INSTITUTE AND FACULTY OF ACTUARIES

EXAMINERS' REPORT

September 2018

Subject CA1 – Actuarial Risk Management

Paper Two

Introduction

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

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

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

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

Mike Hammer
Chair of the Board of Examiners
December 2018

A.   **General comments on the** *aims of this subject and how it is marked*

1. The aim of the Actuarial Risk Management subject is that upon successful completion, the candidate should understand strategic concepts in the management of the business activities of financial institutions and programmes, including the processes for management of the various types of risk faced, and be able to analyse the issues and formulate, justify and present plausible and appropriate solutions to business problems.

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

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

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

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

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

7. Candidates who give well-reasoned points, not in the marking schedule, are awarded marks for doing so.

B. **General comments on** *student performance in this diet of the examination*

- The standard of the answers to Paper 2 was similar to other sessions .Better candidates planned out their answers, particularly for the longer questions and were rewarded because there was less duplication in their answers and ensured they thought widely enough to score well.
- This paper was sat by 7 candidates and therefore comments in each question are based on limited information compared to other papers.
- As per previous sessions answers to the application questions were mixed in that those that were structured scored well, whereas those that weren't had problems getting sufficient depth into their answer
- It was clear that the well thought out answers had planned them better, this is a good use of reading time.
- In this diet the scoring for the exam was done out of 200 and therefore the mark scheme shows a total of 200 marks available for the paper.

C. **Pass Mark**

The Pass Mark for this exam was 60.

Solutions

Q1

(i)   In managing an investment fund, managers will often face two conflicting objectives:
    • to ensure security   [2]
    • to achieve high long-term investment returns   [2]

The first objective encourages a cautious approach, where the assets chosen follow the benchmark or target   [2]

while the second encourages a move away from the benchmark into assets that are expected to generate higher returns, although with a higher associated risk.   [3]
                             [Marks available 9, maximum 6]

(ii)   An appropriate investment policy will need to reflect the extent to which the risks of lower stability and security are to be taken on in order to aim for higher returns.
                                               [2]

This will typically involve a two-stage process:

Will need to establish an appropriate asset mix for the fund - the strategic benchmark.   [1]

This will be set taking into account the nature of the liabilities, and any representations about the structure or asset mix of the fund that have been made to investors.   [2]

Various tools can be used in setting the strategic benchmark.   [1]

The strategic (or policy) risk of the fund is the risk of poor performance of the strategic benchmark relative to the value of the liabilities.   [1]

This strategy can be implemented by the selection of one or more managers, and a decision on the appropriate level of risk that these managers should take relative to the strategic benchmark.   [2]

Within their guidelines, the investment managers have freedom over stock selection, and use their skills and research to maximise the return on the funds allocated to them. The allocation of this part of the investment risk budget is known as the active (or manager or implementation) risk.   [3]

There may also be some structural risk associated with any mismatch between the aggregate of the portfolio benchmarks and the total fund benchmark.   [1]

The overall risk is the "sum" of the active, strategic and structural risks.   [1]

Unless a scheme is very small, structural risks can be made very small, particularly if "peer group" benchmarking is avoided.   [1]
                             [Marks available 15, maximum 8]

[Total marks available 24, maximum 14]

> *(i)   Answered reasonably well*
> *(ii)   Answered poorly by most candidates.*

Q2

(i)   All corporations require working capital to function.   [1]
       This is needed to finance stock and work in progress   [1]
       Any start-up capital   [1]
       and to pay for goods and services that go into the final product before any sales
       revenue is received (new business strain).   [1]

       Financial services providers have these needs but also further requirements owing
       to the long term nature of much of this business.   [1]
       Benefits payable under an insurance policy may arise before sufficient premium
       or investment income has arisen to cover the benefit due –   [2]
       capital will therefore need to be held to cover payments in these cases. [2]

       Often the level of benefit will be uncertain   [2]
       (perhaps linked to inflation)   [1]
       so again a cushion of capital may be needed if experience does not match the
       assumptions made.   [2]
       Capital may be required to support growth plans   [1]
       Regulator may insist on the capital to ensure it can meet its long term
       requirements   [1]
                                                  [Marks available 16, maximum 8]

(i)   One approach is that a regulator might set a highly prescriptive and prudent basis
       containing margins above the best estimate of capital requirements.   [2]
       The provider would then be unlikely to hold additional capital.   [2]
       Alternatively they might require the basic provisions at a best estimate level [2]
       with the providers left to determine the additional capital needed.   [2]
       The capital may be calculated using a prescribed standard model or a company's
       internal model.   [2]
       Using a standard model has the advantage that the calculation is less complex and
       less time-consuming.   [1]
       However, using the standard model has the disadvantage that it aims to capture the
       risk profile of an average company, and approximations are made in modelling
       risks which mean that it is not necessarily appropriate to the actual companies that
       need to use it.   [2]
                                                  [Marks available 13, maximum 8]
                                           [Total marks available 29, maximum 16]

(i)   Answered reasonably well
(ii)   Answered poorly by most candidates.

Q3

(ii)   Literature provided to the customer – this could be key facts document, policy schedules, terms and conditions all given to the customer when they selected the product   [2]

(iii)

    Marketing information provided by the provider – either through literature provided to the prospective customer or the website   [2]

    Statements made by the provider - either through the above or indeed from other statements possibly made in the press   [2]

    Could have had commens from previous customers OR generally from the literature around past practice of the provider – this could have given an expectation based on past practices of the provider   [2]

    Not specific to the provider, the general market information could have indicated this was a good product – again this could have been well documented by the press.   [2]

    May have been provided financial advice through IFA's or if sold via banking product   [2]

    Advice from others   [1]

    General market literature   [1]

[Marks available 14, maximum 8]

(iv)   There may have been asymmetry of knowledge between provider and customer.   [1]

    Information asymmetry is the situation where at least one party to a transaction has relevant information which the other party or parties do not have   [1]

    In this case the provider may not have described the risks that the performance may not be a guide to the future.   [2]

    The complex and long term nature of many insurance contracts mean customers may not have understood the implications of what they were purchasing.   [3]

    The regulator may have reviewed other providers contracts and come to the conclusion they were confusing.   [2]

    The number of the complaints may warrant the regulator to insist – "no smoke without fire".   [2]

Costs and charges may have changed over the period of the policy without the member being aware (e.g. introductory discounts). [2]

The regulator may be aware that the provider has changed the investment philosophy and this may not have been communicated sufficiently. [2]

The regulator may have already done a market review. [1]

The regulator may believe that guarantees have been offered by the market generally. [1]

The regulator comes under political pressure e.g. the national Government demands action [1]

Historic failings in the sales advice process e.g. poor staff training, too much sales commission [2]

[Marks available 20, maximum 8]
[Total marks available 34, maximum 16]

(i)   *Answered reasonably well*
(ii)   *Answered reasonably well by most candidates.*

Q4

(i)   Basic requirement is that there is a reasonable volume of stable, consistent data, from which future experience and trends can be deduced.   [2]

The data ideally needs to be divided into sufficiently homogenous risk groups, according to the relevant risk factors (e.g. age, sex).   [3]

However, this has to be balanced against the danger of creating data cells that have too little data in them to be credible.   [2]

For example for benefit schemes with a small number of members, it may not be appropriate to carry out any analysis or at least the results should be recognised as being very crude.   [2]

This may also be true when events are infrequent and volatile.   [1]

For example, a benefit scheme with only young members may have many members but few deaths in service and so an analysis of the proportion of deaths may lack credibility.   [2]

In practice the level of detail in the classification of the data depends upon the volumes of data available. The volume of data will not only indicate whether or not an analysis will produce meaningful results, but it will also indicate the extent to which data can be subdivided without leading to similar problems.
     [3]

For example, if may be necessary to group data on deaths into, say, five-year age bands rather than single year bands.   [1]

As well as data on the feature being assessed, it is necessary to have data on the exposed to risk, divided into the same cell structure as the experience data. An analysis of experience is not valid unless experience and exposed to risk are matched.   [1]

Once the data have been grouped in an appropriate manner, the analysis can be performed. For statistical factors, such as mortality and withdrawal, this will involve the calculation for each age band of the number of deaths (or withdrawals) divided by the number exposed to risk of death (or withdrawal).
     [2]

The results can then be compared with the assumptions adopted to determine whether there is a significant difference and also with other relevant standard tables to determine if they appear to be more appropriate to the scheme.   [1]
     [Marks available 20, maximum 12]

(ii)   The results of an analysis of experience should not be used blindly.   [2]

Unlikely that the groups would be credible   [2]

There are only 100 members in the scheme so will be very difficult to put into suitable groups.   [2]

May be so few deaths (or even none) in a given period that you cannot treat the results as reliable.   [2]

If the experience indicates that mortality is heavy, this could be influenced by one or two deaths – any change in assumption based on this would not be advisable.   [2]

These deaths could have occurred for a number of reasons so may need to explore whether relevant to make changes to assumptions.   [1]

If all of the 100 lives are of the same age then this may be useful to compare against standard tables and then adjust for some of the experience.   [1]
                                                        [Marks available 12, maximum 8]

(iii)   May be better not to carry out the exercise and use standard tables instead. [2]

Adjust standard table to reflect known characteristics of membership e.g. by postcode or region.   [2]

Could use other schemes mortality information and group the experience such the results becomes more credible.   [2]

But occupations of the other schemes may be different so need to consider if relevant compared to standard tables.   [2]
                                                        [Marks available 8, maximum 4]
                                                        [Total marks available 40, maximum 24]

Generally answered well apart from (iii)

Q5

(i)   Fund A
         Invested in large companies with both domestic and overseas exposure   [2]
         Typically charges low fees   [1]
         Variable returns expected in excess of inflation over the 10 years but not
         guaranteed   [2]
         Real return will typically be in line with economic growth   [1]
         Income from dividends but not guaranteed   [1]

         Fund B
         Potential for higher returns than A or C but also higher volatility   [2]
         Exposed to currency risk   [1]
         Little correlation with other asset classes   [1]
         Typically charge high fees, which may erode some returns   [2]
         Relatively illiquid i.e. long lock-up period and long waiting period if the investor
         decides to divest from the fund   [2]
         Attract risk-seeking investors   [1]

         Fund C
         Matches inflation   [1]
         Typically a low-risk, secure investment   [1]
         Expect lower returns than A or C over 10 years   [1]
         Lower fees than either A or B   [1]
         Steady income flow from coupons   [1]
         Suitable for risk-averse investors   [1]
                                                    [Marks available 22, maximum 12]

(ii)   Individuals
         Recently received a lump sum e.g. inheritance   [1]
         Have a specific liability to meet in 10 years e.g. deposit for house purchase[2]
         Want to diversify their investments   [1]
         Or improve returns on existing investments   [1]
         Has lots of disposable income and/or free assets as willing to lock money away for
         10 years   [1]
         Investment savvy investors who wish to invest in hedge funds   [1]
         Investors who want real returns   [1]
                                                     [Marks available 8, maximum 4]

(iii)   For investors seeking high returns, over 10 years it's expected fund B will produce
         the highest returns, followed by fund A and then fund C   [2]

         However, the volatility increases with the higher returns, which are not guaranteed
                                                                                   [2]

         Returns also impacted by the fees charged   [1]

         Individual investors have access to investment in funds, which they may not be

able to afford to do by themselves. This is particularly the case for fund B as
hedge funds typically required a high level of up-front investment   [2]

For investors seeking inflation protection, all three funds offer this to some
degree, although only fund C will guarantee an inflation match   [2]

Should improve diversity as low correlation between different funds. However,
investors can also stay within a single asset class, if they wish   [2]

Fund C will suit investors with a specific liability to meet at the end of the 10
years, as it is low risk and matches inflation   [2]

Funds A and B are better suited to the investors with high disposable income as
they can afford to absorb any potential losses   [1]

[Marks available 14, maximum 12]

(iv)   Risks
        In most circumstances guarantee is not likely to bite as over 10 years, would
        expect most funds to beat cash   [2]
        Exposed to risk of poor returns, tail-risks   [1]
        Particularly for fund B, given its volatile returns   [1]
        Risk that short-term shocks just before the 10-year period will cause the guarantee
        to bite without the institution being able to put aside sufficient reserves   [2]
        Institution will run a stochastic model to assess the probability of the guarantee
        biting, risk that the model is incorrect and understates probabilities   [2]
        Investment strategy – they could invest some of underlying assets in cash although
        risk is that will reduce the overall expected return   [2]
        Could use 10-year zero-coupon bonds to match against this guarantee, although
        will be difficult to find and may not achieve a full hedge   [2]
        Using derivatives would help, but introduces other risks such as counterparty,
        illiquidity etc   [2]
        Impact of manager fees – should guarantee be before or after fees?   [1]
        Regulatory overview may require large reserves to be held, which is inefficient
                                                                                      [2]
        Reputational risk if guarantee cannot be honoured   [1]
        Risk that competitors will offer something similar or better   [1]
        [Marks available 19, maximum 10]
        [Total marks available 63, maximum 38]

Generally answered well apart from (iii) and (iv)

Q6

(i)   - Specify the purpose of the investigation.

[1]

– A model should parsimonious. It should capture the specific features that is the focus of the investigation to an acceptable level of detail

[2]

- Collect, group and modify data.

[2]

Choose a suitable density function for each of the variables to be modelled stochastically.   [2]
- Specify correlation between variables.   [1]
- Construct a model based on the expected cash flows.   [1]
- Check the goodness of fit is acceptable. This can be done by running a past year and comparing the model with the actual results.

[2]

- The model should be validated. For example comparing scenarios and stress tests results against more detailed deterministic models.

[3]

- Attempt to fit a different model if the first model does not fit well.

[1]

- Run the model many times, each time using a random sample from the chosen density
function(s).

[1]

- Produce a summary of the results that shows the distribution of the modelled results after many simulations have been run.

[2]

- the overall distribution of results should be validated, for example by comparing the where scenario and stress tests would rank and whether this is reasonable.
 Techniques such as comparing smoothed biting scenarios results between the stochastic and deterministic model are useful to validate the reliability of the distribution and the stochastic model   [4]

[Total 22, maximum 14]

(ii)   The credit spread gives an indication on how risky the asset. The higher the spread then generally this indicates that the bonds is more risky than with the bond of a lower spread   [4]

An investment bonds rating also gives a strong indication of the risk that a specific bond has. That is the lower the credit rating the more risky the bond is   [2]

If a bond is downgraded, that is it transitions from a higher credit rating to a lower credit rating then it means that bond is more risky from the investors perspective

[2]

This means that the investor is likely to require a higher return from the asset and hence the spread will need to increase to compensate the investor   [2]

This means there will be a correlation between the transition and the credit spread
                                                                                                          [1]

Likewise if the bonds spread has widened it gives an investor the indication that the bond is more risky. This could be market views of the asset and is before a rating agency has completed its review and therefore indicates a "downgrade" or transition into a new investment grade is likely.   [3]

That is there is a correlation between the increase in spread and the transition because of this increase in spread   [1]
                                                                                        [Total 15, Max 8]

(iii)
- The rules for the construction of the series may have changed over time. For example minimum size of issues, credit rating agency data used
                                                                                                          [2]
- For the transition data the credit rating procedures and requirements will have changed.   [2]
- For the transition data the definition of default or frequency of credit re-rating may have changed

                                                                                                          [1]
- The transition data covers a long period so will capture a larger range of economic events. However, the number and nature of issuers will have changed over time. For example in 1970 proportionately more primary and secondary industry issuers and no tertiary industry issuers. Things like company gearing ratios that affect their exposure to economic cycles change

                                                                                                          [4]
- In 2000 proportionately more issuers from US whereas in 2016 credit rating agencies expanded to credit rate across more countries and more non-US issuers   [3]
- In credit index the historical experience for the highest rating in particular are dominated by a few issuers issuing a large amount of bonds by value
                                                                                                          [2]

To measure correlations we need to compare consistent data.   [2]
There are a number of issues with the two data sets, including:
- Credit spread changes for an index will include the impact of credit rating changes. The data will therefore need to be adjusted.
                                                                                                          [2]
- Credit re-ratings are only carried out periodically, say annually, but the frequency may be changed if there has been a significant change in economic conditions or a company's financial strength, adjusting credit indices is therefore complicated and depends on subjective decisions on how to apply adjustments   [4]

- The fundamental issue with the datasets is they are inconsistent. The credit index is money weighted by issuer and the credit rating equal weight by issuer and therefore measuring the correlation between them is invalid

[4]
- A dominant money weighted issuer of bonds will have a significant impact on the movement in credit spreads, but little impact on transitions. [2]
- Many small money weighted issuers of bonds may downgrade having a significant impact on transitions but little impact on credit spread

[2]

[Total 30, Max 14]

(iv) Alternative correlations can be measured, for example measuring correlations of equity returns to credit spreads, equity volatilities to credit spreads, equity returns to credit transitions, equity volatilities to credit transitions.

[3]

There are various methods that can be used to derive an implied range for the credit spread and credit transition correlation having measured correlations to other factors such as equity returns or volatility

[2]

Rather than measuring the correlation between spreads and transitions the correlation between credit spreads with and without transitions could be measured and used as a target to solve in the model for the correlation between credit spreads and credit transitions.

[2]

In practice there it is difficult to measure a correlation because ideal credible data is not available a variety of methods will be used to support an expert judgement decision. [2]

[Marks available 9,Max 6]

(i)   Answered really well by most candidates
The rest of the question was reasonably well answered with most candidates spotting the consistency issue with the better candidates explaining what could be done.

Q7

(i) Assets will need to be chosen from those available so that their cashflows match the liability cashflows in amount, term, nature, and currency. [4]

Liability cashflows will comprise the annuity payments themselves plus renewal expenses e.g. payment costs of annuities. [3]

The annuity payments need to be projected into the future, to cover the entire period until they have run off.
The projection would not need to include future new business as this would be assumed to get matched by a similar process as being followed for existing business.
Liability projection will require assumptions on longevity and, if annuities escalate at non-fixed rates, assumptions about future increase rates e.g. inflation growth rate if annuities are inflation linked. Similarly expenses will be inflation/salary linked. [5]

A baseline/best estimate set of assumptions will initially be used to project liability cashflows. But additional capital may also need to be held to ensure continued solvency. This would require sensitivity/stress/scenario/deterministic or stochastic analysis. [4]

Once the liability cashflow projection has been made, assets can then be selected with proceeds projected to match the liability outflows.
Where there is a choice of available assets that could match, they should be selected to maximise the available rate of return, net of allowance for risk and expenses. Appropriate diversification will also need to be allowed for e.g. by credit rating. [5]

[21 available, Max 12]

(ii) The timing of the annuity payments will be uncertain, compared with asset proceeds whose timing and amount is likely to be certain. Timing of coupon receipt may not exactly match the timing of annuity payments. [3]

The term of the liabilities is likely to extend beyond the available term of redeemable fixed interest assets. But be shorter than irredeemable assets. [3]

The inflation rate of annuities may be linked to a price or salary index. Assets may not be available with proceeds linked to the same index. Or there is likely to be a more limited range of such assets in the market, again making matching more difficult. For example, few, if any, assets
Provide proceeds linked to salary growth and proceeds on real assets are often very volatile. [5]

[11 available, Max 6]

(iii) Level annuities are normally met by disinvesting the backing assets. High escalation annuities often require reinvestment of earlier asset proceeds. Uncertainty about the rate of return that might be available on future reinvestments makes the matching process more difficult. [5]

If the escalation rate is linked to an index, then again the limited availability of index linked assets again makes matching more difficult. [3]

[8 available, Max 4]

(iv)   It will need to ensure that it is allowed by regulations. Even if current regulations allow mismatching, the possibility of it being imposed in future, to protect policyholders/solvency needs to be considered. [3]

It will need to consider its available capital. Additional mismatching capital will need to be held to ensure annuity payments can continue to be made in full, when they become due, in circumstances when the proceeds from the underlying mismatched assets prove insufficient. This capital is then likely to need to be held in safer assets with a lower available return than would normally be obtainable. This additional cost of capital will be unlikely to be factored into pricing as immediate annuity markets are normally highly price sensitive.
The alternative uses of capital for the company also need to be considered. For example, it may be needed to meet new business strain or for merger/takeover activity *(credit for any reasonable example)*.

The financial strength of the company needs to be considered. Weaker financial strength will be unable to invest in certain classes (e.g. direct property). Or will be unable to achieve sufficient diversification to offset the additional risks of an unmatched approach. [4]

It will need to consider that the financial results of the business will be more volatile and difficult to explain. It will need to be confident that any financial backers would be happy with the approach and in line with risk appetite. Many investors will have low appetites for risk. They will put an ability to meet liabilities above a desire for potentially high returns. [5]

If the annuity market is competitive, insurer may want to generate higher investment returns from the unmatched stragy to charge more competitive prices. It may also look at what other competitors are doing in the market.
[3]

Overall, it will need to evaluate any alternative strategy against a benchmark of the matched position. It will need to be fairly confident that its investment profits will be greater than could be obtained from a matched strategy. There will need to be a significant enough excess return potential to compensate for the issues discussed above. It will need to consider:

* available/likely investment return on alternative assets
* how much excess return is available compared with likely increased risk/volatility
* how much more expensive the strategy is compared with a matching strategy. Likely that the alternative strategy will be more active compared with matching strategy that would be more passive. So the investment costs may be

both more frequent, but also more expensive per asset type, compared with the matching asset types
- altered tax position
- the expected return would need to be even higher to allow for the cost of capital effect described above
- extra governance to monitor the unmatched strategy, which depends on available time and resources

[11]

[26 available, Max 14]

(v)
- Different asset allocation
- Different country allocation
- The funds are actively managed, and therefore tracking error is expected
  ◦ different sector selection
  ◦ different stock selection within sectors
- Timing of cashflows (if money weighted rather than time weighted rate of return is used)
  ◦ premium income variations
  ◦ claim payment variations (longevity risk)
- Expenses/tax differ e.g. stamp duty, taxation on investment income
- Inconsistencies in the benchmark e.g.
  ◦ a change in underlying constituents
  ◦ or lag in collection and publication of data
- changes in investment style or views on outlook by investment managers
- Exchange rate differences when realising foreign investments and converting into domestic currency

[14]
[14 available, Max 8]

(vi)

- Size of charges or other deductions regularly made from assets
- Size of withdrawal penalties, or any other conditions which limit access to
- investments
- Whether investments have been made in line with stated objectives
- Any changes to the stated investment objectives since the last review
- Quality of operational procedures and audit process
- Qualification of investment personnel and training / development plans in place to maintain level of proficiency
- Staff turnover and changes to key personnel e.g.
  ◦ loss of lead investment manager
- Quality of communication, including
  ◦ responsiveness to instructions
  ◦ and accuracy / timing of investment statistics
- Any good or bad publicity surrounding the investment managers
  ◦ possibly including loss of large / key investors in the fund

[14]
[14 available, Max 8]
[Total 90 available, Max 50]

Mixed answers with well-prepared candidates scoring reasonably well, with others not making sufficient points to score well.

END OF EXAMINERS' REPORT