THE INSTITUTE OF ACTUARIES OF AUSTRALIA

INVESTMENT MANAGEMENT **2003 EXAMINATIONS**
EXAM SOLUTIONS **PAPER TWO**

MARKING GUIDE

Level of Difficulty

PAPER TWO

Question	Syllabus Aims	Unit	Knowledge & Understanding	Straightforward Judgement	Complex Judgement	Total
1	14	7	2	5	10	**17**
2	12, 13	5, 6	9			**9**
3	2, 13, 14	1, 6, 7		4	6	**10**
4	12, 17	5, 8		10	10	**20**
5	3, 4, 11, 15, 17	1, 5, 7, 8	4	6	10	**20**
6	9, 11, 15, 17	3, 5, 6, 8	6	12	6	**24**
TOTAL			**21**	**37**	**42**	**100**

QUESTION 1 **(17 marks)**

The asset consulting firm that you work for has been asked to perform due diligence on a US based funds manager, The Pursuit of Alpha ("TPOA"), on behalf of an Australian superannuation fund client. TPOA has an enviable track record of performance in respect of US equities over the last two years, but is relatively new to the management of global equity portfolios.

The Chief Investment Officer is a rather confident fellow, and finishes the meeting by suggesting that he is "Mr Alpha", obviously a reference to his belief in his team's ability to consistently deliver outperformance.

The mandate that the client is considering giving to TPOA is a global equities mandate.

Manager performance vs S&P 500 (US) index for TPOA's US Equities Portfolio

Month	S&P500 performance	Manager performance	Excess return
1	0.5%	0.5%	0.0%
2	-11.0%	-20.0%	-9.0%
3	8.6%	12.0%	3.4%
4	5.7%	8.5%	2.8%
5	-6.0%	-3.3%	2.7%
6	-2.7%	0.0%	2.7%
7	-1.7%	-1.9%	-0.2%
8	0.8%	0.9%	0.1%
9	8.1%	8.9%	0.8%
10	5.1%	5.6%	0.5%
11	1.1%	1.2%	0.1%
12	2.5%	2.7%	0.2%
12 month return	9.6%	12.0%	2.4%
Volatility	20.0%	28.3%	11.2%

Results period	S&P500 performance	Manager performance	Excess return
Last 3 years	-11.3%	-9.0%	2.3%
Last 2 years	-9.2%	-9.2%	0.0%
Last year	9.6%	12.0%	2.4%

(a) The tables above provide summary information relating to TPOA's performance relative to its benchmark index over several periods. Based on this data, what further questions would you put to TPOA?

Further, outline the quantitative tests that you would apply to more closely examine TPOA's claims to be able to consistently add value within risk limits. Explain how you would use each test in assessing the merits of TPOA.

(10 marks)

(b) What qualitative filters would you apply to TPOA's historic performance to assess its suitability for your client? Explain how each of these filters might be used in your assessment. Outline any areas of concern that you would need to evaluate before you would be comfortable in recommending TPOA to your client. (7 marks)

QUESTION 1: SOLUTION (17 marks)

(a)

The first point to note is that the information provided is not by any means sufficient to form meaningful judgements in respect of the manager. (1 mark)

<u>Further questions</u>

The data, does, however, highlight a couple of issues:

- In month 2, the manager suffered significant underperformance. What was the cause of this underperformance?
- What were the principal "bets" or positions that gave rise to the outperformance over the three year period?
- The manager's outperformance was achieved at a cost of additional portfolio volatility. Is this likely to be a consistent feature of their future performance?
- The manager has performed well in both rising and falling markets – do they expect to outperform in both rising and falling markets in general, or does their style preclude this in the general case?

(1 mark per valid point, to a maximum of 4 marks)

The quantitative tests that I would apply once further data had been provided would include:

- Sharpe ratio. This ratio can help to distinguish investment skill from luck.
- Tracking error. Tracking error calculations are required to determine the amount of relative risk taken by the manager.
- Style bias tests. The performance of the manager could be compared to a relevant index that accounts for style (e.g. Russell Value and Growth indices). Such tests are required to determine whether the manager's performance is consistent with their stated style, i.e. has the manager been true to label? Further, it can help to distinguish how much of their relative outperformance (in this case) is due purely to the manager's style and how much can be accounted for by their application of their process.
- Measures of portfolio concentration might also be calculated. How concentrated was the portfolio? What were the sizes and risk associated with these bets? BARRA risk measures might be calculated for the historic portfolios.
- Measures of portfolio turnover. While gross of tax and transaction cost returns might look impressive, the turnover levels of portfolio and the costs associated with this level of turnover need to be examined due to their potential impact on returns net of costs and taxes.

- Measures of risk for the client's total portfolio if this manager was added. This would help us to see how this manager might complement the other equity managers in the portfolio.
- Attribution analysis. An attribution analysis might be required if the manager is permitted to hold a certain percentage of the portfolio in cash.

(5 marks)

(b)

The primary qualitative issues to consider are:

- Ability to manage a global equities portfolio is a real concern – do they have the necessary resources to manage a portfolio
- Risk controls. What are the manager's systems and processes to control relative and absolute risk?
- Is there a sufficient period of data with which to assess the manager's performance? How did the investment managers perform at their previous employers?
- The financial stability of the funds management organization.
- Seniority of the team. How much experience does the team have, across different markets and different types of markets?
- How stable is the team (and how stable has it been historically).
- Key person dependencies. If one or two people left, would we be faced with an immediate manager review? Who are these people? What incentives do they have to stay with the organization (from contractual inducements to equity in the business)?
- The culture of the manager. A certain arrogance is suggested by the comments above. Markets tend to humble such people sooner or later. Are we comfortable that this (perceived) arrogance will not lead them to dangerous overconfidence?
- Back office systems – are they reliable, and reliably audited?

(1 mark per valid point, to a maximum of 7 marks)

QUESTION 2 **(9 marks)**

You have recently been appointed as the asset consultant with responsibility for manager selection and monitoring for a large Australian public offer master trust.

The first task that you have been given is to pick a list of venture capital funds managers to add to the master trust's offerings. List and briefly describe the criteria you would use to select a venture capital manager.

QUESTION 2: SOLUTION **(9 marks)**

The criteria against which one might evaluate a venture capital manager should include:

1. **The credentials of the investment house**. The organization needs to be held in sufficient regard in order to secure "deal flow."
2. **Financial standing**. These investments are long term by nature. One needs to be comfortable that the company has sufficient financial backing to be able to survive over such periods.
3. **Investment team capabilities**. The team needs to have sufficient skills and experience in order to be able to perform the fundamental analysis required for private equity investments.
4. **Remuneration and incentives of key investment professionals**. Is the team sufficiently well paid to keep the risk of key staff from being poached to a reasonable level? It may be preferable for key staff to have equity in the business.
5. **Investment process**. Process regarding deal flow, evaluation, negotiating and closing deals.
6. **Ability to add value over the life of investments**. Good venture capital managers should not only be able to make good initial investments, but should be able to add value to the ongoing management of companies they invest in. This may take the form of having their staff act as company directors. They may also be able to introduce companies to persons/other companies that may be able to assist their progress. Further, the venture capital managers should be capable of knowing when and how best to exit their investments, e.g. via IPO's or trade sales.
7. **Fees**. The level of fees and the structure of these fees need to be considered. Fees should be neither too high nor too low. Further, given the focus on absolute rather than relative returns in this sector, performance fees (appropriately structured) are likely to be useful for aligning the interests of the manager and investors.
8. **Conflicts of interest**. For example, does the owner of the venture capital manager have a corporate advisory business that works on the same deals? Are there processes to manage or avoid conflicts of interest that may arise?
9. **Back office operations**. The firm will need to have good processes for monitoring its investments over extended periods.

(1 mark for each valid point, up to a maximum of 9 marks)

QUESTION 3 **(10 marks)**

You are a recently qualified actuary, and have just commenced work with a retail master trust provider. Your role involves both the preparation of literature for member communications and manager selection in respect of the managers from which your retail investors may choose.

(a) Your manager has been asked to write a short article for an upcoming newsletter on investment "style" with respect to equity investment managers. In turn, your manager has requested your help in putting together this article. Draft an explanation of the "value" and "growth" styles in relation to equity investment managers. You should also comment on whether or not it is possible for a manager to possess elements of a "value" style and a "growth" style.
(4 marks)

(b) An investment analyst at your firm notes that investment firm Dumpster Dudes Equity Management, previously known as a value manager, has started to invest in stocks that have previously been known as growth stocks. She is prepared to downgrade your rating of Dumpster's equity product on the grounds of "style drift".

- **Explain what "style drift" is and why the observation might be important.**
- **Why (without further information) might she be right?**
- **Why might she be wrong?** **(6 marks)**

QUESTION 3: SOLUTION **(10 marks)**

(a)

A "value" manager in the purest sense looks for "unloved" companies that are cheap by comparison to its earnings, cash flow or assets, and consequently looks to make money by holding the stock until its story is better recognised and is at a higher price relative to earnings, cash flow, assets. This recognition may occur via corporate takeover, or agitating for the company to be broken up. (1 mark)

A "growth" manager in the purest sense looks for companies with prospective growth in excess of that currently allowed for in the price. (1 mark)

However, in reality fund managers exhibit both value and growth style characteristics. Even value investors such as Warren Buffett are prepared, on some occasions, to invest in growth companies (for example his original investments in Coke) where such growth companies can be purchased at a reasonable price. Managers with "Growth at a Reasonable Price" approaches would typically be good examples of managers that may exhibit elements of both investment styles.
(2 marks for a view and a reasonable explanation)

(4 marks in total)

(b)

Style drift

"Style drift" refers to a manager unexpectedly changing the kinds of stocks that it purchases, for example a manager that used to focus on low P/E stocks that is now buying lots of high P/E stocks. "Style drift" is important because it suggests that the manager may no longer deliver the pattern of returns that you hired it for. For a multi-manager solution, style drift may also result in the overall manager mix having a higher volatility than anticipated relative to its benchmark index.

(½ mark per point. Maximum 1½ marks)

Note that there are some managers whose investment process will result in its assessed "style" wandering based on their rich/cheap view on the pricing of various market sectors. This is not a mortal sin as such. (1 mark)

Why might she be right?

Style drift can potentially mean (1) the manager's process has changed, (2) the manager is looking to protect what remains of its business and is no longer following its process (e.g. some value managers in the late 1990's), (3) the manager has lost faith in its process. If any of these points are true, and consequently you lose confidence in the manager's process, then that would justify the downgrading.

(½ mark per point & ½ for "lose confidence." Max 2 marks)

Why might she be wrong?

Style drift measured in a quantitative assessment should produce further investigation, as opposed to a quick downgrade. Sometimes the style drift is innocuous; for example if a manager's personnel & process are unchanged over time, its "growth" or "value" orientation as assessed by quantitative analysis will vary over time with market trends. For example, at the peak of the "dot com" boom, the TMT sector was so highly priced that traditional quantitative style analysis was substantially distorted and the non-TMT sector so ignored that Coca-Cola Amatil, usually regarded as a "growth" stock, started to look like a "value" stock. Equally, after the TMT bust in 2000, Microsoft's shares fell so much in price that the former growth stock became attractive (briefly) to some "value" managers.

(½ mark per point & ½ mark for example. Max 1½ marks)

(6 marks for part (b) in total)

QUESTION 4 **(20 marks)**

A general insurance company has long term liabilities (i.e. outstanding claims provisions) that are currently backed by fixed interest assets. As company management has become concerned about inflation risk, it is considering a proposal to redeem a <u>portion</u> of these fixed interest assets and use the proceeds to buy properties to back these liabilities.

(a) What are the issues to consider in terms of redeeming a part of the fixed interest book? (5 marks)

(b) What are the issues with using properties to back these liabilities? (5 marks)

(c) Instead of buying properties directly, suppose that the general insurance company buys units in a trust. The trust in turn uses these proceeds and external debt to buy properties on a geared basis. The net rental less debt repayments and expenses are distributed to the general insurance company and then used to fund the claims as they arise.

i) What are the unique issues created by this structure? (5 marks)

ii) What would be the ideal characteristics of property and debt (including the principal contractual arrangements for each) to make this structure work? (5 marks)

QUESTION 4: SOLUTION **(20 marks)**

(a)

[Note to markers: marks should be awarded for a discussion, not just for a listing of points.]

The key issues are the changes made to total portfolio risk, transaction costs and market impact. They include:

<u>Duration/convexity matching considerations</u>

The duration/convexity implied of the fixed interest book as it currently stands should be compared to the desired duration of this portfolio once we have sold down our fixed interest holdings. Consideration needs to be given to the duration/convexity of the best estimate liabilities and what measures of portfolio risk will be employed once property has been introduced to the portfolio (what is the duration of the property investment?). If property is perceived to lengthen the "duration" of the investment portfolio (ceteris paribus), we are more likely to want to reduce the duration of the fixed income assets in order to maintain a constant duration for the whole portfolio. (2 marks)

Taxation

The taxation impact of redeeming a portion of the fixed interest portfolio. Will this bring forward capital gains or losses? Are these gains/losses material? (1 mark)

Credit risk

The type of fixed interest redeemed (e.g. corporate debt) and what this will do to the overall credit rating of the portfolio. If the property investment is perceived to be increasing the risk inherent in the asset portfolio as a whole, there will be less risk budget for credit risk in the fixed income portfolio. Hence those securities within the fixed interest portfolios most likely to be sold would be those lower down the credit curve, sell the single A and BBB securities, keep the AAA and AA securities. It may also be necessary to change the investment mandate for the fixed income portfolio. (1 mark)

Timeframe / market timing

The timeframe over which fixed interest is to be redeemed. For example, is it to be staggered? A more rapid sale could have a negative impact on the sale prices achieved – especially for the less liquid fixed income securities. (1 mark)

The market into which we are redeeming in terms of interest rate expectations. If interest rates are expected to increase we want to consider the use of futures to lock in more favourable terms. (1 mark)

(1 mark per valid point, maximum of 5 marks)

(b)

The issues raised by using property to back the insurance liabilities include:

- The returns from our direct property holdings are likely to be more volatile than those for fixed interest assets. These swings in value may not be well correlated with changes in liability values. The tradeoff between obtaining an inflation hedge and the potential for additional capital volatility needs to be investigated.
- The extent to which property provides a good inflation hedge needs to be questioned. The answer may vary depending on the type of property purchased, and the nature of any associated lease arrangements (e.g. these might be linked to inflation).
- Given that we are considering direct property investments, we must also consider that we are replacing a relatively liquid asset with low transaction costs (fixed interest) with a relatively illiquid asset with large transaction costs. The importance of this will also depend on the maturity profile of the liabilities.
- This particular property investment is of a discrete size (e.g. in contrast to investments in listed property trusts). It might be difficult or expensive to sell a part of the property as the liabilities run off, or if a decision is made to reduce the holding. Problems could arise if the property were to become too large a part of

the total portfolio. Transaction costs can also be large – especially in the case of a rushed or forced sale.

- General insurers have to hold larger amounts of capital if property is used to back liabilities than if fixed interest securities are employed. This may also raise issues for the insurer – and also raise the required rate of return required on the property.
- There are the usual issues that the liabilities may be highly correlated with property, e.g. mortgage insurance. This would limit the investment in property (or even make it inappropriate).

(Maximum of 5 marks)

(c)

i)

The issues created by this structure are detailed below:

- There is likely to be interest rate correlation between the payment of interest on debt by the trust and interest rate sensitivity on the liability portfolio.
- For example, an increase in interest rates may lead to strained business conditions, prompting a business insurance policy holder to (fraudulently) claim loss of income (under a fabricated pretence). An increase in interest rates is also likely to reduce the payment received from the trust. This will inevitably lead to some friction when trying to marry the two (claim and income from trust) together.
- The level of gearing on the trust may be unacceptably high.
- The trust may not allow quick liquidation of trust holdings. This is likely to be required, especially when trust receipts are insufficient to cover claim payments.
- Trust debt may require interest to be paid on a floating rate basis. This may, to a large extent, erode any inflationary gains to be had from initially investing in property.

(Maximum of 5 marks)

ii)

There are two ideal characteristics that we would require:

- The asset purchased would improve our asset-liability matching position.
- Given that we now have a geared position, a secure investment return from the property is now even more important.

(2 marks)

Based on this, the types of things we would seek from the property and debt packages would include:

- The underlying properties would have relatively long term leases with quality, highly rated tenants to enhance the security of the underlying investments.
- The lease payments could also be linked to inflation to provide for a better match to the liabilities.
- The term of the debt should be appropriate to the term of the leases and the residual value risk of the property (how old is the property, saleability/ "re-letability" of the property at the end of the lease).
- The interest on the debt (net of interest rate hedging) should be appropriate to the structure of the lease payments. If the lease payments are fixed nominally, then fixed rate debt is more likely to be appropriate (note that this means that inflation linkages with the liabilities only come from the equity value of the property). (3 marks)

Additional points might include:

- If interest rates increase, the trust distribution is likely to increase if interest is payable on a floating basis.
- Overall, we would like to uncouple, as much as possible, the debt used to purchase property from interest rate movements. This may be achieved if debt repayments are largely on a fixed (known) basis.
- On the property side, interest rate effects are largely inescapable. These may be mitigated to some extent by having more frequent rate reviews and increasing rent under more favourable economic conditions. Generally, such conditions correspond to a higher interest rate environment (although this need not be the case, e.g. witness the late 80s when interest rates were high and the progression with such high rates into the 'recession we had to have').

(Maximum of 5 marks)

QUESTION 5 **(20 marks)**

You are the asset allocation strategist at a large Australian investment manager with A$100 billion in funds under management globally, with A$30 billion of this amount being in Australian shares. Although you have had some success with your judgement based approach, results have not had the consistency that you would have liked.

In future you have decided to use a quantitative model to assess the likely future returns (over both the short and long term) for all asset classes.

(a) Discuss the difficulties likely to be encountered in building such a model. (8 marks)

(b) What are the difficulties that you are likely to encounter in <u>implementing</u> your model's recommendations? (6 marks)

(c) After some diligent research, the Chief Investment Officer that you report to has suggested you use a variation of one of the Wilkie models (UK or Australian version) or the TY model. Outline the issues you will face in using such a model to guide tactical asset allocation decisions. (6 marks)

QUESTION 5: SOLUTION **(20 marks)**

(a)

Difficulties are detailed below:

- Data is likely to be lacking when considering a global model. This will compromise the validity of the results.
- Setting up the model framework is very likely to be complex. Determining which relationships prevail is likely to be cause for contention. For example, how economic variables relate to each other, as well as the effect that these are likely to have on the various asset classes.
- Specific geographic features, such as individual debt markets in locations as different as Hong Kong, Japan, Germany and the U.S., are likely to require a considerable amount of expertise when trying to take each of these into account.
- Trying to encapsulate structural changes in, say, a specific geographical location is likely to require coding at a later stage. This can be difficult and further exacerbate cost issues.
- Two models may be required, one for the short term and the other for the long term, as their structure may be radically different.
- Construction of the model is likely to be expensive. Off-the-shelf models (if they are available) are also likely to be expensive.
- The model will have to incorporate fee structures across the globe. This compounds the problem of keeping up to date and accurate data.
- Paramaterising such a model is a non trivial exercise. Market return data tends to be non stationary. Many would argue that such data does not even represent a

statistical series. Markets tend to go through different stages, and data from one cycle may not be especially relevant to another. (8 marks)

(b)

Implementation issues relate to the practice of putting into action the recommendations of the model. These issues may include:

- Based on relative value alone, certain shifts in the portfolio may make sense. Such changes may not be maximising portfolio returns in light of the transaction costs (brokerage, stamp duties, etc) associated with the buying and selling associated with the recommendations.
- Further, the model may not take into account that in some market circumstances its recommendations cannot be reasonably implemented. For example, in some extreme events, while certain quoted security prices may look like attractive buying or selling opportunities, there may not be sufficient liquidity to implement the necessary trades.
- The model is also not likely to take into account the market impact of such trades. The funds manager has a large portfolio in the context of the Australian market, and this is a very important factor to be considered.
- Another consideration is that the model may recommend asset allocations based on relative value that are not consistent with mandates. There will almost certainly be upper and lower restrictions on the ranges of asset allocation positions.
- The model may require tactical shifts at too rapid a frequency to be able to implement. This can be ameliorated by extending the period over which parameters are estimated.
- The model may produce results that run contrary to any one's expectations based on non modelled factors (e.g. momentum factors, the impact of short term supply and demand issues). In these situation's one is faced with the prospect of acting contrary to the model's recommendations, which raises questions about what "rules" might be set in place for deviating from the model's recommendations (or vice versa – what rules might apply before implementing the model's recommendations!).
- Frequent trading can also lead to tax problems, e.g. earlier than otherwise realisation of capital gains, the use of derivatives to move asset allocations synthetically can also run foul of the tax rules in respect of franking credits.

(1 mark per valid point, to a maximum of 6 marks)

(c)

The principal issue is that the Wilkie model is more of a model for long term returns rather than one for <u>tactical</u> asset allocation. (1 mark)

Even if the model correctly identified that various sectors were over or undervalued, reversion of market values to their true values (as identified by the model) might take too long. By the time we were proven correct, our fund may have underperformed for

an extended period. Tactical asset allocation decisions are likely to be made on a shorter time frame. (2 marks)

To use the Wilkie model without adjustments would make no allowance for potentially important factors driving asset returns over shorter time frames, such as weight of money, expectations of large IPOs. (1 mark)

Since the Wilkie model was released, several new asset classes have emerged as significant in their own right, for example the hybrid equity market, private equity, credit derivatives, asset backed securities, etc. The model might need to be updated if the manger's funds have material exposures to these assets classes. (1 mark)

One would also have to contemplate updating the parameters to allow for current market conditions, in particular the current low inflation/low interest rate environment. (1 mark)

(Maximum of 6 marks)

QUESTION 6 **(24 marks)**

XYZ Superannuation Fund is an Australian superannuation fund with 30% of its total funds allocated to fixed interest investments. Currently this entire allocation is invested in Australian fixed interest assets.

To diversify its credit risk exposure, the fund would like to invest one half of this allocation, i.e. 15% of total funds under management, in overseas fixed income markets.

While this move might help to diversify its credit risk exposures, it does raise the spectre of currency risk.

(a) Outline the advantages and disadvantages of three different currency hedging approaches, namely:
- **Completely unhedged**
- **Hedging the principal amount of the investments on a rolling 3 month basis**
- **Hedging each individual cashflow for all overseas bonds held.**

(6 marks)

(b) To analyse the impact of the above strategies in terms of the distribution of returns, the Trustee of the fund has asked you to build a stochastic model of the Australian dollar returns from investing in a portfolio of domestic and international bonds. Describe the key elements of the model you would build.

(12 marks)

(c) Having presented your concept of a stochastic return model for global bond portfolios, the Trustee has engaged you to build the model. In your presentation, however, you suggested that there are a number of issues to be wary of in interpreting the results of such modeling. The Trustee, keen to be aware of these issues before you present your final findings, has asked you to formally write to them outlining these issues (briefly). Draft a brief response to the Trustee in letter format. **(6 marks)**

QUESTION 6: SOLUTION **(24 marks)**

(a)

<u>Completely Unhedged</u>

Advantages:

- No currency management fees are incurred.
- Overseas fixed interest returns will be enhanced when the AUD is depreciating.
- It is much easier to explain than hedging strategies.

Disadvantages:

- It is likely to lead to volatile overseas returns. This will be of concern given that the class, fixed interest, generally has low volatility of returns.
- The AUD might just as equally appreciate, leading to an attrition of returns.

(2 marks)

Hedging on a Rolling 3 Month Basis

Advantages:

- Volatility of returns is reduced dramatically.
- It is much easier to implement than hedging individual cash flows.

Disadvantages:

- Fees are incurred. These may be high.
- This type of hedging is not perfect to the extent that the capital value changes over the three months. Therefore, there is still likely to be some residual volatility. (2 marks)

Hedging Individual Cash Flows

Advantages:

- This type of hedging is perfect in that all currency translations are known in advance.
- It is relatively easier to explain than the preceding hedging strategy.

Disadvantages:

- It is likely to be costly and time consuming. This is a very significant disadvantage. (2 marks)

(b)

[Note to markers: The following represents one possible structure for a solution to this question. Well structured and thought out responses should score well even if they are presented in a different format/style. The key points that the student should make involve an understanding of an appropriate model structure (yield curves and FX rates) and the types of relationships that such a model should try to capture.]

The key elements of the model are detailed below.

The model will need to be able to perform the following routine:

- Project domestic and foreign yield curves and exchange rates in the required currencies. These are the principal stochastic elements (and perhaps the only stochastic elements) of the model.
- Based on these yield curves and exchange rates, calculate the returns for fixed income portfolios in their foreign currencies, and then translate these back into Australian dollar returns for the given hedging strategy.
- Store the returns from a given simulation.
- Repeat the above three steps for the required number of simulations.
- Once all simulations have been performed, summary statistics will be required (means and variances of returns, a frequency distribution of the returns, etc).

(3 marks)

Accordingly, the engine of the simulation model is the projection of the foreign yield curves and foreign currency rates, allowing for random variation.

Subject to checking that linkages are valid, such a model might work as follows.

Short term (cash) interest rates in each country are projected. These rates may themselves be functions of stochastic modeled variables. Likely candidates for drivers of short term rates in each country are real GDP growth and inflation. Beyond this, there may also be a residual stochastic variation in short term interest rates.

(1 mark)

Allowance for the correlations of these variables between the various countries should also be allowed for. At the very least, some allowance must be made for the correlations of interest rates between different countries.

(1 mark)

Some element of mean reversion in interest rates should also be contemplated. Regime switching models might also be considered. (1 mark)

Based on the projected short term rates, the remainder of the yield curve can then be projected, probably based on one of the econometric theories of the yield curve.

(1 mark)

Exchange rates must then be projected. These will be heavily influenced by GDP growth, inflation, inflationary expectations (i.e. the same drivers as interest rates), and indeed interest rates themselves. It may also be reasonable to consider including momentum factors. Spot exchange rates may also need to incorporate some element of mean reversion. (1 mark)

Projected spot rates, combined with the yield curves projected for each country, can then be used to value any forward rate hedges implied by the strategy.

(1 mark)

Armed with our projected yield curves, spot exchange rates and hedge values, we can then value the bond portfolios in each country. A decision will need to be made as to whether bond indices for each currency will be modeled directly or indirectly via

representative bond portfolios. Once valued in their home currency, their values and returns will need to be translated back to Australian dollar values and returns.
(1 mark)

Other matters that may need to be incorporated into the model may include:

- Transaction costs.
- Costs involved with hedging strategies.
- Taxes.
- Additional return levels and volatility from credit risk factors and active management of portfolios. (2 marks)

To keep the complexity of the model within reasonable bounds (at least in the first instance), it would be practical to restrict consideration to the main currencies in which we would be investing. In practice, this would almost certainly restrict our attention to Australia, the United States, Japan, and the Euro and Sterling markets.
(1 mark)

(1 mark per valid point, up to a maximum of 12 marks)

(c)

1 October 2003
The Trustee

XYZ Superannuation Fund

Dear Trustee

MODELLING RETURNS FROM FOREIGN FIXED INCOME INVESTMENTS

At our meeting of last month, you asked me to formally write to you outlining some of the practical limitations of stochastic models in respect of modeling investment returns, specifically in the context of modeling the Australian dollar performance of global bond portfolios.

While we believe that this modeling can be very useful in helping us to better understand the range and volatility of return outcomes, it does have its limitations. These limitations do need to be kept in mind when interpreting the model's results.

These limitations include:

<u>Model structure</u>

All investment models are a simplification of a much more complicated real world. While these simplifications help us to focus on the (hopefully) more important drivers of returns, they will not capture all of the potential drivers of returns. Models are much better at giving us a sense of the potential for variation in returns, rather than predicting what future returns will be. Even then, one needs to be careful that our models do not unduly underestimate the possibility of extreme events (e.g. the

effects of September 11). Incorporating the possibility of such events is a considerable challenge. (2 marks)

Parameter estimation

Assuming that we can derive a model structure that is reasonable, we still need to quantify the relationships between the model's variables, for example expected returns and the volatilities of the underlying variables. These estimates need to be those we will believe will apply in the future. In practice, however, we are heavily dependent on historic data and experience in quantifying these relationships. With subjective judgements, we can adjust these parameter estimates to reflect our view of the future. This subjectivity does, however, introduce another element of uncertainty to our modeling. (2 marks)

Regime changes

A further limitation to the blind acceptance of model results is the possibility of regime changes. Sometimes relationships that existed for an extended period of time, and hence were necessary to include in our models, no longer apply. A good example of this would be the experiences of global markets pre and post the gold standard, or more recently the movement to the current low inflation environment. We need to constantly be checking the validity of our models to current conditions.

(1 mark)

Trustee, I hope that this helps you to have a clear perspective of the limitations of stochastic investment models. Please note that despite these limitations, serious as they can be, as noted above these models can yield us important insights.

Yours sincerely

An Actuary

(1 mark per valid point, maximum of 5 marks plus one mark for proper letter format)

END OF PAPER TWO SOLUTIONS