THE INSTITUTE OF ACTUARIES OF AUSTRALIA

INVESTMENT MANAGEMENT **2004 EXAMINATIONS**
EXAM SOLUTIONS **PAPER ONE**

MARKING GUIDE

Level of Difficulty

PAPER ONE

Question	Unit	Aims	Knowledge & Understanding	Straightforward Judgement	Complex Judgement	Total
1	1, 2	3, 5, 6	3	2	4	**9**
2	2, 7, 8	6c, 7a, 15, 17	4	10	10	**24**
3	2, 7, 8	6b,c, 15, 17	2	9	7	**18**
4	2, 8	5, 6, 16c, 17	5	6	8	**19**
5	6, 7	13b,c, 14b	5	10	7	**22**
6	1	3a,b,c, 4b	1	2	5	**8**
TOTAL			**20**	**39**	**41**	**100**

QUESTION 1 **(9 Marks)**

You are the consultant responsible for advising on the investment strategy of a closed defined benefit scheme. The scheme provides for both lump sum and pension benefits. In recent years, pension liabilities have increased significantly in proportion to total liabilities and now represent 50% of total liabilities. The Trustees have adopted one investment strategy for the defined benefit scheme. The current strategy is detailed in the table below.

Class	Allocation (%)
Australian shares	25
International shares	20
Listed property	15
Australian bonds	15
Inflation linked bonds	20
Cash	5
Total	100

(a) Comment on the current strategy of the scheme and the suitability of the allocations. **(3 marks)**

(b) One of the Trustees has suggested that you consider income-generating assets for the scheme, given the significance of pension liabilities. In light of the observations in (a) and given the comments by the Trustee, recommend any changes (if any) you would make to the investment strategy and identify any issues you would need to highlight with respect to each change. **(4 marks)**

(c) It has been brought to your attention that the pension benefits include reversionary pensions, making the term of the liabilities longer than what you initially anticipated. Comment on how this may influence your advice in part (b). **(2 marks)**

QUESTION 1: SOLUTION **(9 marks)**

(a)

The ‘correct’ asset allocation obviously needs to have reference to several factors, including:

- The fund’s liability profile i.e. currently likely to be cash flow positive, the contributions plus investment income being able to service the cash flow requirements of the pension payments. At some point in the future, however, this will change and investments will have to be redeemed.
- The level of solvency in the fund.

- The financial state and the level of risk aversion of the employer sponsor.
- The extent to which the fund's liabilities, in particular pensions, are inflation linked.

Assuming a reasonably healthy and not too risk averse financial sponsor, the current allocation is not unreasonable. The growth / income asset split of 60% / 40% is probably in line with most defined benefit funds.

The exposure to listed property assets is one feature that does stand out as a little higher than one might generally expect. Again, however, given the relatively high proportion of liabilities due to pensions having a higher proportion of the growth assets invested in lower volatility property (relative to equities) is reasonable.

Even with 50% of the liabilities relating to pension liabilities, this split is likely to be within the acceptable range for such a fund.

Marking guide:

- 2 marks for additional factors that need to be considered (½ mark each including liability profile, solvency position, employer's funding policy, whether liabilities inflation linked)
- 1 mark for saying whether 60/40 is appropriate (1/2 mark for saying yes, ½ mark for reason)
- bonus ½ mark on comment for LPT allocation being on high side
- 3 marks maximum.

(b)

The asset allocation changes that I would recommend would not be immediate, but rather that, over time, the allocation needs to be changed to reflect the 'maturing' of the liabilities.

The Trustee's suggestion is indeed a good one, in that as the liabilities become more certain, investing more in income generating assets such as bonds and inflation linked bonds at the expense of equities makes sense.

Given that the liabilities will all (I will assume) be Australian dollar denominated, I would suggest that this increased allocation to income oriented assets should first be at the expense of international shares.

Issues that would need to be addressed in making these changes would include:

- Optimising the transitions when they occur, being mindful of:
  - Transaction costs
  - Taxes might be brought forward (capital gains tax)
  - Market impact might be an issue if the fund is large or if it has some large holdings relative to the liquidity in certain securities

- Increasing the allocation to bonds etc is often predicated on duration matching strategies for the pension liabilities. This may be hard to implement in practice
- Given the relative dearth of long dated bonds available in this market. Moving from equities to bonds alone could introduce a 'duration risk' of sorts if one naively buys bonds of relatively short durations (e.g. in line with the UBS Composite index).
- Buying inflation linked bonds in the future may also prove difficult given the Commonwealth Government ceasing to be an issuer in this market.

Marking guide:

- Liability profile is the key!!! Also depends on employer objectives and contribution policy (whether they are trying to match/immunise liabilities or reduce contribution levels) these 2 points should be compulsory and each account for at least 1 mark!
- 1 mark for maintaining or reducing the growth allocation, with reasons.
- Limitations of ILS and nominal bond market (½ mark each).
- Also accept answers discussing merits of global nominal bonds or ILS (US TIPs), transition costs.
- Maximum of 4 marks.

(c)

This change has increased our prima facie exposure to pure interest rate risk if pensions are not indexed and inflation risk if pensions are indexed.

We are faced with some difficult choices here, namely:

- The duration of liabilities is higher, but
- We cannot hope to match them in terms of interest rate risk – nor in terms of eradicating inflation risk if it exists using the inflation-linked market.

In short, we now have even less hope of obtaining a matched portfolio than before - if that had been our intention.

We also face higher longevity risks than before.

The lengthening of our liability profile then suggests that we use the best matching assets available to us. Given the complete lack of good matching assets, we might choose to stick with our current strategy (60/40 split) a little longer. Another alternative might be to redeem funds from equities as originally intended but to invest the proceeds in property instead for some period of time.

Marking guide:

- 1 mark for recognising it increases duration.
- 1 mark for suggesting increasing equities allocation or longer dated bonds /ILS (if available).

- 1 mark for longevity risk, and discussion of inflation and interest rate risk exposures.
- Maximum of 2 marks.

QUESTION 2 **(24 Marks)**

You work in the product development team of a large Australian bank. About nine months ago, the bank launched a reverse mortgage product after some consultation with your department. The main features of this product are as follows:

- **The product is available to persons who are 65 years old or older who own their own home.**

- **Purchasers of this product (borrowers) enter into a loan and receive a payment from the bank, taken as either a lump sum, a stream of smaller payments, or both. This payment is commonly used for daily living expenses, home repairs, medical bills and travel.**

- **The main features of the loan are as follows:**

  - **The maximum amount that can be drawn down by borrowers is a function of their age and is based on a sliding scale. For 65-69 year olds, it is 25% of the value of their home. For 80+ year olds the proportion is 35%.**

  - **Interest is accrued monthly at the following rate:**

    = Residential Borrowing Rate + 1.0% pa.

  - **Fees include an establishment fee, a biennial property valuation fee and a monthly loan service fee. The latter two fees are payable in advance.**

  - **Repayment takes place on the first of a) the sale of the home, b) the borrower moving out of their home, or c) the borrower dying (in the case of a couple, when the last remaining borrower dies).**

  - **Generally, the loan will be repaid from sale of the home. If the proceeds of this sale do not meet the loan balance, the bank wears the loss. Any excess on sale of the home over the loan balance is repaid to borrowers or their specified associates.**

  - **Alternatively, the borrowers or their associates can repay the loan directly, in which case the home need not be sold.**

  - **There are no penalties for early repayment (either in part or in full).**

The product was marketed as a way for senior citizens to "tap into the equity of their own home" to either enhance or preserve their quality of life and maintain their independence.

(a) List the advantages and disadvantages of such a product to borrowers.
(3 marks)

(b) From the bank's perspective:

(ii) List the advantages of such a product. (1 mark)

(iii) List the disadvantages (or risks) of such a product and state, with reasons, which you consider to be the most important. (4 marks)

Recently, new players have entered the reverse mortgage market and allow a larger amount to be borrowed for effectively the same rate as that charged by your bank. The reason for this is that the initial launch of your product was rushed. As a consequence, the product was conservatively designed. The little testing that was done rationalised that the adopted interest rate, along with the relatively low borrowing limits, would suffice to cover the entire risk of the product.

The bank is now worried that if the product is not made more competitive, market share will be lost. Your manager, the head of product development, has also pointed out to you that, at present, no reserve for risk is set aside. Instead, the bank realises all profit on a cash flow basis. Within the bank, you have close acquaintances in the quantitative arm of the risk management department. They can provide you with simulated Bank Bill Swap (BBSW) rates and property appreciation rates from the bank's sophisticated risk management engine.

(c) Draft a discussion paper for the bank that addresses the above mentioned concerns and, specifically, takes into account the following:

- **The different approaches you could take.**
- **How you would apply a model (if any).**
- **The broad features of any modelling you might undertake.**
- **The type of sensitivity testing that you might undertake in order to assist in making a decision on adequate methods of risk control.**
- **The type of risk management measures that might be implemented.**

(Hint: consider product optimisation as a resolution between offering the highest possible loan to home value and ensuring a positive risk management outcome.) (16 marks)

QUESTION 2: SOLUTION **(24 Marks)**

(a)

Advantages:

- Older age owners can access funds without having to sell their house immediately.
- Preserves or enhances quality of life.
- Maintain independence without having to rely on relatives or friends for income.
- People are living longer and there are likely to be circumstances where superannuation is insufficient.
- The loan repayment is capped at the value of the home at the time of repayment.

Disadvantages:

- Borrowers may not appropriately budget or completely understand the impact of the loan on their assets/spending as the product is complex. Therefore, the product may be purchased inappropriately.
- Reduces the amount available as an inheritance.
- Can potentially be divisive for families as the family home is wrapped up in emotional issues and competing interests of different generations.
- If borrowers need to move to a residential aged care facility, there will be a reduced amount available to fund this.
- Borrowers may not properly understand the consequences of interest rates over the longer term, especially in the current climate of low interest rates (i.e. exposes the borrower's estate to interest rate risk).
- If borrowers are thinking of moving house they will be unable to do so when the loan exceeds the value of the property, unless they can fund the shortfall (i.e. reduces flexibility).
- The payment received from the bank could have an impact on pension payments.

(½ a mark for each point, subject to a maximum of 1½ marks for each of the advantages and disadvantages. Maximum of 3 marks.)

(b)

(i)

Advantages are detailed below:

- The bank is likely to share in first player advantage as this is a relatively new product (with only two banks and one credit union offering this product in the early part of 2004).
- Establish market share and keep up with competitors.
- Tap into the market potential of retired or soon to retire baby boomers (i.e. a growing market).

(½ a mark for each point, subject to a maximum of 1 mark.)

(b)

(ii)

Disadvantages are detailed below:

- Interest rate risk. This refers to the situation where interest rates rise such that the loan balance exceeds the home value on repayment.
- Property appreciation risk. This refers to the situation where the home value appreciates at a relatively low rate such that the loan balance exceeds the home value on repayment.

(1 mark for each of the above.)

- Reputation risk. This might manifest itself as current affair style television shows with images of bank officers throwing pensioners out of their homes.
- The current low interest rate environment, coupled with the generally overvalued property market, is likely to lead to a fall in property values when interest rates eventually increase. This will exacerbate the risk of the loan balance exceeding the home value on repayment.
- Mortality risk. This refers to an overall decline or improvement in mortality (in conjunction with a particular gap between interest rates and property appreciation rates) such that the loan balance exceeds the home value on repayment.
- Mobility risk. This refers to an overall increase or decrease in the rate of movement of borrowers out of their home (in conjunction with a particular gap between interest rates and property appreciation rates) such that the loan balance exceeds the home value on repayment.

(½ a mark for each of the above, subject to a maximum of 1 mark. Bonus ½ mark for stating that the current low interest rate environment may very likely lead to a general decline in property values when interest rates eventually increase.)

Interest rate risk and property appreciation risk are deemed to be the most important risks as they affect the extent to which the difference between the home value and the loan balance either shrinks (potentially becoming negative) or grows. Mortality and mobility risk are not as important as they only affect the timing of repayment.

(½ a mark for recognising that interest rate and property appreciation risk as the most important risks and ½ a mark for stating why this is the case. Bonus ½ mark for stating why mortality and mobility risk are not as important.)

(Maximum of 4 marks in total)

(c)

(A broad answer framework is detailed in the table below. Candidate answers need not follow this framework but for full marks, sections must be logical and follow a logical development.)

Section in Report	General Topic Covered	Points that Might be Mentioned	Guideline for Markers
Introduction	Background and re-iteration of main issues.	• Competition has prompted greater scrutiny of our reverse mortgage product. • Our product was conservatively priced with lower borrowing limits at each age. • Therefore, conduct a more scientific study for the purpose of increasing borrowing limits, in conjunction with appropriate risk management measures. • Note that any modelling results will be used to assist decision making but ultimate decision will require judgement.	½ mark per point subject to a maximum of 2 marks.
Broad Approaches	Discuss potential approaches, recommend one of these and provide reasons behind the recommendation.	• Potential approaches are do nothing, buy reinsurance, enter into a swap agreement or set aside money for a risk reserve. • Under the do nothing approach, profits are realised initially and a provision is made for bad loans as and when they occur. This approach does not address our manager's concern. • Purchasing reinsurance for the product is an option (currently adopted in New Zealand) but this essentially transfers management of the product to the reinsurer. This does not answer the question. • Swaps may be entered into where the uncertain series of cash flows are swapped for pre-defined payments. This option may be costly and if any products are available, they may not adequately cover the term of the product. • Ultimately, the most feasible solution is to use a portion of the interest rate charged on the product to set up a "Risk Reserve". The premise, then, is to provide the highest Loan to home Value Ratio (LVR = Loan / Value of Home) while ensuring that the Risk Reserve remains positive. The portion of the interest rate that provides for the Risk Reserve will be referred to as the Risk Margin.	1 mark per point subject to a maximum of 3 marks.

Key Modelling Features (of Adopted Risk Management Approach)	Main aspects to be modelled.	• Basic description of impact of product interest versus property appreciation rate and what we are solving for (the LVR and the Risk Reserve). See the formulae and the associated wording in the sample answer below. • Could use an optimiser to solve for Risk Margin by maximizing the LVR with the constraint that the Risk Reserve exceeds zero for all t. • Risk Reserve rolls up at a lower (more conservative) rate. • Mortality and mobility. • Treatment of BBSW and property appreciation rate data. • Incorporation of fees paid by the borrower and expenses incurred by the bank. • Timing and amount of loan repayments. • Subsequent redraws. • Discount rate on profits. • Timing of repayment.	For the first point, 1 mark. For remaining points, 1 mark per point subject to a maximum of 5 marks.
Applying the Model		• Simple model at various ages. • Assumption of average home value. • Assumption on mortality and mobility. • Expand to study of portfolio that broadly replicates existing portfolio. • Add new business to current portfolio. • Consider realism of marketing department's new business projections.	½ mark per point subject to a maximum of 3 marks.
Sensitivity Testing and Risk Management		Sensitivity testing: • Consider something like 50th, 5th and 95th percentile of results based on risk management/quants division projection. (1 mark) • Consider variety of different BBSW and property appreciation rates (separately and together) and calculate present value (PV) of the Risk Reserve. Pattern should be decreasing PV for increasing BBSW and vice versa for property appreciation rates. (1 mark) • Also conduct similar runs on mortality and mobility but note impact on PV not likely to be as dramatic. (½ a mark) Risk management: • Set lower LVRs than those indicated. (½ a mark) • LVRs will increase into older ages. Consider a cap for these given the short duration likely before	Marks are indicated on left and subject to a maximum of 2 marks for sensitivity testing and 1 mark for risk management (not including the bonus ½ a mark).

		repayment. (½ a mark) • Ensure annual reviews of product but note that market conditions may not permit an increase in the Risk Margin on new or existing loans. (½ a mark) • We are in a period of rising interest rates, along with a purported property bubble. The former can lead to a property crash with significant falls in property values. (Bonus ½ a mark) Therefore, run the model assuming a 10% to 20% fall in property values immediately after loans have been provided. (½ a mark)	
Total Marks (Bonus Marks)			**16 (½)**

(The total marks available for the question proper tallies to 16 marks (and ½ a bonus mark). Marks should also be awarded for language and structure. As a guide, ½ a mark should be awarded for writing something down, 1 to 1½ marks should be awarded, depending on the quality of the English, for a coherent argument not in a report structure, and 2 marks should be awarded for a coherent argument in a report format. In the latter two cases, a bonus ½ mark should be awarded for conciseness.)

(A sample answer is provided below. All of the points listed in the table above are discussed. Given time requirements, it is not expected that candidates will provide as complete an answer.)

Introduction

This discussion paper is being prepared in response to the increasing competitive pressure against our reverse mortgage product which, on initial release, was conservatively priced with lower borrowing limits at each age than those being offered by competitors. The main aim of this paper is to suggest various approaches that might be taken to assist in increasing borrowing limits, in conjunction with appropriate risk management measures.

It is noted at the outset that any modelling results that derive from this paper will be used to assist in decision making. However, any final decisions taken will require judgment to be exercised.

The paper first details broad approaches that might be adopted in tackling the above problem and recommends, with reasons, one of these approaches. From here, a broad modelling approach is discussed, along with how this model may be applied. Finally, sensitivity testing and risk management are discussed.

Broad Approaches

The various approaches that might be adopted are listed below:

- Do nothing.
- Buy reinsurance.
- Enter into a swap agreement.
- Set aside money for a risk reserve.

Each of these are discussed below.

Do Nothing

Under this approach profits are realized initially and a provision is made for bad loans as and when they occur. This approach does not address the issue of a lack of a risk reserve.

Purchase Reinsurance

Although an option (currently adopted in New Zealand), this approach essentially transfers management of the product to the reinsurer. Currently management have not expressed a desire to exit this product so this is not an option.

Enter into a Swap Agreement

Under this approach the uncertain series of cash flows are swapped for pre-defined payments. This option may be costly and if any products are available, they may not adequately cover the term of the product. Hence, this is not considered a feasible option.

Set Aside Money for a Risk Reserve (the Recommended Approach)

Ultimately, the most feasible solution is to use a portion of the interest rate charged on the product to set up a 'Risk Reserve'. The premise, then, is to provide the highest Loan to home Value Ratio (LVR) while ensuring that the Risk Reserve remains positive. The portion of the interest rate that provides for the Risk Reserve will be referred to as the Risk Margin.

We detail below a broad modelling framework for establishing a Risk Reserve.

Key Modelling Features

The key drivers of the product are detailed in the formulae below:

Definitions
L(t) = Loan value at time t.
L(0) = V(0) x LoanToValueRatio.
V(t) = Value of home at time t.
PB(t) = Product Balance at time t.

RR*(t) = Risk Reserve at time t prior to meeting any strain (when L(t) > V(t) at repayment).
RR (t) = Risk Reserve at time t after meeting strain.

Critical Formulae
PB(t+1) = V(t) x (1 + PropertyAppreciation)
– L(t) x (1 + InterestOnLoan - RiskMargin),

where InterestOnLoan is a function of the BBSW rate and a variety of administration and expense margins.

RR*(t) = [RR(t-1) + L(t) x RiskMargin] x (1 + CashRate).

The following comments are made with respect to the above:

- Essentially what we would like to achieve is the highest possible LVR while ensuring that the Risk Reserve is positive (by varying the Risk Margin charged in the product interest rate) after all obligations for the last policy in a portfolio have been expended. Ultimately, competitive pressure will also apply to the Risk Margin as borrowers also assess the competitiveness of the interest rate, in addition to the amount able to be borrowed.
- In relation to the above, we could use an optimiser to solve for the Risk Margin by maximizing the LVR with the constraint that the Risk Reserve exceeds zero for all t.
- Note that the Risk Reserve has been assumed to roll up at a conservative rate as it is a contingency margin.
- I have ignored mortality and mobility (when a borrower moves out of their home) to make the example easier. In reality, the loan is payable on either movement (i.e. PB as detailed above is realised). This is also the point at which the Risk Reserve may be called upon (i.e. a point of 'strain' in the definitions above).
- The property appreciation rates and BBSW rates can either be simulated (and can be provided to us by the risk management department) or can be set deterministically. A deterministic approach is favoured initially for simplicity. However, the simulated BBSW and property appreciation rate pairings should be analysed (to determine the 50th percentile, 5th percentile and 95th percentile for example) for meaningful plug-in values.
- Fees paid by the borrower and expenses incurred by us can also be incorporated.
- A profile of early partial repayment can also be modelled.
- Subsequent redraws can also be modelled but for simplicity can be assumed to be nil since property values are more likely to fall at present.
- A discount rate on profits should be based on the bank's internal rate of return.
- Repayment of the loan is assumed to take place six months after movement and can incorporate selling fees.

Applying the Model

The model may be applied in stages from simple to more sophisticated, with the worth of each stage analysed before progressing to the next. These are detailed below:

Simple Model

- This would consist of a study of the product at individual ages.
- An average home value based on the bank's average home value for older age members might be adopted for simplicity.
- Similarly, older age loan holders may be analysed to determine a suitable mortality and mobility rate.

Replicate Existing Portfolio

- This might consist of a number of loans in five year age bands that broadly mimic the existing portfolio.
- The overall average home value might be retained or average home values for each band might be adopted if it is known that there are significant differences between bands.
- Similarly, mortality and mobility rates might be varied at each of the bands.

Consider New Business Entering the Portfolio

- This might be hypothetical or based on marketing forecasts. In the case of the latter, the realism of such forecasts needs to be considered.

Sensitivity Testing and Risk Management

Given the framework described above, some sensitivity tests are detailed below:

- As mentioned above, consider various percentiles for BBSW and property appreciation rates to establish a likely range for results.
- In addition, consider a stepped series of BBSW and property appreciation rates (separately and together) and calculate the present value (PV) of the Risk Reserve. The pattern should show a decreasing PV for an increasing BBSW and vice versa for property appreciation rates.
- Also, conduct similar runs on mortality and mobility. It is noted, however, that the impact of these is not likely to be as dramatic.

The following risk management suggestions are provided with the aim of ensuring a positive PV of the Risk Reserve:

- Set lower maximum LVRs than those indicated by the modelling.
- LVRs will increase into older ages due to a decrease in the duration of the policy. Consider a cap for these at, say, the 90+ age.
- Ensure annual reviews of the product. It is noted, though, that market conditions may not permit an increase in the Risk Margin on new or existing loans.

- We are in a period of rising interest rates, along with a purported property bubble. The former can lead to a property crash with significant falls in property values. Therefore, run the model assuming a 10% to 20% fall in property values immediately after all loans have been provided.

QUESTION 3 **(18 Marks)**

Having recently passed your final actuarial exam you have been promoted to manage the asset liability function for Rock Solid Australian Life Company (a newly publicly listed company on the ASX).

On your first day in the position, your manager (who is not an actuary) calls you into his office for an urgent meeting. Apparently those annoying investment analysts have been questioning the earnings guidance given by senior management and the share price of Rock Solid has been under pressure. As such, your manager is keen to improve profitability. However, he emphatically states that "if they sack any more people, I'm going to have to make my own coffee". Consequently, cost cutting is not an option.

After some thought, your manager has come up with a 'great idea'. Clearly the margins earned on the annuity portfolio are far too low, and the opposition are selling significantly more volume than we are because we are not at the top of the league tables. So, why back annuities with bonds and earn small margins, when you can back them with equities and improve margins instantly, even after increasing returns for customers (which will presumably sell more product). Clearly lifetime annuities represent long term liabilities and as such you should back them with a long term asset such as equities. After all, some competitors are using property to back annuities! Furthermore, your manager reminds you that the company broker has said that equities look like good value now.

Your manager demands a report for the board by tomorrow to support the idea – there is an analyst briefing and it would be very handy to give them some good news for a change.

(a) Set out a covering letter to your manager on your initial thoughts about his 'great idea', including the merits of such actions, the consequences (short and long term), the positives and negatives, and your responsibilities as an actuary. (10 marks)

(b) Set out the process you would undertake to support your views with hard data, how you would go about determining the inputs, modelling the key variables to be studied, scenarios to be tested, final output and any other factors you think important to consider. (8 marks)

QUESTION 3: SOLUTION **(18 marks)**

(a)

(1 mark) for presentation, i.e. in appropriate letter format.

The letter should include:

- A definite view on the proposal (1 mark)

- A discussion of regulatory requirements.
- The option for a compromise position, ie backing short term cash flows with bonds and the longer term liabilities with equities (or other long dated investments) (1 mark)
- A discussion about cash flow constraints eg the need to match cash flows. (1 mark)
- Capital considerations, eg the size of the capital requirement (½ mark), the requirement for an adequate return on that capital (½ mark) and the sources of that capital (1 mark).
- The profit implications, in particular the volatility of earnings this approach would bring (1 mark). Furthermore the implications for this on the share price of the firm (eg a volatility discount would be added by the market) (1 mark).
- Shorter term gains may be more than offset by longer term capital losses (1 mark).
- As an actuary you need to consider the equity between policyholders and generations of policyholders (1 mark), and you have a long term responsibility for the fund meeting its liabilities when they fall due (not just a short term profit focus) (1 mark).
- Answer should comment on boss' remark and distinguish between current market value of equities relative to historical/equilibrium vs long term structural difference between equities and bonds (Equity risk premium).
- Comment on appropriateness of property (listed vs unlisted)? (1 bonus mark)

Looking for a structured answer to the issue, so will award marks for other points as long as they are well thought out and practically applicable.

(Maximum of 10 marks)

(b)

The process should include a long term modelling exercise of the annuity fund, including both the assets and liabilities of the fund.

The process should include:

- the projection of the liabilities for the fund of the lifetime of an annuity product (1 mark).
- the projection of the assets of the fund under various scenarios (1 mark) eg backed 100% by bonds (½ mark), backed 100% by equities (½ mark), and a number of scenarios involving a combination of the 2 classes (½ mark) (it may include other asset classes to be complete).
- The projections should take into account the cash flow match/mis-match of the fund (½ mark).
- Capital requirements of the fund should also be modelled (½ mark) as well as the profit implications (½ mark).
- The asset returns can be generated under various scenarios in either a deterministic manner (pre defined to highlight certain outcomes), or in a

stochastic manner to highlight real world volatility and unpredictability (2 marks).

- The final output would ideally be a distribution of outcomes for profitability, cash flow and solvency/capital adequacy. (1 mark)

An extra mark may be given for an explanation of how the asset returns are generated/sourced.

(Maximum of 8 marks)

QUESTION 4 **(19 Marks)**

You have recently been appointed as the asset consultant to the Trustee Board of an endowment trust that awards scholarships to talented actuarial students. Until recently, the trust was solely focused on scholarships to students attending Australian universities, and all assets were conservatively invested in short term Australian bonds.

A recent contribution from a wealthy Asian based structured finance actuary has expanded the potential activities of the trust immensely. The charter of the trust is now being extended to provide for scholarships to selected undergraduate students across the entire Asia Pacific Region.

The aim is that each scholarship should fund the selected student's full tuition costs, plus a modest living allowance to enable them to pursue their studies.

The current assets of the trust are now of the order of A$120million. The intention is to have a steady state of 200 students on scholarship at any one time, each receiving an annual scholarship of A$30,000 (indexed to CPI inflation). Once a student is awarded a scholarship, they are guaranteed this funding for the duration of a 4-year actuarial education, subject to satisfactory performance in their studies.

The Trustee has come to you for advice as to how they might change the configuration of the trust in light of their changed circumstances, and has raised the possibility of seeking a full asset-liability study.

(a) Discuss the key issues that you would need to consider as part of a broad asset-liability investigation for the trust. In your answer you should outline any further information you would request from the Trustee about the trust and its proposed activities. (8 marks)

(b) What are the issues involved with investing the trust in a combination of Australian, Asian and global <u>bond</u> managers? In your answer you should discuss your recommended portfolio structure, including the allocations to Australian and global bonds, nominal or inflation linked securities, active or passive approaches, government or credit rated securities. You should also discuss how you would select a bond manager and what sources of value added you would pursue. (6 marks)

(c) How would your answer to (b) change if the trust invested in a combination of Australian, Asian and global <u>equity</u> managers? (5 marks)

QUESTION 4: SOLUTION **(19 Marks)**

(a)

The key issues that any asset-liability study should address will include:

Information should be sought from the Trustee primarily in respect of the nature of the liabilities and the risk tolerance of the Trustees. This information would be used as an input to setting the level of investment risk appropriate to the trust. The principal questions would include:

- Level of risk aversion? What are their risk and reward constraints? Can they tolerate negative returns in any one year?
- Potential future income sources. What other sources of income other than investment income might they have at their disposal?
- Time horizon. What is the time frame over which the trust is investing? Is the trust meant to continue in perpetuity?
- Currency. In what countries – and hence currencies – would the trust consider awarding scholarships? What are the projected amounts in each currency?
- Is the trust a taxable entity? Do the tax arrangements applying to the trust provide for any favouring of certain asset classes over others (prima facie)?

Given the Trustees' views on how the liabilities will be constituted, and their level of risk tolerance, consideration can now be given to the specific asset-liability issues arising. In particular, one should consider:

Inflation risk

- The long term inflation risk is unusual. They are exposed to inflation across several different countries, and also the inflation is largely related to tuition costs, which may significantly diverge from general inflation.
- There are not many inflation-linked instruments that will necessarily assist in terms of across the Asian region (Australia included). This may well just be a risk that the trust has to substantially wear.
- Depending on the countries chosen, the currency risk might be difficult to manage. Some of the currencies are pegged to the US dollar, and hence subject to 'event risk'. Some of these are also relatively illiquid. Hedging forward may well be difficult or expensive.

Cash flow projections and matching strategies

- Once a student is awarded a scholarship on a four year basis, the next few years payments in that currency are relatively well defined (inflation risk aside). Some thought should be given to the possibility of hedging these known cash flows in terms of duration and currency once they are known.

Available matching assets

- If strict currency matching is to be adopted, there may be serious constraints on the investments available, given that some of the countries in the region have financial markets that are relatively immature. Some balance may need to be made between the benefits of currency matching and the appropriateness of the available investments.
- In particular, finding suitable assets that provide a good inflation hedge is likely to prove challenging – even in Australia.
- If equities are used, could the trust use a smoothing/reserving mechanism when allocating trusts available for scholarships in each year?

Event risk

- Given that many Asia Pacific economies are developing rapidly, there could be an argument that they are subject to greater event risk (although the developed economies of the Western world have given them a run for their money in recent years). Such possibilities for extreme downturns in financial markets need to be considered when setting asset allocations in this situation in particular, as the Trustee might feel that have an even greater moral obligation to assist students in the region in times of economic downturn.

(1 mark per point, maximum of 8 marks)

(b)

The merits of investing across a range of Australian, Asian and global bond managers would include:

- This would allow some degree of matching of asset and liabilities across currencies.
- It would provide diversification across different asset classes, good diversification across different credit markets and reduced country risk.

Assuming that the Trustee wished to pursue a relatively low-risk portfolio, I would recommend a portfolio split by currency / geography that roughly reflects the balance between (i) the desire for currency matching between the assets and liabilities and (ii) investment in the more developed asset markets. In respect of each of the three allocations mentioned (Australian, Asian and global) bonds, I would recommend the following:

For the portfolios invested in Australian and global bonds

- Passive management to be employed. This would be cheaper than active management and provide no active performance risk in what can be difficult markets in which to outperform.
- Currency to be hedged back to the preferred profile, as discussed above (i.e. no active currency bets).
- Some credit risk is permissible given the large spread of investments across securities and jurisdictions. Investments in investment grade credits only.
- Exposure to inflation-linked securities would be recommended where practicable, but as noted above, finding such securities with the “right” inflation linkages is likely to be very difficult (e.g. the ability of US TIP’s to protect against Asian inflation is somewhat dubious).

For the Asian component of the bond portfolio, active management with a view to protecting capital is reasonable. Some credit risk is reasonable, but again all investments should be investment grade or above.

Given the size of the trust, a standalone portfolio will not be reasonable for this portfolio. Hence a pooled trusts strategy will have to be employed.

(1 mark per point, maximum of 6 marks)

(c)

Introducing equities would involve a considerable increase in operational complexity. As would international equities. Many of the economies that we are dealing with are emerging economies, which are exposed to exogenous shocks. Hence, investing in their equity markets may not be a reasonable approach given the likely risk aversion of the trustee.

Hence, if we were to move to equity investments in these markets, likely changes in the portfolio configuration might include:

- A higher than otherwise exposure to American and Australian securities to keep the investment risk to appropriate levels.
- Active management rather than passive management could be employed in all three sectors of the portfolio. A more conservative mandate that required the manager to consider carefully the capital stability of the portfolio. This might create a bias towards value managers, and require the Trustee to be aware that the trust could underperform materially in persistent bull markets.

Again, pooled products would be required due to the size of the trust.

(1 mark per point, maximum of 5 marks)

QUESTION 5 **(22 Marks)**

You are the asset consultant to a superannuation fund of a large Australian company (XYZ) which is listed on the Australian Stock Exchange. The assets invested by the Fund are greater than $2 billion and the fund has in excess of 10,000 members. The Fund has historically offered defined benefits and accumulation accounts with interest style crediting rates and limited investment choice. Investment options offered to members have been branded "XYZ Super Fund" conservative and "XYZ Super Fund" balanced options. The Fund has been administered by a small team of staff employed by the company.

The company has decided to upgrade the features of the fund to include a competitive range of investment options with well recognised brand names to enable members to implement their own investment strategies. These investment options are detailed in the table below.

Provider	Type of Option Provided
Citibloc	Australian Socially Responsible Shares
MAP Hinderson	Balanced Growth
Imperial First State	High Growth
Credit Sheesh	Cash
Merry Lynch	Overseas Shares
Flaming-Green Abbott	Balanced Pooled Super Trust

(a) For each of the options recommended in the table above, suggest, with reasons, appropriate benchmarks to apply in reviewing performance.

(6 marks)

(b) Disparities between the performance of the options and underlying benchmarks will need to be explained to members and their advisers. Write a report to the Trustee covering the points detailed below:

- **Identify sources of tracking error that the Trustee should be concerned about.**
- **Which of these sources are the responsibility of the Trustee and why is it important to minimise these?**
- **How can the Trustee minimise tracking error from these sources?**
- **Which of these sources are the responsibility of the fund manager and why is it important to manage these?**
- **How do fund managers manage tracking error from these sources?**

(10 marks)

(c) One of the Trustees is very concerned about press reports from the US about the late trading and market timing scandal.

(i) Explain what is meant by late trading and market timing and the impact this activity could have on members. (2 marks)

(ii) How can the Trustee ensure that these activities do not occur in this fund?
(2 marks)

(iii) Using a simple example explain how the use of buy sell margins can reduce tracking error and reduce the incentive to engage in late trading.
(2 marks)

QUESTION 5: SOLUTION **(22 marks)**

(a)

Reasonable benchmarks for each of the suggested offerings could be as follows:

Provider	**Type of Option Provided**	**Benchmark**
Citibloc	Australian Socially Responsible Shares	ASX 200 (Accumulation)
MAP Hinderson	Balanced Growth	Median balanced manager returns, or a theoretical composite fund based on the performances of the relevant underlying indices, adjusted for fees and taxes as appropriate (refer comments below)
Imperial First State	High Growth	Median growth manager returns, or a theoretical composite fund based on the performances of the relevant underlying indices, adjusted for fees and taxes as appropriate (refer comments below)
Credit Sheesh	Cash	UBS Bank Bill index
Merry Lynch	Overseas Shares	MSCI Accumulation International Shares index, unhedged
Flaming-Green Abbott	Balanced Pooled Super Trust	Median balanced manager returns, or a theoretical composite fund based on the performances of the relevant underlying indices, adjusted for fees and taxes as appropriate (refer comments below)

One might also want to take into account issues such as the style bias of the manager, e.g. might it be better to use or construct value and growth indices for examining the performance of the manager.

Care would also need to be taken to ensure that one was comparing like with like. For instance, where a median balanced fund result was being used, one would need to make sure that the results used were before fees, and that the benchmark and the fund result were both comparable in terms of being either pre or post tax.

Marking guide:

- ½ mark for identifying benchmark, ½ mark for reasons, bonus mark for pointing out broadmarket vs style/more specific benchmarks as reasons for balanced, high growth and PST are similar - median manager in peer universe or weighted composite of asset class benchmarks.
- answer should explain why either is appropriate/has limitations.

(b)

The student's answer should be in report format. The following points should be made:

- Trustee should have policies and procedures in place for risk control and monitoring of operational and administrative issues.
- Functions delegated to managers should also include feedback/reporting loops, eg compliance reports on portfolio holdings vs mandates, RMS updates/reviews, etc.
- The sources of tracking error that the Trustee should be concerned about would include that due to stock selection and asset allocation bets, timing of investments and redemptions and style drift (where applicable).
- The sources of tracking error that are the responsibility of the Trustee to minimise would include those due to poor administration (e.g. contributions not being forwarded on promptly enough) and unit pricing mistakes.
- How the Trustee would go about minimising tracking error from sources under its control by auditing its processes for forwarding on contributions and setting unit prices. Errors are almost inevitable in respect of unit pricing, and it is important that any errors are picked up quickly before they become large issues.
- Most fund managers will have quantitative people and processes to monitor tracking error on a prospective basis, e.g. using Barra tools. An active manager might be just as concerned about having too little tracking error as too much.

2 marks for each point above (maximum of 10 marks). 1 mark for other relevant points.

(c)

(i)

The practice of late trading and market timing involves investors in products exploiting differences between the value of a fund's underlying assets and the unit prices at which they can buy or sell units in the product. These differences will typically arise from delays in setting unit prices after markets have closed.

An example will illustrate. Suppose that the current unit price is $100. If markets have fallen 5% over the course of the day, but the unit price at which investors can redeem their funds has not been updated to reflect this, they could redeem their units in the fund for the $100 unit price, despite the fact that there is only $95 worth of assets to back each $100 of units. The following day when the unit price is updated to $95 (actually this should be less to reflect the hit taken in respect of late trading), they can reinvest their redeemed $100 in return for a full $100 of units. In short, they have preserved their capital despite the market fall – at the expense of other unitholders in the pool who will have been diluted. Effectively, this leads to inequity between members. (2 marks)

(ii)

There are various means at the Trustees disposal to ensure that these activities do not occur in its fund. These include:

- Incorporating a buy / sell spread in its unit prices. This reduces the profitability of late trading, and also the probability of this occurring by requiring a larger market move for such trading to be profitable.
- Beyond this, having effective unit pricing systems that allow for up to date unit pricing (linked to market values) is a good start.
- Further, rules requiring that the unit prices used for new investments and redemptions should be based on end of day valuations and such investments / redemptions should be processed at this price. (2 marks)

(iii)

By incorporating a buy / sell spread of 0.5%, for instance, the Trustee can reduce the risk as follows. The size of the daily market movement required to make the late trading profitable is greater than 0.5%. Given the risk involved (i.e. getting caught in what may be an illegal practice), for such a practice to be considered worthwhile might be necessary for the daily move to be considerably more than this. To put this in perspective, assuming a volatility of the underlying portfolio of 10%, the standard deviation of the average daily move would be of the order of 0.63%. Hence the opportunities for worthwhile profit might still present themselves reasonably often – but far less often than without the buy / sell spread.

Further, the existence of the buy / sell spread will reduce the tracking error of the fund to the extent that it helps to fund the transaction costs associated with investing new monies in or selling the underlying assets. (2 marks)

QUESTION 6 **(8 Marks)**

You work as a risk management specialist with an understanding of the issues impacting investment markets. A listed property trust (LPT) manager has approached you in this capacity. The manager is looking to secure a deal in which a third party buys approximately $0.5 billion of LPT shares. However, this purchase will also involve the provision of a Revenue Guarantee by the manager in which the initial capital value of the shares is guaranteed in 10 years time.

The LPT manager has requested that you estimate the premium to be charged to the third party for the provision of the Revenue Guarantee. The manager has also requested that you use Monte Carlo simulation and expects the use of a Black-Scholes approach or a variation on this.

You mention this exercise to a friend of yours who works as an independent consulting actuary in the area of derivatives and derivative transactions. She informs you that this exercise is unusual and there are unlikely to be any players in the market who are capable of providing rigorous advice in this area. She goes on to say that, due to the lengthy term of the contract (10 years), rigorous advice is likely to be spurious. She has agreed to undertake the options modelling work.

(a) Outline the broad nature of the transaction which the LPT manager is hoping to implement. (1 mark)

(b) Elaborate on the 'spurious' nature of any advice as indicated by your consulting actuary colleague in the context of a Black-Scholes framework. Suggest a broad approach that you might take given these drawbacks. (3 marks)

(c) You speak to the manager in relation to the points you have outlined in part (b) above. They are aware of these weaknesses and point out that this was the reason why they constrained your fees for this exercise. They are keen for you to approach the task in the fashion that they originally recommended.

You have been assigned the task of setting assumptions for key parameters. Detail these key parameters and any particular considerations you will need to make in setting these. (4 marks)

QUESTION 6: SOLUTION **(8 marks)**

(a)

- The Revenue Guarantee is an option (or derivative) contract.
- In particular, it is like selling a put option over the shares with a strike price of $0.5 billion.

(½ a mark for each point above, subject to a maximum of 1 mark.)

(b)

(Marks are indicated below in brackets and are subject to a maximum of 2 marks.)

- The Black-Scholes approach (or a variation thereon) is subject to reduced accuracy over a 10 year projection period. The main concern is the sensibility of a normal distribution assumption over this term (1 mark).
- In addition, and very importantly, the risk free growth rate on the contract is likely to be violated due to the very conceivable likelihood of there being no short-selling, especially given the size of the ($0.5 billion) exposure (1 mark).
- Also, property values are likely to move to some extent in cycles. This is unlikely to be encapsulated in conventional modelling (½ mark).
- Lastly, conventional modelling will result in widening confidence bands over the term of the projection but stock prices will exhibit some degree of mean reversion (½ mark).

(Given the above points, students should suggest a scenario testing approach over and above trying to construct precise answers.)

- Given the above points, a range of premiums for a variety of different assumptions is a more sensible way of tackling this task (1 mark).

(c)

Key parameters are detailed below:

- Estimate the past volatility of price on the LPT shares.
- In addition, and as a check, do the same on an appropriate property index.
- Derive an assumption for growth above the risk free rate.
- Derive an assumption for the dividend yield.

(½ a mark for each point subject to a maximum of 2 marks.)

Particular considerations that need to be made in setting assumptions are detailed below:

(Marks are indicated in brackets subject to a maximum of 2 marks.)

- When setting parameter values, consider a range of historical time periods (e.g. 5, 10 and 15 years) to get a feel for the volatility on these (½ marks).
- In addition to historical estimates, consider forecasts of the key parameters given that historical rates are not necessarily a good indicator of the future (½ marks).
- Also, keep in mind the not infrequent meltdown in property markets (e.g. the early 90's) and the prospect of this occurring at present given the over heated nature of property markets and the likelihood of interest rate increases (1 mark).

END OF PAPER ONE SOLUTIONS