loss experience

The potential for accumulation of claims:

- Concentration — the company would want to limit the exposure it would have to any particular area so could transfer the risk of a percentage of the business
- Catastrophe — a major catastrophe would cause major losses to the provider and hence risk transfer would help mitigate the risks

Statutory solvency: how will changing the risk transfer protection impact any statutory solvency position?

Company strategy: is the company expecting to expand its business

Technical assistance: does the company need to have technical help

Market reputation: how will investors, analysts, brokers and customers react?

Security status: a counterparty with better security may charge more for the cover

Value for money of arrangements available in the market, their type and cost

- (ii) DISCOUNTED COVERS — these provide full cover without the immediate need to finance the full undiscounted liability.

INTEGRATED RISK COVERS — typically arranged between insurers and reinsurers. They can be used as a substitute for debt or equity in the investment portfolio of the original insurer. They are used to avoid buying excessive cover, to smooth results, and to lock into attractive terms.

**SECURITISATION** — this is the transfer of insurance risk to the banking and capital markets. Insurance risk is not correlated with market risk and so there is benefit to investors.

**POST LOSS FUNDING** — this guarantees that in exchange for a commitment fee funding will be provided on the occurrence of a specific loss. The funding is often on a loan on pre-arranged terms or equity.

**INSURANCE DERIVATIVES** — e.g. catastrophe or weather options

**SWAPS** — Organisations with matching, but negatively correlated risk can swap packages of risk so that each organisation has a greater risk diversification.

The company can also use the following tools to aid the management of risk:

- Improved underwriting prior to acceptance of risk – this ensures a fair price is paid for the risk.
- Improved claims control procedures – these mitigate the consequences of a risk event that has occurred and should guard against fraudulent or excessive claims. Must ensure costs do not outweigh benefits.
- Good management control systems to reduce the company's exposure to risk.

- (iii) Provision of cover might not be available  
Stabilisation of results  
Cheaper  
Tax advantages  
Greater security of payment  
Management of solvency margins  
More effective provision of risk management e.g. diversification  
As a source of capital

(iv) **First approach**

- Parent company would determine its overall risk appetite and divide this up amongst the business units.
- Just as each business unit has its own management team to run its business the business unit management team manages the risks of the business within the risk appetite they have been allocated.
- As a risk analysis involves allocation of capital to support the risks retained by each business unit this approach is likely to mean that the group is not making the best use of its capital.
- Makes no allowance for diversification.

- A crude approach to allow for diversification would be to simply allow the risk appetites allocated to the business units to add up to 130% or 150% of the group's overall risk appetite.

### **Second approach**

- Establish group risk management function as a major activity at enterprise level.
- Group can impose similar risk assessments procedures on various business units which will enable the results from various models to be combined into a risk assessment model at entity level.
- In turn this will give the group management insight into the areas with resulting undiversified risk exposures where the risks need to be transferred or capital set against them. It will also show where not enough risk has been taken on.
- This will be an important feed into the business planning and capital allocation cycles.

*Part (i) was generally poorly done with a lot of answers that talked around the issues without really getting to the circumstances of the question. There was no need for lengthy discussion about the nature of risks and how to assess them which is a bit tangential to the point here concerning controlling risks and their effects. Not many candidates looked explicitly at property factors especially when considering concentration, catastrophe and profit stability.*

*In part (ii) most candidates outlined the main options, though some became confused in detailed descriptions.*

*Part (iii) was generally well answered.*

*There was a wide range of marks on part (iv). Some did not distinguish clearly between their two proposed approaches. Only the better candidates discussed the pros and cons.*

- 5** (i) Consideration would need to be given to the scale of the operations and the vehicle to be used. The corporation could attempt to cover the whole country from the start. Alternatively, they may decide to focus on certain areas of the country. Perhaps they would concentrate on large urban areas or on areas of the country that are closer to developed countries culturally or economically.

They may decide to develop a small number of high profile flagship sites rather have a relatively large number of small sites.

They may decide to develop new sites using their own resources, i.e. an independent venture established from scratch. Alternatively, they may try to purchase a domestic company (if one exists and if allowed by regulation) that operates in their market. In this case, they will need to decide whether to maintain any existing brand names or use their own. Ultimately the aim may



be transform such operations so that they resemble operations in other countries in terms of products and management techniques.

If these options are not practical, they may decide to set-up joint ventures with local companies e.g. suppliers, retailers or property companies. This may mean that they are investing in a business rather than having total control over it.

- (ii) The factors will depend on the nature of the operations set up, since the particular risks will vary under each alternative.

However, at the heart of any option, the core issue will be to assess the factors that could have significant impact on profitability — level and volatility.

This will primarily depend on the demand for the products they intend to sell. Assuming that they intend to bring out similar products to those sold elsewhere (this is the business that they know) they need to study the suitability of those products for this market and consider how they need to be adapted.

The type of food sold may not be popular e.g. if large sections of the population are vegetarians or traditional foods have dominant positions or religion could be a factor if products from certain animals are forbidden.

There may not be the same culture of eating out that exists in developed countries, and traditional societies may have codes of behaviour that are incompatible with the corporation's normal business model. To this end, careful consideration will need to be given to the target market it may not be the same as in other countries. In particular, sections of the population with sufficient disposable income will need to be identified and targeted.

Pricing will need to take into account the level of affluence in the country and the price of alternatives. A broad decision will be needed as to whether to aim for a slightly upmarket image or to go for a cheaper mass-market policy.

Consideration will need to be given to the availability and cost of raw materials. Do they exist in the country or will they have to be imported? Can the corporation use existing suppliers or will they need to establish new relationships?

A careful analysis of other expected costs will be needed. The most significant are likely to relate to labour and property (rent or construction). The availability of a labour force with the necessary skills will be an issue.

Will also need to know whether there is any competition.

Taxation both in relation to the point of sale or on profits (especially on those taken out of the country) will be an issue.

Compliance with local regulations and customs e.g. employment or planning law and advertising could incur a cost or delays due to bureaucracy. Selling food may imply that health and safety considerations come into play.

The political situation will need to be analysed in particular the attitude to foreign companies and restrictions on their operations. A view will be needed on future stability and whether changes in regime could cause a problem.

Linked to this will be attitude of the population at large to “global” influences. Are such restaurants likely to be focal targets of popular disaffection?

If the corporation is buying an existing company, in addition to the above, a full assessment of that company including management and financial structure will be needed in order to assess a fair price to pay.

Likewise, the strength and reputation of any partners in joint ventures must be analysed. Any contracts should be thoroughly checked in relation to the legal system of the country.

It will also be necessary to consider currency risks.

- (iii) Avoid the risk — e.g. look at risky location profiles and avoid
- Reduce the risk — e.g. lower the scale
- Reduce uncertainty — e.g. thorough market research
- Transfer risk — e.g. franchising
- Insure the risk — e.g. against disruption to supplies
- Sharing risk — e.g. joint venture

*Part (i) was answered reasonably well, though some candidate duplicated their answers for part (ii)*

*In part (ii), few candidates commented on how the choice in (i) has an effect. A standard bookwork answer on risk assessment was not expected. Better candidates gave a practical discussion about actual aspects of this project that will need to be considered. But many answers lacked planning or logical structure – rather than rushing in on long questions, candidates need to assess what is important and start from the beginning and develop. The question specifically did not ask for discussion of financing and raising capital.*

*Part (iii) scored highly on average because the list was accurately produced. However, weaker candidates did not score highly on the examples, perhaps because they had not answered (ii) well so could not link back to a point they had already articulated.*

- 6** (i) Economic growth may have slowed down and the country may be in recession.

Reducing interest rates should encourage investment spending by companies especially if there is an increase in confidence. This should lead to increased employment levels. There is likely to be a lag between the timing of the investment and any increase in growth.

There should also be an increase in the level of consumer spending. This may be due to:

- increased income due to a reduction in debt servicing costs
- lower borrowing costs making borrowing more attractive
- lower savings rate making savings less attractive

This should provide growth in the short term but this may take time if consumer confidence is very low.

If interest rates are reduced, international investors will be less likely to deposit money in that country. The exchange rate will therefore be likely to fall. The lower exchange rate should increase the competitiveness of exports although the costs of any imported materials used will increase which reduce the benefit. The lower exchange rate should also increase the relative competitiveness of domestically produced goods, but will increase the costs of imports which can lead to increased inflation (supply side).

Lower real interest rates mean an increased quantity of money is demanded which is met by an increase in the money supply. This can lead to inflation. Low real interest rates can also lead to inflationary pressures by increasing demand. Inflation will need to be monitored to ensure it stays within any target range.

Interest rates may also be reduced if the rate of inflation is lower than desired or to restore confidence in the property market.

They may also be reduced to decrease the exchange rate.

There may be pressure from the government to reduce rates for political reasons.

There may be a global tendency to reduce rates and the central bank wants to keep currency/trading balance unchanged.

- (ii) **Government bonds**

The yields on short term bonds are closely related to returns on money market instruments so a reduction in short term interest rates will almost certainly boost prices of short bonds. However, investors in long bonds may interpret a cut in interest rates as a sign of monetary easing, with potentially inflationary

consequences over the longer term. So the yield on long bonds might decline by a smaller amount, or even rise.

A lower exchange rate will affect the demand from overseas investors. It will also alter the relative attractiveness of domestic and overseas bonds for local investors. This is likely to increase the price of bonds.

Index-linked bonds will be influenced by real interest rates. The reduction in short term interest rates may lead to an expectation of increased inflation or uncertainty over inflation. This is likely to increase the relative attraction of these bonds and so should increase the price.

### **Corporate bonds**

The factors affecting government bonds will also apply to corporate bonds.

If the change in interest rates is viewed as likely to lead to economic growth then this should increase corporate profitability and so reduce the risks of corporate bonds relative to government bonds. This should reduce the yield margin of corporate over government debt. The margin will also be influenced by the availability and price of government bonds.

### **Equities**

Low real interest rates should help to stimulate economic activity, increase the level of corporate profitability, and hence raise the general level of the equity market. Also, the rate of return required by investors should be lower, so the present value of the future dividends will be higher.

Any inflationary fears would tend to increase the relative level of the equity market at the expense of the bond market.

If the exchange rate weakens, exports will become more competitive but imports will be more expensive. The effect on equity markets will depend on the proportion of profits earned abroad. It will also lead to improvement of any overseas earnings in domestic currency terms.

### **Property**

Lower interest rates stimulating economic growth should lead to an increase in demand for commercial and industrial premises as levels of employment rise.

Increasing the supply of property takes time and so property prices can increase rapidly (subject to sufficient confidence).

Lower short term interest rates should reduce the cost of borrowing and this may lead to an increase in property prices.

If expectations of future inflation rise, institutional investment in property may also rise, as property has traditionally provided a good hedge against inflation.

Where overseas investors are significant purchasers of property the exchange rate will have an effect on demand levels.

*Given the topicality of part (i) and its fundamental importance, unsurprisingly most candidates scored very well and the answers were often thorough and well reasoned. The distinction between good and bad answers often related to structure and argument. The weaker candidates didn't explain or justify the jargon, and gave disjointed answers that did not cover wider issues such as politics and the international position. The stronger candidates took an issue at a time and showed how the cut would achieve the objective, in sufficient range and detail for the marks available.*

*Part (ii) was disappointing, with answers often not argued or developed fully. Some candidates tried to jump straight to prices or yields without giving the rationale. It is much easier to consider what the cut directly implies and work from that rather than working backwards from a conclusion.*

*Not that many distinguished between long and short bonds and very few considered index-linked bonds. The real assets were often dealt with better, though many looked at residential property only and didn't consider exchange rate effects. Few candidates considered changes in demand from overseas investors.*

*Some candidates confused controlling inflation with reducing it. Others created problems for themselves by drilling too far into second order effects that are hard to predict, rather than commenting on more direct consequences.*

## **END OF EXAMINERS' REPORT**

# EXAMINATION

29 September 2009 (am)

## Subject CA1 — Actuarial Risk Management

### Paper One

*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.*

<p><i>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.</i></p>
--

- 1** An insurance company is subject to state regulation. The regulator is concerned that the company's solvency capital has deteriorated and has decided to intervene in order to protect the interests of policyholders.

(i) List four actions that the regulator can take. [2]

The regulator is developing a model to project the insurer's solvency position.

(ii) State the main aspects of the company's insurance business that need to be modelled. [3]  
[Total 5]

- 2** (i) State the main conditions for:

(a) A risk to be insurable.

(b) A risk transfer to take place. [2]

A small insurance company writes a large volume of term assurance business.

(ii) State how underwriting can be used to manage risks so that the company can charge appropriate premiums. [3]

(iii) Explain why underwriting will be particularly important for this line of business. [3]  
[Total 8]

- 3** A medium-sized family-owned company manufactures a range of industrial products.

(i) Outline the main sources of the operational risks that the company may face. [4]

(ii) State the aspects of the company's activities on which an actuary could provide advice. [6]  
[Total 10]

- 4** A life insurance company in a certain country has been selling term assurances directly to policyholders via the internet for five years. The company is about to conduct an analysis of the mortality experience on this portfolio.

(i) Describe the considerations that should be taken into account when deciding how the data should be grouped. [6]

This analysis shows that the mortality experience on this portfolio is much lighter than what was allowed for in the pricing basis.

(ii) Discuss possible reasons for this. [3]

Currently, the company has different premium rates for males and females. The government of this country is about to introduce legislation banning gender discrimination in the provision of goods and services. There are no exceptions for insurance.

- (iii) Discuss the effect this legislation will have on the approach that this company uses to set premium rates. [5]

[Total 14]

**5**

A large company has sponsored a funded defined benefit scheme for many years. Benefits on retirement are in the form of pensions. The actuary to the scheme is responsible for calculating the provisions required for various purposes. Provisions are defined as the value of accrued past service liabilities in the scheme.

- (i) Outline the reasons why provisions are calculated. [5]
- (ii) Explain why different reasons for calculating the provisions may lead the actuary to use different assumptions for the relevant calculations. [5]

The scheme contains various guarantees and options. In particular, there is an option for members to exchange part of their pension at retirement for a tax-free cash sum calculated by using guaranteed conversion factors.

- (iii) Describe how the provisions should take into account any guarantees and options. [3]
- (iv) Discuss the approaches that could be taken when valuing the possible impact of the cash sum option. [3]

[Total 16]

**6**

A private investment company owned by a small number of shareholders has recently bought a large, under-performing conglomerate, which has a wide range of subsidiaries operating in many domestic industries.

The investment company financed the purchase of the conglomerate by a combination of short-term borrowing and longer-term debt in the form of corporate bonds.

- (i) Explain why the company may have chosen this approach to raising finance rather than issuing new equity. [7]
- (ii) Outline the main risks to the company associated with this method of raising finance. [4]

The investment company now wishes to dispose of about half the subsidiaries of the conglomerate. It intends to finalise the disposals within one year.

- (iii) Explain possible reasons for the nature of this program of disposals. [4]
- (iv) Discuss the criteria and methodology that the investment company should use in undertaking an analysis to determine which subsidiaries should be retained and which should be disposed of. [10]

[Total 25]



- 7** An insurance company is investigating offering kidnap and ransom insurance. Policies are to be sold to multinational companies to provide cover for certain named employees who are based in or travel to a range of countries. The cover provides protection against losses incurred by the company and its employees (or their families) in the event of an actual/attempted kidnap or hijack.

The main benefits include:

- Reimbursement of ransom.
  - Insurance against loss in transit of ransom.
  - Insurance for additional outgoings, which may arise as a result of a kidnap or hijack.
  - Payment of medical bills for actual injury or psychological care.
  - Compensation for the stress and trauma suffered by employees or their families, for example as a result of threats made.
  - Compensation for damage to property of the company or its employees.
- (i) List the information that would be requested on the proposal form to aid in underwriting the policy. [7]
- (ii) (a) Describe the conflicts of interest that could exist between any of the insurance company, the employer and the employee.
- (b) Explain how such conflicts could be reduced. [6]
- (iii) Describe how the insurer could provide assistance to its clients to help them manage or mitigate the risks covered under the policy. [9]
- [Total 22]

**END OF PAPER**

# **Subject CA1 — Actuarial Risk Management**

## **Paper One**

**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 solutions 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

- (i) Require the insurer to close to new business
  - Require it to establish a recovery plan
  - Arrange for the state to take over the insurer (nationalisation)
  - Facilitate a merger/acquisition with another insurer
  
- (ii) Estimate future premium income and claims outgo from existing business
  - Current value of surplus assets
  - Amount/timing of loan/debt repayments
  - Staff relationships and redundancies
  - Considerations on staff benefit schemes (especially if in deficit)
  - Outstanding financial obligations, unpaid tax, creditors etc.
  - New business either volumes or cash-flows from it
  - Investment strategy eg matching
  - Expenses

*In part (i), the better candidates scored well, giving succinct lists covering the main points without repetition.*

*In part (ii), too many discussed assumptions or looked solely at current solvency without looking to what may happen in the future. The better candidates looked at sources of revenue and costs as well capital issues.*

2

(i)

a. For a risk to be insurable:

- The policyholder must have an interest in the risk being insured
- A risk must be of a financially quantifiable nature.
- The amount payable in the event of a claim must bear some relationship to the financial loss.

b. For a risk transfer to take place:

- The price at which the insurer is prepared to quote must be less than the perceived cost of the risk to the prospective policyholder.

(ii) To protect from anti-selection.

To identify risks for which special terms will need to be quoted.

For substandard risks, to identify the approach (e.g. decline) or the level of the special terms to be offered.

To aid in risk classification, which helps to ensure that all risk are rated fairly.

Underwriting at the claims stage can help prevent fraudulent or excessive claims and so help ensure that claims experience does not depart too far from what was assumed in the pricing basis.

To help reduce the risk from over-insurance (via financial underwriting).

(iii) Fluctuations in mortality experience will be the most important factor affecting the profitability of this line of business. Higher than expected claim amounts could affect the solvency of the company.

This is because there is no savings element to the policy. Hence the reserves built up are relatively small since the chances of a claim under each policy are relatively low.

The amounts payable on a claim will thus be high relative to the reserves held and premiums payable. Therefore high claims will cause capital strains.

The company is small and a significant part of its business is from these policies. Hence it is unlikely to have other resources to cope with poor claims experience from its term assurance business.

Term assurance business tends to be without profits. Hence there are few margins in the premium rates to help cope with poor experience.

Likewise, this line of business tends to be very competitive causing pressure to keep premium rates low.

This company is likely to use reinsurance for this class of business. Strict underwriting may keep reinsurance premiums low.

*Parts (i) and (ii) were straightforward bookwork and many candidates scored well.*

*Part (iii) requires some application to the particular case, picking up on the key characteristics set out. Weaker candidates merely repeated their comments from (ii).*

3

- (i) Operational risks are the risks that the company may face in managing its operations.

They can arise from:

- Inadequate or failed internal processes people or systems. For example, in this case a lack of clear managerial responsibilities leading to deadlocks or succession problems.
- The dominance of a single individual (or group of individuals) in the running of the company. This is clearly relevant for a family firm where strong personalities may exist.
- Reliance on third parties to carry out tasks for the company. This company may not have the resources, for example, to employ professional legal or accounting staff.
- The impact of external events on the company's operations. For example, events that affect customers or suppliers will have knock-on consequences for this company.
- In particular, the failure to provide for mitigation against the effects of external events such as natural disasters or criminal activity (eg staff fraud).

- (ii) An actuary (with suitable expertise) could provide advice regarding identification, assessment and management of risks (in general) and in particular in this case:

- A Protection against financial losses to the company arising from employees' death or ill health in particular for key staff. They could also advise on the levels of benefits to pay to employees (or their dependants) in such circumstances.
- B Insurance protection of tangible assets or against claims for liability or business interruption (consequential loss)
- C Provision and design of benefits and remuneration packages. Both for employees and members of the family or other executives. In particular contribution rates for retirement benefit schemes.
- D Interpretation and reactions to legislation or taxation policy.
- E Managing the costs of running the company.
- F Quantification of the amount of surplus capital in the business.
- G Distribution of surplus capital
- H Investment policy, in respect of both the company's assets and the assets of any employee benefit funds

- I Raising additional capital.
- J Project appraisal.
- K Negotiations with outside parties (e.g. banks, investment managers) or liaising with other advisors.

*This should have been straightforward, if candidates applied their answers to the question. Weaker candidates overdid a few areas and so did not answer sufficiently broadly.*

4

- (i) Ideally data to be analysed should be split into homogeneous groups, for example, by age, sex, smoker status, geographical location or particular website/search engine.

As the investigation is being completed within the first 5 years, this may be within the select period and hence the data may not be representative of long-term experience.

However, where data is scarce, for example numbers of deaths at young ages, splitting data into homogenous groups may result in data groups that are too small to enable any credible analysis to be carried out.

In such cases data may need to be combined into groups which are less homogeneous, but which are large enough to be credible.

Whenever data is to be analysed there needs to be a balance between splitting the data into homogeneous groups and having sufficient data in each group to enable a credible analysis to be carried out.

The reduction of heterogeneity within the data for a group of risks makes the experience in each group more stable and characteristic of that group, and enables the data to be used more appropriately for projection purposes. This is important when monitoring mortality experience.

Any heterogeneity in data groups will serve to distort the results and can lead to setting provisions that are too big or too small and calculating premiums that are incorrect.

There is also a need to carry out sensitivity testing to check that if the data are grouped in a different way the same results are obtained.

- (ii) The company may have been conservative in setting its mortality assumption for this business as it had no previous experience of the internet market (i.e. a lack of data).

It may also have deliberately over-estimated mortality to keep business volumes low until experience became clearer

This business may be subject to a different underwriting process (e.g. only small number of strict questions) and the company may have made the wrong assumption about the effects of such practices on experience.

General population mortality may have improved over the past five years by more than anticipated in the pricing basis.

There may have been random fluctuations in the experience data

The data used for the experience analysis may have been inadequate eg the heterogeneity problems in (i) may be present).

The company may have based the pricing assumption on existing experience adjusted to allow for the different sales channel. This adjustment may have turned out to be inaccurate.

- (iii) There will be a single premium rate for males and females. Before the change, female rates would generally be cheaper than male rates

The premiums could be priced on the existing male/female split. This would lead to an increase in female rates and a decrease in male rates.

Each company in the market is likely to have a different male/female split in its existing business and so rates will vary in the market.

However, commercial pressures may in effect force the company to end up charging rates based on the industry male/female split.

For example, if the company had more males than the average, its rates would be higher and so they may have to be reduced to attract more business.

Conversely, a company with a higher proportion of females would start with a lower rate, which would attract a lot of business – in particular, males hence rates would tend to rise.

Subject to (or deliberately accepting) the problems involved in having rates that are too high, the company may take a very prudent approach so as to reduce business volumes until experience becomes clearer.

The company may need to focus on increasing the proportion of female policyholders. They may use marketing or add on additional features or try to differentiate the product in another way.

It may be necessary to introduce stricter underwriting standards (eg reject more low quality males).

Given the likely change in business mix, the impact on other rating factors will need to be considered i.e. are different men or women being attracted because of the common rates.

The company can also consider using national statistics or industry statistics from the start to give the male/female split.

The male/female split will need to be monitored very frequently to ensure that the mortality assumptions used are appropriate.

*In part (i), most candidates scored for commenting on the desirability of homogeneity, but too few explained why it is important. There was a wide variation on part (iii), with better candidates considering the competitive issues in practice.*

5

(i)

- To determine the liabilities to be shown in the company's published accounts and help to show the cost of accruing benefits (eg last years' pension cost).
- If separate reports have to be prepared for the purpose of supervision or solvency, to determine the liabilities and costs to be shown in those reports
- To disclose the overall solvency/funding position to members eg via scheme accounts.
- To determine the liabilities and costs to be shown in internal management accounts.
- For the purpose of valuing the liabilities in respect of employees involved in mergers or acquisitions.
- To compare with the existing assets of the scheme, and hence decide how to spend a surplus or correct a deficit, for example introduce benefit improvements or amend contributions.
- To set future contributions for the scheme.
- To value benefit alterations or the cost of discretionary benefits.
- To assess the implications for investment strategy.
- To assess changes in experience e.g. salary or withdrawals.
- On discontinuance or buy-out of all or part of the scheme.

(ii) Provisions are calculated for a range of different purposes. Different assumptions are appropriate for different purposes. In particular, the treatment of uncertainty will vary with the specific purpose.

The legislation governing the calculation of provisions for accounting and regulatory supervision may be different. Hence different approaches or assumptions will be required for each set of calculations.

Regulators may want provisions to be calculated with margins for prudence. This will help to ensure the solvency of the scheme.

The assumptions may be dictated by legislation or left to judgment with a requirement for disclosure of the assumptions used. Where judgement can be exercised, a range of figures may be produced to show the effects of different future experience.

This may be particularly relevant to the funding or costing discretionary benefits or other alterations where a range would be useful but a generally cautious approach may prevail.

Shareholders and potential shareholders make decisions on the basis of information in a company's accounts. It is therefore preferable (to the extent



allowed by legislation) for values to be included in the accounts that represent an actuary's "best estimate" of the future experience.

In any event, figures prepared for internal management use or for some funding calculations should be on a best estimate basis.

It may be necessary to transfer liabilities and assets from one party to another eg on a bulk transfer, a buy out or discontinuance. In such cases the values being placed on benefits and assets have a real monetary value.

It is therefore important that both the transferring and receiving parties view the terms of the transfer as being fair. This is likely to involve reference to current market conditions and investment strategy.

Different actuaries will represent each side. It is likely that each actuary will, representing their clients' interests, have different views as to the appropriate assumptions. Provisions calculated on a range of assumptions will therefore form the basis for negotiations.

(iii) In general when valuing options and guarantees a cautious approach is taken.

With options, there is a risk of selection against the scheme.

In placing a value on options when setting provisions it may be appropriate to assume the highest cost option is always exercised –this may mean the provisions are too cautious.

However the scheme rules or eligibility conditions may have been framed in such a way, that always favour one option over another. Hence the "choice" as to which option to value is easy.

With guarantees there is a risk that the guarantee will apply and so the costs will be greater than would otherwise have been the case.

The value of a financial guarantee will normally be assessed using a stochastic model. The parameters input to the model should reflect the purpose for which the results are required. For example are we looking at a best estimate or a worse case scenario?

The purpose may also drive the approach in terms of legislative requirements.

(iv) When valuing the option, assumptions will be needed as to how many retirees opt for the cash sum and how much cash (up to the maximum allowed) each chooses.

Since it may not be possible to predict whether the guarantee will be attractive in future years, a stochastic modelling approach may be needed to derive these assumptions.

If the guaranteed rate is likely to be beneficial to the retiring member (i.e. greater than the relevant annuity factor that would otherwise be used to value the pension), then the valuation should assume that all members take the maximum cash sum allowed.

If not, in theory, members will take all their benefits in the form of pension.

However, many members will prefer cash to pension irrespective of the relative values eg due to the tax treatment of pensions. Hence it may be acceptable to assume that a proportion of retirees opt for the less valuable benefit.

It may be necessary to allow for anti-selection in that the mortality experience of retirees may vary depending on the option they select.

*Parts (i) and (ii) were generally answered well, though many candidates wasted time by giving unnecessary detail (for instance on specific assumptions). Part (iii) was less well answered, with many candidates concentrating too much on the cash option, effectively answering part (iv), and others going beyond valuation/provisioning.*

## 6

- (i) Essentially, the reasons can be grouped as being due to relative cost, flexibility or control.

In an environment of low interest rates it is likely that the **cost** of short-term borrowing would be low.

Similarly, if inflation and inflationary expectations and hence expectations of future interest rates were low then longer term borrowing costs would also be low.

Alternatively, equity markets could be low so increasing the relative cost of equity capital.

In general it may be more beneficial to the existing shareholders to raise finance via borrowing than giving up part of any future growth to new shareholders i.e. they do not wish to see a dilution of earnings. Alternatively, existing shareholders may be unable or unwilling to raise funds for additional equity stakes.

In relatively benign economic conditions, financial institutions may view risks (especially short term) as being low hence they may be willing to lend a lot of money at low rates. Cheap money may be available e.g. due to Government policies.

Given the nature of the company it may have a good reputation or track record and hence a high credit rating. Given also that a lot of cash may be being raised, the company may be in a strong position to negotiate favourable borrowing terms.

It may be more tax efficient to pay interest on loans than equity dividends (or reward investors via capital gains).

Raising debt may involve lower costs/fees than raising equity.

Short-term borrowing gives the company **flexibility**. It will be relatively easy (and cheap) to adjust its borrowings (repay or raise more) as circumstances dictate. Equity capital may not be as flexible e.g. share buy-backs and new issues are complex to perform.

Similarly, the company can tailor the type of bonds it issues (income and capital proceeds) to its expected revenues but also introduce features (e.g. options) that may make re-financing easier should it be required.

The company may simply not want to cede any **control** to outside shareholders. They may have a clear strategy and strong opinions and don't want external interference e.g. appointing directors chosen by these new shareholders.

This may be particularly relevant if raising capital would require a stock exchange listing.

Such a listing may require compliance with many regulations or conventions that the company would find tiresome or costly. For example there may be rules on disclosure, corporate governance, preparing reports, holding meetings and communications.

Outside investors especially institutions may exert pressure to generate short-term results in a manner that doesn't suit the company's business model.

(ii) The general point is an inability to service the debt.

Short term borrowings are likely to be at variable rates of interest. Interest rates may rise significantly.

Similarly, if loans or bonds need to be re-financed at the end of their terms, rising interest rates will increase costs.

In particular, in times of economic uncertainty, increasing risk margins will increase borrowing costs.

There may be a mismatch between revenues and borrowing repayments for example if any disposals were delayed. This could cause cash-flow problems (borrowings must be repaid, dividends can be cut) and increase the need for short-term finance. This may lead to more volatility in earnings for shareholders.

In a downturn, revenues may fall or the prices obtained on disposals may be lower than expected. This could cause problems if coupons and redemption payments on bonds are fixed.

The company may be caught in the pincer of falling revenues but higher costs if problems in the economy are caused by higher real interest rates. Thus there is a real risk of insolvency.

Similarly, in a deflationary environment, the real cost of debt may be high if interest rates do not fall correspondingly.

The company may be expecting to squeeze value out of the conglomerate in order to service its debts. Failure to produce revenue gains or cost savings in a timely manner will cause difficulties.

It is likely that borrowings will need to be secured against some assets. Lenders may insist on security coming from existing (pre-purchase assets). This could constrain the company's operations.

Likewise, higher gearing could affect the company's credit rating, cause it to breach banking covenants and adversely affect its image or ability to conduct its operations.

If difficulties did arise, the company may be forced to swap debt for equity on unfavourable terms and lose some control over its operations.

- (iii) This is the way many private equity companies operate. In effect, they want to identify undervalued assets and make a profit by exploiting the situation either via sales or improving businesses they choose to keep.

The view is that the conglomerate will be worth more if split into its component parts compared to its value as a group.

It may be possible to find buyers for each subsidiary who would pay more than the company, in effect, did for the particular subsidiary.

The company is likely to have raised a lot of cash to fund the purchase. These debts will need to be serviced. Making profits on relatively quick disposals will reduce its borrowings fairly rapidly. Such debt may not be manageable in the longer term if the company is over-gear.

The company may need some time to make each subsidiary attractive to potential buyers hence the 1 year window. This window will also apply simply because it will take time to do all the analysis required.

They are not disposing of all of the subsidiaries. They may choose to dispose of the subsidiaries that don't fit in with their existing assets or that lead to over-concentration. In effect they will cherry-pick the subsidiaries, which they think have good long-term growth prospects perhaps due to synergies with existing businesses. Alternatively, competition regulations may force some disposals.

The existing management of the company may have skills in certain industries or types of businesses. One method of improving the conglomerate will be to bring in this expertise and new management techniques. Hence certain subsidiaries will not be suitable to be kept.

The company will not want to spread its management expertise too thinly. They will only have limited capacity to cope with new businesses. Hence part of the conglomerate will have to go.

- (iv) The main criteria will be financial.

Though other more subjective factors such as those discussed in (iii) will play an important part

The ultimate determination will depend on to what extent and how each subsidiary can enhance shareholder value.

There may be two broad reasons for disposing of a subsidiary. Either, the company can see no potential for a business and it wants to get rid of it as soon as possible. Alternatively, the company may view the business as having good long term profit potential and so be inclined to keep it but it is worth more to someone else. So they could sell it for a higher price than they value it at.

Reasons why there could be no potential include: the business or industry is in long term decline e.g. products are out of date, it doesn't fit in with other parts of the company e.g. a lack of synergy or management expertise, internal political issues such as turf wars or integrating different cultures.

In order to assess the prospects for each subsidiary the company will need to assess future profit potential and the impact on earnings (current and future) for its shareholders. A form of IRR calculation could be used. It is likely that this will be expressed in terms of say a return on capital for each subsidiary or earnings per share or EBITDA.

It is likely that the company will have targets that it uses to assess its existing businesses. Each subsidiary will have to be measured against these targets. Only those that have the potential to meet the targets will be retained.

The targets may need to be adjusted to reflect each subsidiary e.g. if the business is materially different to existing businesses.

Clearly the targets will need to take into account the cost of servicing the debt issued to fund the purchase. If the purchase is large relative to the existing business or costs are out of line with "normal" costs of capital, existing targets may be amended.

It is likely that actions will be needed to improve the prospects of many of the subsidiaries as they not be performing anywhere near their potential.

Hence many subsidiaries may fall short of their targets now but could meet them once remedial measures are taken.

Detailed business plans will need to be prepared for each subsidiary. Future costs, revenues and profits can then be estimated.

At this stage, subsidiaries that are unlikely ever to satisfy targets can be identified and prepared for sale. Ditto those subsidiaries that are clearly worth retaining.

For the more borderline cases, the targets would be reassessed once the business plan has had time to take effect as the actual effects may not be as envisaged — hence the one-year window for final decision making.

In assessing the subsidiaries, allowance needs to be made for the cost of any capital that will need to be invested under the business plan together with any existing debt in the subsidiary.

Accounting or tax treatment may play a significant part in the process.

Ultimately, the company is concerned about net earnings per share.

Subsidiaries may have revenues (or costs) e.g. from overseas that are attractive (or not) under the regime the company operates under.

The company can then put a value on each subsidiary based on future net earnings. More likely this will be in the form of a range of values under various scenarios.

It can then approach possible purchasers of the subsidiaries that are worth keeping (those that aren't will be sold anyway unless the price available is laughably low). It is probable that potential purchasers were lined up prior to the takeover and preliminary negotiations started.

The company can then consider whether it would be better to sell or retain based on offers received. It would take into account any transaction costs on such sales. Accounting and tax considerations would also apply here.

*Many candidates appeared to be intimidated by the apparent complexity and unusual scenario in this question. Better candidates related their comments to the specific issues set out in the question and structured their answers well.*

7

- (i) For each employee to be covered:
- Nationality
  - Date of birth
  - Country of residence i.e. normal work location
  - Gender
  - Specific occupation
  - Destinations the employee travels to on business or pleasure
  - Average number of trips per year and average length of stay
  - Do employees regularly travel together on trips?
  - Have there been any prior incidents including threats involving the employee?
  - Is the employee privately insured?
  - Medical history/conditions
  - Are any methods of personal security and protection adopted?
  - Does the employee have a non-minor criminal conviction?
  - Does the employee have a high profile due to their social or political activity or occupation?
  - Details of partners/children travelling/based with the employee

In addition some information will be needed for the company as a whole:

- Nature of business
- Profile of the company e.g. large , well-known, perceived as “rich”
- General security measures, policies or procedures in place
- Other relevant insurance provided for employees
- Sum insured and/or excess requested for each event (may vary by employee)

- Is the company aware of any specific threats to or prior incidents involving it or specific employees?
- Any particularly valuable property eg specialist equipment
- Or any other factors that could increase the chance of a claim?

(ii)

a. There is the conflict of interest between the insurance company and the employer.

- The insurer will seek to minimise the cost of claims. The employer will want re-assurance that claims will be paid in full.
- For example, the insurer may want to impose maximum payouts or excesses.
- And the employer may want a quick (but costly) settlement to minimise disruption.
- This is especially relevant since much of any “claim” would be initially paid by the employer and then reimbursed by the insurer.

There is the similar conflict between the insurance company and the employee.

- In that in trying to reduce the level of the claim (e.g. no ransom is paid), the well-being of the employee is jeopardised. The insurer may prefer a long period of captivity.
- There could be dispute over the interpretations of stress and trauma. The employee may expect compensation to be paid but the insurer may disagree.

There is the conflict between the employer and the employee.

- It may be in the interests of the employer to keep the claims low with regard to future premiums eg profit shares for good experience.
- This is especially the case if the policy wording is unclear or there are a lot of exclusions. For example, any negligence on the part of the employer or employee. That is, is the employer actually covered?
- Some of the benefits may be optional (see (iii)). Those that are attractive to the employee may be deemed as too costly by the employer.

There is also the issue of moral hazard particularly relating to the employer v insurance company or employee. The employer may

expect/encourage the employee to take more risks because insurance exists.

- b. Arranging the policy benefits so that a speedy resolution and payment of ransom (within reason) results in a lower claim than prolonged captivity, negotiation and expense with possible injury, death or trauma.

Clear policy wording and precise description of benefits including when they would be payable would clarify the situation. There is hence no ambiguity or confusion.

Co-operation between the insurer and the employer at all stages e.g. deciding whether to pay a ransom and how much to pay, will prevent arguments later on.

To this extent, having agreed procedures or even arbitration as part of the policy would help. For example the insurer may insist that the employer follows the advice of law enforcement agencies or politicians. If the employer went against such advice, any claim could be invalid.

- (iii) The insurer could provide or arrange for the provision of a range of services to the employer (or directly to employees).

The aim would be to reduce the chance of an incident or if an incident did occur, to control the level of a claim.

In addition, assistance could be given to help with procedures to make things run as smoothly as possible with a reduction in anxiety and unnecessary complications.

Specific features of this assistance could include:

- The provision of regular kidnap and ransom reports for various countries or regions so that clients are aware of the conditions they are exposing themselves to.
- The provision of personal security advice, and training.
- This could include booklets, courses, presentations videos, self-defence, recruiting security staff or purchasing equipment.
- Providing basic information on how to respond should an incident occur e.g. to reduce the risk of injury or increase the chances of escape.
- The provision of a help-line or text or e-mail alerts so that clients have direct and immediate access to up to date information, which can help with their personal security and avoidance of risk.
- The provision of corporate crisis management guidelines to assist the company in dealing effectively with a range of crisis. In particular how to respond quickly, liaise with relevant authorities and set up teams to manage the situation.



- The provision of practical advice to employees to help them manage in a crisis. For example how to behave towards kidnappers or cope with threats.

Similar advice could be given to families in respect of how they should respond. For example providing access to services of psychologists to provide support.

The insurer could pay for the client to use an independent consultant to provide assistance and advice. Such an expert could help with negotiation, liaising with police etc and generally help to obtain release quickly and at minimal cost.

The consultant could train staff of the employer for example in how to negotiate or with public relations. This could include access to interpreters to deal with language barriers.

The consultant may be able to co-ordinate rescue attempts or assistance in tracking down or contacting kidnappers, and the selection and training of a person designated to deliver any ransom payment, including advice on the form of the ransom and how, where and when it should be paid.

*A non-standard situation, but we had plenty of good answers that showed imagination and a practical appreciation. In part (ii), too many looked at professional conflict issues which are not the issue here. Better candidates gave broad answers rather than going into extensive details on one or two points.*

## **END OF EXAMINERS REPORT**