

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

**EXAMINERS' REPORT**

**April 2009**

**Introduction**

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

R D Muckart  
Chairman of the Board of Examiners

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## **General comments**

*As the title of the course suggests, this subject examines applications in practical situations of the core actuarial techniques and concepts. To perform well in this subject requires good general business awareness and the ability to use common sense in the situations posed, as much as learning the content of the core reading.*

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

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

*Comments for individual questions are given in the solutions that follow.*

- 1** A Futures contract involves 2 parties either of which could default and hence the need for the exchange. Credit risk arises in respect of the guarantee: if one side defaults then the exchange is liable

The exchange protects its credit exposure to participants in the futures market in several different ways.

Institutional investors, corporates and individuals who wish to effect futures transactions must have their trades cleared by members of the exchange with clearing status. Clearing status involves authorisation, having certain minimum capital and operational standards. Clearing members of the exchange must pass on at least the initial margin requirement and the variation margin calls to their clients. They can of course pass on higher margin requirements.

The exchange imposes initial margin requirements on clearing firms (and hence their clients) as part of the procedure of entering into a futures contract. Typically, the initial margin requirement would provide the exchange with sufficient capital (usually with 99.5% certainty) to weather an adverse price movement in the futures contract in the event that the client/clearing member defaulted.

The credit exposure of the client/clearing member to the exchange varies with the value of the futures contract. For example, where the client has a short futures contract on the FTSE 100 index and the index rises the client's exposure to the exchange via the clearing member increases. Variation margin is also required where the initial margin falls below a threshold specific to the contract. This provides collateral movement from the client to the exchange that varies with credit exposure of the client/clearing member to the exchange.

Price movement limits allow the exchange to suspend trading in a contract if its price moves up or down by more than set limits. Such limits allow the exchange to limit its credit exposure to clearing members/clients in the event of sudden moves in the price of the futures contract.

The margin requirements for speculators may be different to those for hedgers, as speculators may not have the underlying asset to deliver.

Exchanges usually reserve the right to increase the margin requirements if they deem it fit and to close a contract if margin is not produced.

The exchange could limit its exposure to a counterparty and/or particular contact

*Generally this was not well answered. Many candidates got the concept of margin but didn't explain it clearly or in enough detail. Better candidates distinguished clearly between initial/variation, described how margin related to risk, and explained the distinction between exchange member and ultimate client.*

- 2 (a) In the event of illness or accidental injury the insured would be provided with an income, which could be used to allow them to continue to afford to live in their home.

But:

- No income is provided for the first three months after illness or accident occurs.
- 60% of earnings may be insufficient.
- Income may not be provided even after 3 months or is terminated if the injury is not accidental, or the illness or accidental injury is not sufficiently severe to meet the conditions insured against.

- (b) On diagnosis of a permitted critical illness or on death the mortgage can be repaid using the sum assured, and the policyholder is making provision to repay the mortgage after 25 years.

But:

- There is a risk that the mortgage could not be paid if an illness or accident occurs that prevents the insured from working but that does not meet the critical illness conditions or does not result in death.
- If the policyholder becomes ill they may be unable to afford the premium.
- At the end of the policy term there is no guarantee that the maturity benefits are sufficient to repay the mortgage.

- (c) In event of death the sum assured will repay the mortgage, and in event of illness, the premiums will be paid and cover will continue.

But:

- In event of illness the insured may be unable to afford interest payments on the mortgage.
- No provision is being made to repay the mortgage after 25 years (assuming mortgage is interest only).
- The definition of ill health may be too tight.
- As the mortgage decreases then may have over-insured, if a repayment mortgage.

*By some distance, the question that most candidates scored best on. Most grasped the discuss point and so covered the “buts”, though some went too far and commented on things*

*not covered rather than clarifying what was covered. Some candidates dealt with all 3 contracts together rather than individually, leading to repetition and confusion.*

**3** There are really three possible sources for the model. The actuary could either:

- Buy a commercial modelling product.
- Use an existing model possibly after modification.
- Develop a new model.

In general, the approach used will depend on:

- The level of accuracy required.
- The expertise and resources the actuary has access to.
- Whether the model needs to be flexible so as to carry out related tasks.
- The cost of each option relative to any budget.
- Availability of data to do the task

It will also be necessary to make sure that the model is fit for the purpose for which it is being used. This is particularly relevant when a model is being purchased from an external provider or when an existing model is being reused for a different purpose. Since it may not be apparent for a while (and after some expense) that the model can't do what is required of it.

The nature of the investigation is important. Many models are available but if the task is obscure or unique, then a new model will need to be developed. In this case, it would appear that the resources to spend on the model are limited. Hence developing a new model may be too costly or time consuming.

Even though the investigation is one-off, a new model could have applications for other work either for this or other clients, which could mitigate the costs. It may be possible to sell the model to other actuaries or potential users if it is novel with a range of applications.

If the model required is unlikely to have wider applications, the actuary may take a very broad-brush approach (within the constraints of professionalism) using judgement rather than detailed modelling.

*Most candidates got the standard bookwork, but often not clearly or concisely. The focus should have been on this client and how to get a suitable model, rather than what a general model should do and discussions of deterministic v stochastic.*

- 4** Two features need to be explained. Firstly why there is a wide range of quotes. Secondly, why all the quotes are lower than the premium currently being paid.

### **Wide Range**

The policyholder specifies the type of cover. But for practical purposes this is likely to be expressed in generality eg third party, fire and theft, comprehensive etc. Within this broad categorisation, the details of each policy from each provider is likely to differ

For example, differences may exist in terms of excesses, maximum payouts, amounts and methods of determining no-claims discounts and if protected or courtesy car, unnamed driver or breakdown cover.

There will also be differences in terms, conditions and definitions (e.g. what comprehensive means) for example what is covered by liability, exclusions and how values on a claim are obtained (there may be replacement value or a current sale value view taken).

Such nuances will clearly lead to different premiums for what at first glance may seem to be the same cover.

The main reason however, could be due to different interpretations and experience of the various ratings factors.

Some companies will simply charge differently for the same exposure. Principally this may relate to age or sex of driver, location, value (or engine size) of car, occupation, annual mileage etc.

Such differential rating could be down to views on future experience (perhaps with reference to past experience) or it could result from a positive decision to target (or avoid) certain sections of the market. Some companies may see profitable niches that they can exploit. Perhaps they have expertise (e.g. lots of good data) in certain areas.

Some companies may be moving away from pricing purely on experience and taking commercial, longer-term decisions to boost (or reduce) market share in certain areas. That is they may alter profit or contingency loadings.

Some companies may be more efficient than others e.g. only sell via the internet and so have lower overheads and be able to charge less.

Some companies will have economies of scale and therefore can charge less.

Some companies may have large free reserves, which could help them to follow a more aggressive investment strategy or subsidise rates.

Some companies may be based overseas and so may have less onerous tax or regulatory regimes to comply with.

Some companies may have stricter underwriting criteria both on acceptance and claim (e.g. rejecting poor risks means less subsidy from good risks). Lower premiums may mean that the company is less willing to pay out on a claim — more investigations and hoops to jump through.

Some companies may have links to the comparison site. They may have negotiated better terms than others in ways that could reduce costs or boost volumes (e.g. commissions paid to or charged by the site provider or have their products more favourably displayed or commented on).

The payment method (e.g. annual versus monthly or paying via direct debit) may have affected the premium offered.

### **Lower than current premium**

The fall in premium rates may relate to the stage of the underwriting cycle. It could be that competition is forcing prices down as new entrants come in due to previous good profits in the sector.

There may economic or social factors contributing here. For example, in times of economic growth, there may be fewer claims (less fraud). Alternatively, tougher regulation (e.g. speed cameras) or policing and better education may cut down claims. Essentially, future experience is expected to be “better”.

The rating factors may be out of date (e.g. new information).

The current premium may have arisen through a more expensive sales channel.

Rates for new business may be more competitively priced than for renewals. A web renewal may be viewed as new business in that the policyholder is clearly shopping around. Those who renew in a more lazy way may not need encouragement to stay and so are prepared to pay more for less hassle.

The level of cover may be different. For example the car is now older and less valuable and so may cost less to insure. Alternatively, the policyholder may have altered the type of cover required from comprehensive to something cheaper.

One more year without a claim, may lead to a reduction in the premium if they haven't yet reached the maximum no claims discount.

Also, rates may be quite sensitive to age.

There may have been a data error in either year's premium.

*There was a fairly wide range of scores on this question. Very few candidates answered broadly enough to score very well, given the marks available. Many grasped one aspect e.g. change of circumstances and laboured the point with many examples, which were essentially repetition.*

*A big distinguishing factor was the approach adopted. Those who clearly distinguished between “range” and “size” tended to do best.*

- 5** (i) Under any contract, the benefit is linked to the premium by the probability of the event happening. Hence the pure benefit per premium is calculated as  $1/\text{probability}$ . This would give multiples of:  
A: 2.5, B: 3.333, C: 6.667, D: 10.0, E: 20

Allowance needs to be made for the investment return the provider could obtain on the premium prior to benefits being paid. Given the term and nature of the liability, cash would be an appropriate, low risk investment. So load all multiples up by 5%.

Allowance needs to be made for the expenses of the provider and for margins for profits and contingencies. So divide all multiples by 1.15 (say). This would give multiples of:  
A: 2.25, B: 3.0, C: 6.0, D: 9.0, E: 18

With such products, one will need to look at the market and could skew prices towards the market. Provider may also accept lower margins on parties with higher volume of business (for example, on the parties with higher chances of winning). This could give multiples of:  
A: 2.375, B: 3.25, C: 6.0, D: 8.0, E: 15

This assumes that the provider accepts the data provided by the pollsters. If they disagree or have other information not widely available, returns would be adjusted accordingly.

- (ii) The most important issue will be a clear definition of win.

This will depend on the nature of the election for example the party with the highest number of seats or votes or the party that provides the prime minister or president. Any criteria used will have to agree with those commonly accepted in the country concerned.

This will be particularly important if the election consists of more than one round. The ultimate winner rather than, say, a first round winner must be specified.

Clarification will be needed if the result is inconclusive or contested. Preferably, this should be linked to the verdict of an independent body e.g. an electoral commission. Decisions may be needed as to whether to void investments in such circumstances or have them stand for any re-run.

Clarification will also be needed if the election is postponed. Perhaps a time limit will be applied.

Procedures will need to cover drawn elections, the withdrawal or merger of parties or entry of new parties before the election.

- (iii) There are two issues: investments on parties that withdraw and investments on parties that remain. The treatment of one directly influences the treatment of the other.

Investments on withdrawing parties could be refunded. If so, the multiples on parties that remain will have to be reduced. Deductions will be needed to reflect the greater probability of victory for each remaining party. In effect, the contest has always been a three party one.

Alternatively, investments on withdrawing parties are lost. In this case, the original terms for investments on the remaining parties can stand as there is no refund on “losing” investments

- (iv) Essentially, an investor could arrange his premiums so as to guarantee a profit or no loss. For example, investing 1 on X, 1 on Z and 1.5 on Y, would return 4.0, 3.5, or 3.75 for a total outlay of 3.5. The provider could go bust.
- (v) Providers in these markets (bookmakers) can use reinsurance techniques to control and manage the risks that they face.

Bookmakers could suffer large losses as a result of certain sets of results. This would arise if profits on losing bets didn't cover losses on winning bets for one or a series of events.

Risk analysis would be carried out to analyse the net liability the bookmaker would face for each potential result (together with the current chances of adverse results arising). In cases where the bookmaker views the risks to be too great, they could make bets with other providers that in the event of an adverse result would provide returns that offset the liabilities they have to their investors.

Risks could arise from a particularly large individual stake. The bookmaker could in effect share a proportion of the risk by laying-off part of the bet with another bookmaker. This has the advantage of allowing the provider to take on large bets that their capital otherwise wouldn't allow them to write.

Other risks could arise due to the concentration of a lot of relatively small bets on the same result. For example, with major football tournaments, English bookmakers have a huge proportion of their liabilities payable on an English win. To hedge this risk, they could place bets on England with overseas bookmakers who can price on a more realistic view of the underlying probabilities (or who have similarly skewed liabilities).

There are risks relating to multiple or cumulative bets. Here a small stake could give rise to a very large payout albeit with a small chance of occurrence. The problem here is really in identifying such build ups and choosing the correct moment to hedge without losing profit potential

For small bookmakers, hedging could enable them to access the pricing, data and technological resources of larger bookmakers. They cede some profit for the use of others' expertise.

Much of the reinsurance will be done on credit. This will help with working capital and cashflow requirements since returns need to be paid to investors on demand but can be deferred on inter-industry transactions.

*Many candidates seemed to struggle to apply actuarial concepts to a "non-actuarial" situation.*

*In part (i) most candidates scored for the basic calculations, but few made the additional comments required to explain their loadings and score high marks, despite the clues in the question. Some candidates stated they were ignoring expenses/profit, which is clear but not appropriate in a practical pricing question. Some candidates seemed to think that the terms needed to offer at least a fair return to investors, rather than at least some profit for the provider.*

*In part (ii) many candidates made good points with a lot of practical awareness, often starting by asking what "win" means. Some others diverted themselves by discussing issues not relevant to the question about determining the result.*

*In part (iii), most candidates correctly stated the broad options of refund or not, though few commented on investments already made on the remaining parties.*

*Part (iv) was generally poorly answered – many looked at implicit probabilities but failed to comment on what a sum of less than 1 meant.*

*Part (v) was reasonably well answered. Weaker candidates just described types of re-insurance without applying them to this case. Better candidates tailored their points to the question – for example commenting on the need to identify outcomes with high payouts, whether or not the outcomes were perceived as high/low probability.*

**6** (i) Factors include:

- Sex: rates will need to be developed for males and females separately. Females will generally have lower risk.
- Age: rates will need to be developed by age – younger lives generally have lower risk.
- Height and weight: a measure such as BMI can be used to adjust for weight and associated risks – the higher the BMI the higher the risk.
- Lifestyle: factors such as being a member of a gym can be used to identify preferred policyholders. However the most important underwriting consideration is whether the membership is used or not. Hazardous hobbies identify less preferred policyholders.
- Smoking status: non smokers will receive lower rates as the risk of death is lower.

- Alcohol consumption: low consumption of alcohol indicates a lower risk and hence should receive lower rates.
- Employment status: occupational classes can be used to identify lower risks.
- Marital status: can be an indicator of lower mortality (i.e. married males generally lower risk).
- Address: provides an indication of affluence which also indicates lower risk.
- Individual's medical history: will indicate any specific conditions.
- Relatives' medical history: may indicate genetic/cultural predispositions.
- Sum Assured/Level of Income: provides an indication of affluence which indicates lower risk.

(iii) Could offer “discounted” lifestyle options that act to reduce the risk. Examples include:

- gym membership
- assistance with quitting smoking
- weight loss programs

Provide additional benefits

- e.g. critical illness
- other riders
- ability to extend the contract
- change type of contract (e.g. convert to savings product)

(iv) It is important to consider external factors when designing such a product, particularly as it is new to the company.

- Legislation/regulations, as the product is different to other life insurance products, the documentation provided to customers must be clear.
- State benefits; similar considerations for usual insurance products since insurance is not provided.
- Tax; subject to the same tax regulations as other insurance products.
- Accounting standards: the product will be treated the same way as other insurance under accounting standards.
- Capital adequacy and solvency: the company will need to assess its capital requirements and allow for the different underwriting requirements.
- Risk management requirements: a number of risk categories will be affected (e.g. insurance risk, underwriting risk, operational risks due to differences) and this must be allowed for in the capital calculations.

- Competitive advantage: the marketing of this product may provide a competitive advantage.
- Changing cultural and social trends that might affect the market for this product.
- Changing demographic trends might affect the market for product.
- International practice: if this product is sold in various countries experience there can be used to refine the product design.
- Care needs to be taken to ensure that cultural differences are factored into the design of the product.
- Technological changes: technology can be used to underwrite the product automatically. The internet and other facilities can be used to sell the product, although it is important to require evidence of each of the risk factors that reduce the premium payable.
- Discrimination – are there any rules that need to be considered.
- Contestability – will the initial application form be able to be checked at claim.
- Inflation – need to consider current and expected inflation rates and consider how this will be reflected in design of product.

*Apologies for mis-numbering the question parts.*

*Part (i) was generally well answered and we looked for candidates to address the context rather than simply cover standard concepts. The better candidates set the scene by showing what the scenario implied in terms of what to focus on and then gave some explanation on a range of specific rating factors. Others missed the point and looked at a pricing model i.e. expenses, investment returns, margins etc. or discussed annuities.*

*A wide range of scores on part (iii). Better candidates imaginatively suggested specific examples that made the link with reduced risk for the target market. Many candidates spent too much time on general marketability rather than on “design features”.*

*Again a wide range of scores on part (iv). The best candidates took each factor in turn, made them distinct and applied them to the specific product.*

**7** (i) Actuarial: costings/design and financial management.

Legal: drafting the documents.

Accounting: proper accounts for the arrangement.

Administration: establish procedures for accurate record-keeping and payment.

Company X and its financial backers: ensure the agreement is put into place and to understand the finances/risks of the new arrangement.

Company X's employees: ensure the new scheme meets the terms of the agreement.

Trustees will also want to ensure that the terms are met.

Regulators: ensure that the new scheme meets all the regulations.

(ii) **Specifying the Problem**

Assess the risk being taken on by the company in respect of mortality, and investment, and other areas such as disability.

The benefit structure must meet the requirement of broad comparability, but may be adapted to meet the needs of the company and its workforce, and the broad comparability requirement may only be temporary.

The design should have acceptable levels of cost/risk.

**Developing the Solution**

We can build a model to project the scheme's financial position on any statutory or other relevant funding measures, showing the contributions that will be required from the company and how the scheme will be reported in the company's accounts.

It will be necessary to make assumptions about future experience and to illustrate the sensitivity of the outcomes to the assumptions.

Discuss with the company how great is its tolerance for risk bearing in mind the other business risks that it faces, and compare this with the volatility shown by the model and consider whether/how pension risk can be laid off.

May be useful to research employees as to preferred design options and to compare with relevant competitor employers.

When developing the solution, professionalism must be considered.

### Monitoring the Experience

Compare actual experience with the expected outcomes, bearing in mind that the scheme's specific experience may not be very meaningful due to lack of data and (initially) a short experience period, but more general experience may be relevant and financial/economic conditions may have changed.

Review the appropriateness of the original benefit design accordingly considering whether the company's circumstances have changed and any trends in pension provision or the competitive position.

- (iii) Asset data at the valuation date and 2 years ago (transfer date) at market value and analysed by asset type.

Market data (including inflation and bond yields) for economic assumptions.

Membership data at the valuation date on current employees and those who have left/died/retired, with relevant data on benefit entitlements such as salary/pension and service dates, and relevant data for valuing the entitlement (assumptions) such as age and marital status.

Details of membership movements since establishment.

Details of cashflows in the period: contributions and benefit payments, any transfers in/out and investment flows, from audited accounts preferably.

- (iv) Reconcile the membership against original data, and check salary growth for those employed throughout and check benefit payments against membership movements.

Investigate any unexpected data items (such as high ages).

Spot check some individuals.

Check contributions paid against salary data, and check investment income against assets, and check asset values (especially if unaudited).

Take particular care on data not under your control (such as that provided by the sponsoring company).

*In part (i) the best answers had 6 or so distinct and important parties with a concise description of what they do. Some candidates commented on Y despite the question's instructions, and some candidates wasted time/effort with repetition (for example different versions of X's management)*

*In part (ii), disappointingly few candidates focussed their answer on benefit design. Many answers were too general and only covered the standard points without a clear application, perhaps due to an inclination to rush in rather than to plan before starting to answer.*

*Flowing from design is the risk aspect of the ACC in relation to benefits, contributions and affordability – but no detail was required on investment strategy, administration, governance, actuarial modelling, etc.*

*Most candidates scored well on part (iii). The best started from “to get surplus we need asset and liability values, hence the data we need is ...”. Too many looked at liabilities only, or just gave lists without any context/justification.*

*Part (iv) was fairly straightforward, but many candidates missed out on full marks because of repetition, not focussing on data, or not being specific.*

## **END OF EXAMINERS' REPORT**