COURSE 1 INVESTMENTS APRIL 2012 EXAMINATIONS

Marking Guide

Level of difficulty

Question	Units	Learning Objectives	Knowledge & Understanding	Straight-forward Judgement	Complex Judgement	Total Marks
Q1(a)	3	5.1, 5.2	2	1		3
Q1(b)	3	5.1, 5.2		8	2	10
Q1(c)	3	5.1, 5.2		1	2	3
Q1(d)	3	5.1, 5.2		1	1	2
Q1(e)	3	5.1, 5.2		1	1	2
Q2(a)	1	1.1	2	2	1	5
Q2(b)	3	5.2			5	5
Q2(c)	2	4.3		2	2	4
Q2(d)	1	1.1	2	2	2	6
Q3(a)	1, 2	3.1, 4.1	2	1		3
Q3(b)	2	4.1	2	1		3
Q3(c)	1	3.1	1	1		2
Q3(d)	1	3.1	1	1		2
Q3(e)	1	1.1, 3.1	1	1	3	5
Q3(f)	1,2	3.1,4.1	1	1	3	5
Q4(a)	2	4.1 – 4.7			3	3
Q4(b)	2	4.1 – 4.7	1	2	2	5
Q4(c)	2	4.1 – 4.7	2	3		5
Q4(d)	2	4.1 – 4.7		1	1	2
Q4(e)	3	5.2		1	1	2
Q5(a)	3	5.3	2			2
Q5(b)	3	5.3	1			1
Q5(c)	3	5.2, 5.3		2		2
Q5(d)	3	5.5		2		2
Q5(e)	1	2.1		2		2
Q5(f)	3	5.3		3		3
Q5(g)	1	2.1			3	3
Q5(h)	3	5.3-5.5			5	5
Q5(i)	3	5.5			3	3
Total			**20**	**40**	**40**	**100**

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Answer all 5 questions.

QUESTION 1 (20 Marks)

MakeMore Super is a small to medium sized defined contribution superannuation fund. It is about to embark on a merger with another small to medium sized fund in which MakeMore will be the larger merger partner and will retain its identity. The membership of the Investment Committee will change as a result of the merger. You advise the Investment Committee.

MakeMore Super has only had one investment choice for its members and is predisposed for efficiency reasons to continue this practice after the merger. This fund is a typical "balanced" fund – some 60-70% of its assets are Australian and international listed equities; the rest is a mix of Australian and international sovereign bonds, corporate credit exposures, cash and a small parcel of hedge funds.

Its merger partner also has a single fund and the asset allocation of the fund is similar.

Both partners have used a range of active managers to manage all their exposures.

Some members of the soon-to-be-merged Investment Committee have begun to question this latter practice after several years of indifferent manager performance. You have been asked to comment on several statements that were made at a recent meeting of the new Committee:

- **"The case for active management is increasingly suspect. In any event, in aggregate, the clients of active managers must underperform the market."**
- **"I couldn't in all conscience sign global bonds over to a passive manager given the state of sovereign balance sheets at the moment."**

a) How would you define passive management in the context of the comments reported above? Include within your definition examples of how such passive portfolios are managed. (3 Marks)

b) Outline the cases for and against passive and active management for a fund like MakeMore Super. Give two points for and against each of active and passive management. Also include any theoretical considerations that might be relevant and consider the role of alternative beta strategies such as fundamental indexation within your answer. In your answer assume securities management is outsourced by the fund. (10 Marks)

c) Do you agree with the assertion that, in aggregate, clients of active managers must underperform the market? Give reasons for the position you take. (3 Marks)

d) What factors might be motivating the comment about the passive management of sovereign bonds? (2 Marks)

Question 1 continues over the next page.

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e) **For a bond investor who wishes to maintain traditional passive investment in sovereign bonds, comment on the relative merits of the following indices as market proxies in current market circumstances:**

Country/Region	Barclay's Global Treasury Index (%*)	PIMCO Global Advantage Government Bond Index (%*)
United States	23.6	25.9
Eurozone	27.1	21.7
Japan	32.7	8.7
Other Industrial Countries	11.2	11.8
Emerging Markets	5.4	31.9
Total	100.0	100.0

***At July 2011.**

(2 Marks)

SOLUTIONS: QUESTION 1

a) How would you define passive management in the context of the comments reported above? Include within your definition examples of how such passive portfolios are managed. (3 Marks)

Passive management in this context is most likely market capitalisation based indexation. A passive manager aims to reproduce the performance of a market capitalisation index taken as a proxy for the market under consideration. Various methods are used for this purpose: for example, full replication under which the manager buys all securities in the index; and sampling methods such as stratified sampling under which the manager buys a sufficiently representative set of securities.

The passive manager will control tracking error whichever method is used because there will be periods when the portfolio held does not match the index. This will be so even under full replication due to rebalancing lags. For this reason passive portfolios are often optimised relative to the index to ensure they are consistent (within a control tolerance) with the index in important risk measures.

There may also be implied active strategies used occasionally to make up for the performance penalty incurred through paying manager fees. An example might be dividend reinvestment plan participation where discounts to the ruling market price are used for reinvestment or phased portfolio changes when indices are reconstituted.

Marking Guide: (2 KU, 1 SJ)

- **Definition (1 KU)**
- **Management methods (must include some specificity to gain full marks) (1st mark awarded KU, 2nd mark awarded SJ)**

b) Outline the cases for and against passive and active management for a fund like MakeMore Super. Give two points for and against each of active and passive management. Also include any theoretical considerations that might be relevant and consider the role of alternative beta strategies such as fundamental indexation within your answer. In your answer assume securities management is outsourced by the fund. (10 Marks)

Passive Management

The case for passive management rests on a belief in some or all of the following:

- perfectly or largely efficient markets, and
- the use of an investable index sufficiently broad to represent the market so that the Capital Asset Pricing Model (CAPM) notion of diversifying unnecessary idiosyncratic risk can hold.

Alternatively, despite markets being inefficient at some level, a fund may regard itself as unable to find or access active managers who consistently beat the index on a net return basis; or it may regard the business case for doing so as unsupported on cost-benefit grounds.

Other arguments in favour of passive management include lower costs, greater ease of implementation (in terms of researching manager capabilities) and low relative risk.

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Arguments against passive management include the fact that passive management:

- operates pro-cyclically (it forces you to hold more of securities that have performed well) and this ignores valuation impacts (security entry price is one aspect an investor can control), and
- requires you to hold securities that are undesirable for some reason (e.g. poor corporate governance, impending credit downgrade).

Active Management

The case for active management rests on a belief in in some or all of the following:

- market inefficiency at some level or for some meaningful period
- the ability of preferred active managers to identify inefficiencies and exploit them profitably before they disappear
- the ability of the fund to be able to find and access such managers at a fee that leaves net returns higher than index returns, and
- a willingness to withstand some margin of tracking error.

Other arguments in favour of active management include the fact that:

- there are times when there will be securities you will clearly not want to hold or you will want to hold less than market weight (see corresponding passive management discussion for examples) and active management allows you to exercise such a discretion, and
- the potential to lower absolute risk or customise a portfolio to a particular risk or liability profile.

Arguments against active management relate to higher costs in terms of manager fees and search and monitoring costs.

Alternative Beta

Passive management as defined in (a) above involves taking a market beta (=1) position where beta is defined as in CAPM . There are alternative ways of defining a beta such as a factor beta under the Arbitrage Pricing Theory. Alternative beta strategies such as fundamental indexation aim to capture such betas in a systematic or market based way. They are active strategies relative to the passive management via the market capitalisation indexation view of the world but they do not take a particular view of the prospects of individual stocks in the way that active management is usually viewed.

Put another way, market capitalisation indexation is only one way of ordering the market. Equal weighting ranks securities equally, for example, and inherently secures a size premium relative to a conventional index. It would also be possible to rank stocks in the order of return on capital x no. of shares at float (to use an example) and buy them in proportion of the individual share of the total market weight on this measure. This latter approach is indicative of the approach taken by fundamental indexation.

Marking Guide: (8 SJ, 2 CJ)

- **Passive management: case foundations (2 SJ)**
- **Passive management: arguments for/against (2 SJ)**

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- **Active management: case foundations (2 SJ)**
- **Active management: arguments for/against (2 SJ)**
- **Alternative beta (2 CJ)**

c) Do you agree with the assertion that, in aggregate, clients of active managers must underperform the market? Give reasons for the position you take. (3 Marks)

The Committee's proposition as to the clients of active managers is not necessarily true. It would be more accurately restated in respect of active investors as a class and as the inability to outperform the market.

The "market" consists of active and passive investors. If we assume that passive investors attempt and attain market performance, M, then the best gross performance active investors as a whole can hope for is also M.

Within active investors there will be active managers and active other investors. The only way that active managers can outperform M in aggregate is by the other active investors underperforming it.

The clients of passive managers have a performance hurdle they must make up before their average net return matches M. This hurdle is made up of the fees paid to passive managers as noted in (a) above. The clients of active managers have an additional hurdle over and above passive manager fees. This additional hurdle is the "active fee spread" (the difference between active and passive manager fees).

Marking Guide: (1 SJ, 2 CJ)

- **Statement as to agreement/disagreement (1SJ)**
- **Arguments – note: the question requires students to consider the clients of**
- **active managers, not active investors per se; arguments should not be mere assertions (2 CJ)**

d) What factors might be motivating the comment about the passive management of sovereign bonds? (2 Marks)

Passive management via market capitalisation involves periodic security weights in the following proportions:

$$\frac{\text{securities on issue per issue i x price per security i}}{\sum_{\text{all issues}} \text{securities on issue x price per security}}$$

For debt securities prudent management will take account not only of a security's weight in the index but also an issuer's total weight in the index.

The more debt an issuer needs, the more securities it will issue. The claim this debt will have on the issuer's worth needs to be measured relative to its balance sheet and its ability to pay among other things.

For sovereign issuers national balance sheets are not often published. Income is measured by national income or flow proxies such as GNP or GDP.

(Note that larger issuance per se is not the issue – a country with a larger GDP could be expected at face value to issue more debt simply on scale grounds.)

Traditional passive management takes no account of GDP or GNP relativity or other scaling of a country's indebtedness and places no limit on total issuer exposure. A country may well issue more debt when it gets into trouble or have to do so as part of its recovery planning or has financing needs that cannot be accommodated otherwise. Passive management forces you to take such debt into your portfolio (albeit with issue/trading price as a moderating factor) thus reducing its overall credit quality.

This is arguably the case for the USA and Europe in the wake of the global financial crisis.

Marking Guide: (1 SJ, 1 CJ)

- **Greater issuance = greater issuer exposure (1 SJ)**
- **Link to current conditions (1 CJ)**

e) For a bond investor who wishes to maintain traditional passive investment in sovereign bonds, comment on the relative merits of the following indices as market proxies in current market circumstances:

Country/Region	Barclay's Global Treasury Index (%*)	PIMCO Global Advantage Government Bond Index (%*)
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Emerging Markets	5.4	31.9
Total	100.0	100.0

***At July 2011.**

(2 Marks)

The major differences between country/region exposures are for the Eurozone, Japan and Emerging Markets: 27.1% vs 21.7%, 32.7% vs 8.2% and 5.4% vs 31.9%.

The Eurozone and Japan are more heavily indebted relative to their GDP than are Emerging Markets (although there may be significant variation at individual country level, particularly as to the latter). For this reason the Barclay's index is likely to have a lower credit quality and greater relative exposure to problem countries in current circumstances.

On the other hand Emerging Market debt is generally less liquid than Mature Market debt owing to generally lower issuance, particularly in Asia, so that the PIMCO index would likely result in a less liquid portfolio under passive management.

Marking Guide: (1 SJ, 1 CJ)

- **Principal exposure differences (0.5 SJ)**
- **Liquidity (0.5 SJ)**
- **Credit quality (1 CJ)**

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QUESTION 2 **(20 Marks)**

The Investment team of a superannuation pension issuer have shortlisted two active managers of listed Australian equities for a portion of the portfolios that back the pensions.

The pensions are of various types – account-based pensions, pensions that are fully or partially guaranteed, pensions that are fully or partially indexed for inflation. The investment income of the pension portfolios are tax-free both to the issuer and to the pensioners; moreover, Australian franking credits are claimable for cash.

The two managers operate in the following manners:

	Manager A	Manager B
Approach	Select high dividend shares within a valuation context	Aim for total return, quality companies, diversification and value orientation
Universe	All listed shares	All listed shares
Process	Stocks are ranked by: – Sustainable dividend yield, and – price to manager valuation A decision tree process selects the 30 stocks with the best combined rankings, which are weighted within a 2-5% range according to their rankings.	Stocks must satisfy a series of quality filters. All stocks which satisfy these filters will be held in the portfolio. Those which do are then subjected to the manager's proprietary valuation process to determine the relative weighting - the best value stocks receive the highest weights; low value stocks will be held lower than index weights.
Additional analysis	The portfolio is scanned for obvious "no's" that are based on the team's knowledge of the stock or understanding of current market dynamics. Such stocks are eliminated and the process is repeated. The portfolio is then optimised.	The portfolio is optimised.

a) What are some reasons for including Australian listed equities within pension portfolios? What problems do you foresee using equities for the purpose/s suggested? If necessary, differentiate between types of pensions and take into account any prudential matters the issuer should be concerned with. **(5 Marks)**

b) Do you see potential overlaps between the approaches and processes of the two managers or the outcomes their approaches and processes are likely to produce? Argue your case. **(5 Marks)**

c) What is the role of an optimiser in the context of the equity processes outlined above? What factors would you expect to find within the optimisation processes the managers use? **(4 Marks)**

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d) Comment on a proposal to use listed emerging market equities within any overall equity allocation within these funds. Make reference to arguments you may have made in (a) and any other matters you consider relevant. (6 Marks)

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SOLUTIONS: QUESTION 2

a) What are some reasons for including Australian listed equities within pension portfolios? What problems do you foresee using equities for the purpose/s suggested? If necessary, differentiate between types of pensions and take into account any prudential matters the issuer should be concerned with. (5 Marks)

Australian listed equities have the following characteristics that lend themselves to inclusion in a fund backing pension liabilities:

- They have long durations, making them attractive on term matching grounds particularly for the ongoing funding of those pensions which are not account based.
- They may provide an income stream through dividends, thus supporting the payment of pensions
- As noted in the question, franking credits are claimable as cash in a zero tax environment, adding to both total return and income, so equities which produce high levels of franking credits are attractive on these grounds

(There is some interaction between the franking regime and high dividends as the former encourages the latter owing to shareholder preferences.)

- They are generally regarded as growth assets making them potentially suitable for supporting inflation-sensitive liabilities, and
- They may provide diversification benefits relative to other asset classes.

In general Australian listed equities would be suitable for inclusion in funds backing account-based pensions to the extent product objectives and the strategic asset allocation anticipate such characteristics (e.g. balanced style products).

Their volatility and risk-return relationship would, however, impose a regulatory or prudential capital cost where there are guarantees embedded within the pension or cause difficulties where there are expectations based on short to medium relative stability.

Marking Guide: (2 KU, 2 SJ, 1 CJ)

- **General discussion – e.g. duration, inflation, tax, diversification (2 KU)**
- **Distinctions – e.g. account-based pensions, guarantees/volatility (2 SJ)**
- **Quality of answer (1 CJ)**

b) Do you see potential overlaps between the approaches and processes of the two managers or the outcomes their approaches and processes are likely to produce? Argue your case. (5 Marks)

Any overlaps that might arise will depend on the extent that quality companies pay high dividends and the two valuation models coincide.

Manager B's ideas on quality are not provided. Quality can be assessed quantitatively and/or qualitatively according to various characteristics such as franchise, governance, accounting transparency, management, balance sheet strength, RoE and earnings sustainability including cashflow richness and payout ratios. In general quality companies are more likely to produce recurrent cash-rich earnings, making them able to pay attractive dividends.

It is difficult to comment on the extent to which dividends will be franked other than that sustained dividends are more likely to be based on recurrent, cash-based earnings, which are also often associated with quality companies. In turn such earnings are probably more likely to generate taxable income than one-off items. To this extent there may also be overlap between the two managers.

There is, however, a potentially significant difference between the two managers - high dividend yields can arise from price falls and may expose Manager A to "value traps". This is presumably one of the reasons that Manager A can intervene to eliminate a stock from consideration.

This notwithstanding there is, therefore, a good chance the selection criteria of the two managers will lead them to research similar stocks, although Manager A can look outside the quality compass and may have a broader universe to research.

Details are not given on the two valuation models. Manager A compares current price to its valuation, whereas Manager B gives greatest weight to the "best value" stocks. It presumably must have some price reference within its approach but may also have other value measures; so, while there is likely to be some overlap, it is not possible to comment more fully on its extent.

At face value Manager B's portfolio may be more diversified than Manager A's, which is relatively concentrated at 30 stocks with weights between 2% and 5%. Individual mid and small cap stocks may, therefore, be represented at significantly greater than index weights. Stocks numbers are not specified for Manager B but their orientation is said to encompass diversification. The extent of same will depend on how many stocks progress through their quality filters.

Marking Guide: (5 CJ)

Answer requires identification of possible overlaps and discussion reasoning for and extent of same. Where the student discerns no overlaps, then reasoning should be also be given, noting this appears to be a harder case to sustain.

- **Overlaps (3 CJ)**
- **Extent, reasoning (2 CJ)**

c) What is the role of an optimiser in the context of the equity processes outlined above? What factors would you expect to find within the optimisation processes the managers use? (4 Marks)

Optimisation is concerned with improving risk-return efficiency – improving return for an unchanged risk, reducing risk for an unchanged return or targeting an efficiency statistic such as expected information ratio. The most efficient portfolio lies along the efficient frontier.

Each manager seeks to construct an efficient frontier within the screened universe of stocks it has selected according to the systematic biases its process embeds within its portfolios (Manager A - dividend yield and value; Manager B - quality, then value).

The optimiser would be used to construct these efficient frontiers. It is also likely that the optimiser would examine a range of other risk or style statistics to reduce factor risks that are not proportionately rewarded in an ex ante sense.

In these ways the optimiser would influence final stock weights.

The manager may have also set advisory limits for some risk factors and will check that the stocks within the portfolio stay within such limits. The optimisation process could also be augmented by holdings based analysis. Possible risk factors would include:

- Industry sector
- Capitalisation size and liquidity
- Momentum
- Contribution to price or return volatility, and
- Contribution to tracking error.

Marking Guide: (2 SJ, 2 CJ)

- **Explanation of optimisation/optimiser – efficiency, reduce unrewarded risks, influence on stock weights (2 SJ)**
- **Risk factors (2 CJ)**

d) Comment on a proposal to use listed emerging market equities within any overall equity allocation within these funds. Make reference to arguments you may have made in (a) and any other matters you consider relevant. (6 Marks)

In terms of the issues identified in (a):

- Duration – unchanged: like all equities, EM equities have long durations
- Dividend yield – EM equities pay dividends but generally at a lower average rate than Australian equities
- Taxation – There are no franking benefits with EM equities
- Growth designation - They are growth assets
- Diversification – They have the same if not greater diversification benefits historically relative to non-equities and offer some diversification within an equities allocation subject to the following qualifications:
  - Globalisation may have affected correlations in that an increasing share of developed market profits are sourced from sales to EM, especially in high value-added manufacture and services
  - Likewise, an increasing share of EM profits are sourced from sales to developed markets, especially on high labour cost manufacture and services
  - Australia's leverage to China in current conditions may lessen the diversification EM equities offer in relation to Australian equities, and
  - The greater the share of Asian stocks within the EM allocation, the more likely at face value these arguments are to have some force
- Account-based pensions – EM equities would be suitable for inclusion in funds backing account-based pensions under the same arguments as applied under (a)
- Volatility & guarantees - EM equities are likely to be more volatile than Australian equities, hence may increase the amount of prudential capital required where relevant

EM equities offer further challenges under the currency heading:

- Denomination mismatch – More important than for lump sum funds owing to the contractual outflow nature of pensions, and
- Hedging – EM currencies are nominally harder and more expensive to hedge than developed market currencies (nominally because some currencies are pegged to the USD and, more generally, may be more highly correlated to the USD than the EUR for example).

EM equities are also less liquid than developed market equities – in particular, liquidity tails off more rapidly as the degree of "emergingness" increases.

Marking Guide: (2 KU, 2 SJ, 2 CJ)

- **General discussion from (a) (2 KU)**
- **Differentiations from (a) – diversification, volatility vs prudential capital (2 SJ)**
- **Other factors – currency, liquidity (2 CJ)**

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QUESTION 3 **(20 Marks)**

You are an investment consultant providing advice on asset allocation to the board of trustees of a fund supporting a government employee superannuation scheme.

The scheme pays pension benefits based on the member's average salary over the five years prior to retirement. As the scheme has been closed to new members for some years, most of the liabilities are for pensioners and past service liabilities for remaining active members.

Back when the scheme was open to new members, member contributions were collected and placed in the fund on which you are providing advice. However, no employer contributions were made into the fund. The current amount of the fund is considerably less than any reasonable valuation of liabilities.

The government has now settled on the following arrangements:

- **The net liability (PV of benefits *less* PV of member contributions *less* amount of fund) is reported on the government's balance sheet.**
- **The government pays benefits on a pay-as-you-go basis, with a partial contribution from the fund. For the current year these amounts are given by:**

  Government payment = Total benefits current year– fund contribution

  Fund contribution = Total benefits current year × funded ratio

  Funded ratio = Amount of fund start of year / PV future benefits

  The funded ratio currently stands at 30%.

Under the legislation governing the scheme, the board is charged with maximising the return on the fund without incurring "unreasonable risk", this being undefined. You are considering how to formulate a static investment strategy for the fund.

a) List six main factors considered in constructing an asset-liability model for the fund. (3 Marks)

b) Two criteria have been suggested as a basis for formalising the investment objectives:

(i) the net liability reported in the government's balance sheet;
(ii) the annual amounts paid by the government to provide the benefits.

Discuss the ways that investment objectives might be formulated for each of these criteria. (3 Marks)

c) Suppose that the government decides to set the actuarial valuation rate of interest equal to the projected yield on long term government bonds at the end of each year. How will this affect the asset-liability model? Assume that the investment objectives are based on the balance sheet net liability. (2 Marks)

d) A simple model of long-term government bond yields is that the *change* in yield over one year has a standard deviation of 0.7%. If the duration of the net cash flows (benefit payments – member contributions) is 10 years, what is the approximate standard deviation of the *percentage change* in net present value of liabilities arising from volatility in the change of valuation rate? (2 Marks)

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e) Write the change ΔB in balance sheet liability in terms of the change ΔV in the value of net cash flows and the change, ΔF in the value of the fund. Noting that the current funded ratio is 30%, obtain an approximate expression for the percentage change, $\Delta B / B$ in terms of the percentage changes $\Delta V / V$ and $\Delta F / F$. Denote the volatility of the fund return by s, and assume for the moment that the returns on the fund are uncorrelated with yield changes on government bonds. Under the model outlined in (d) above obtain an approximate expression in terms of s for the standard deviation of $\Delta B / B$. Using this result for a range of values of s, comment on the effect of asset allocation strategy on the volatility of the change in balance sheet liability. (5 Marks)

f) Suppose that the duration of long term government bonds is 5 years, the duration of net cash flows is 10 years as in (d), and assume that the investment objective is to stabilise the changes in the reported balance sheet liability (that is, a steady rate of change is more desirable than a fluctuating rate of change). By relating the changes in the value of the net cash flows and in the fund to the change in the bond yield, and again noting that the current fund ratio is 30%, express the percentage change $\Delta B / B$ in the balance sheet liability in terms of the change in the bond yield. Under the bond yield model from (d) above, to what extent will the objective be furthered by investing 100% in long term government bonds? (5 Marks)

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Solutions Question 3

(a)
List six main factors considered in constructing an asset-liability model for the fund.
(3 marks)

- The first step is a projection of liability cash flows.
- These may be deterministic or stochastic in real terms, but should allow for stochastic inflation in real terms.

The asset model should take into account the following concerns for modelling the emergence of liability realistically:

- dynamic volatility, especially for equities
- serial correlation in returns
- a full yield curve, in line with the duration of liabilities
- return expectations in line with current interest rates and inflation.

Marking Guide: (2 KU, 1 SJ)

- **0.5 marks for each point up to 3 marks. 1st 2 marks awarded KU, last mark awarded SJ**

(b)
Two criteria have been suggested as a basis for formalising the investment objectives:

(i) the net liability reported in the government's balance sheet;
(ii) the annual amounts paid by the government to provide the benefits.

Discuss the ways that investment objectives might be formulated for each of these criteria.
(3 Marks)

The following risk measures may be useful for the reported net liability:

- probability of exceeding a given target level
- conditional on exceeding the target level, the expected amount of the excess.

Possible measures of the government's future benefit payments include:

- the present value, which could be assessed relative to a target level as above
- the expected value of a power penalty.

Marking Guide: (2 KU, 1 SJ)

- **1 mark per point up to 3 marks. 1st 2 marks awarded KU, last mark awarded SJ**

(c)
Suppose that the government decides to set the actuarial valuation rate of interest equal to the end-of-year yield on long term government bonds. How will this affect the asset-liability model? Assume that the investment objectives are based on the balance sheet net liability. **(2 Marks)**

The yield on long term government bonds directly affects the fixed income component of the portfolio, and is related to other asset classes through the return correlation matrix. Thus the returns on the portfolio are related to the actuarial liability of the net cash flows (benefits – contribution), and this must be built into the model.

Marking Guide: (1 KU, 1 SJ)

- **1st mark awarded KU and 2nd mark awarded SJ**

(d)

A simple model of long-term government bond yields is that the *change* in yield over one year has a standard deviation of 0.7%. If the duration of the net cash flows (benefit payments – member contributions) is 10 years, what is the approximate standard deviation of the *percentage change* in net present value of liabilities arising from volatility in the change of valuation rate? (2 Marks)

$$\frac{\Delta V}{V} \approx -\Delta i \times D$$

where *V* is the actuarial value, Δi is the change in yield and *D* is the duration. Thus

$$SD\left(\frac{\Delta V}{V}\right) \approx SD\,(\Delta i) \times D = 0.7\% \times 10 = 7.0\%$$

Marking Guide: (1 KU, 1 SJ)

- **Duration formula (1 KU)**
- **Application (1 SJ)**

(e)

Write the change ΔB in balance sheet liability in terms of the change ΔV in the value of net cash flows and the change, ΔF in the value of the fund. Noting that the current funded ratio is 30%, obtain an approximate expression for the percentage change, $\Delta B / B$ in terms of the percentage changes $\Delta V / V$ and $\Delta F / F$. Denote the volatility of the fund return by *s*, and assume for the moment that the returns on the fund are uncorrelated with yield changes on government bonds. Under the model outlined in (d) above, obtain an approximate expression in terms of *s* for the standard deviation of $\Delta B / B$. Using this result for a range of values of *s*, comment on the effect of asset allocation strategy on the volatility of the change in balance sheet liability. (5 Marks)

Let *B* denote the balance sheet liability, *V* the PV of net cash flows, and *F* the fund.

$$B = V - F$$

so that

$$\Delta B = \Delta V - \Delta F$$

and

$$\frac{\Delta B}{B} = \frac{\Delta V}{B} - \frac{\Delta F}{B}$$

Noting that $B \approx 0.7V$ and $F \approx 0.3V$,

$$\frac{\Delta B}{B} = \frac{\Delta V}{0.7V} - \frac{\Delta F}{(7/3)F}$$

Thus

$$Var\left(\frac{\Delta B}{B}\right) = \frac{1}{0.7^2} Var\left(\frac{\Delta V}{V}\right) + \left(\frac{3}{7}\right)^2 Var\left(\frac{\Delta F}{F}\right) = \frac{0.07^2}{0.7^2} + \left(\frac{3}{7}\right)^2 s^2$$

and

$$SD\left(\frac{\Delta B}{B}\right) \approx \sqrt{0.01 + \left(\frac{3}{7}\right)^2 s^2}$$

The table below shows how *SD(db/B)* varies with possible values of *s*.

Fund Return volatility *s*	Liability change volatility *SD(db/B)*
4%	10.1%
6%.	10.3%
8%	10.6%
10%	10.9%
12%	11.2%
14%	11.7%
16%	12.1%

The investment return volatility has only a minor effect on the volatility of the change in balance sheet liability. Most of the volatility arises from the volatility of the change in bond yield used to value the cash flows.

Marking Guide (1 KU, 1 SJ, 3 CJ):

- **Reasonable attempt at variance expression (1 KU)**
- **SD expression (1 SJ)**
- **Comparison (2 CJ)**
- **Conclusions re investment return volatility (1 CJ)**

(f)

Suppose that the duration of long term government bonds is 5 years, the duration of net cash flows is 10 years as in (d), and assume that the investment objective is to stabilise the changes in the reported balance sheet liability (that is, a steady rate of change is more desirable than a fluctuating rate of change). By relating the changes in the value of the net cash flows and in the fund to the change in the bond yield, and again noting that the current fund ratio is 30%, express the percentage change $\Delta B / B$ in the balance sheet liability in terms of the change in the bond yield. Under the bond yield model from (d)

above, to what extent will the objective be furthered by investing 100% in long term government bonds? (5 marks)

Using the notation above,

$$\Delta V \approx -V \times 10 \times \Delta i$$
$$\Delta F \approx -F \times 5 \times \Delta i \approx -V \times .3 \times 5 \times \Delta i$$

Thus

$$\Delta B \approx -V \times (10 - .3 \times 5)\Delta i = -V \times 8.5\Delta i$$

Because $B \approx .7V$,

$$\frac{\Delta B}{B} \approx -\frac{8.5\Delta i}{.7} = -12.1\Delta i$$

and

$$SD\left(\frac{\Delta B}{B}\right) \approx 12.1 \times 0.7\% = 8.5\%$$

Comparing this figure with those in the table above, an appreciable reduction in the volatility of the reported change in funding level can be obtained by investing in government bonds, but the yield variation effect is still sizeable.

Marking Guide (1 KU, 1 SJ, 3 CJ):

- **2 marks for Delta B expression (1st mark awarded KU, 2nd mark awarded SJ)**
- **SD of Delta B over B expression (2 CJ)**
- **Conclusion (1 CJ)**

QUESTION 4 **(17 Marks)**

As the newly appointed investment strategist for a large Australian superannuation fund, you have inherited responsibility for maintaining the asset return model on which asset allocation decisions are based. The model is a classical mean-variance model covering the following asset classes:

- Australian equities
- International equities hedged
- Australian fixed interest
- International fixed interest hedged
- Australian listed property trusts
- Australian cash

One area that needs investigation and possible revision is the treatment of foreign currency and the implications for the hedging decisions for international asset classes. Focussing on just international equities for the present, write

R_H = return on international equities hedged 100%

R_U = return on international equities unhedged

Then the hedging return R_C is given by:

$$R_C = \frac{1 + R_H}{1 + R_U} - 1 \approx R_H - R_U$$

Now define

R_H^α = return on international equities hedged at proportion α $(0 < \alpha < 1)$

To get R_H^α we have to "unhedge" a proportion $(1-\alpha)$, so that

$$R_H^\alpha \approx R_H - (1-\alpha) R_C$$

These equations allow us to handle hedged, unhedged or partially hedged international equities within the mean-variance structure by including R_C in the model.

Table 1 shows averages and standard deviations for R_H, R_U and R_C. Table 2 shows correlations between the hedging return R_C and the asset classes currently in the model. Figure 1 shows how three-year rolling correlations of R_C with return on Australian and hedged international equities vary appreciably over time.

Figure 2 shows three-year average hedge return, R_C.

Table 1 – Performance over Last 10 Years

Asset Class	Return (%)	Std Dev (%)
International equities hedged	3.6%	15.7%
International equities unhedged	-2.3%	12.2%
Hedging return	6.1%	11.3%

Table 2 – Correlations with Hedging Return Over Last 10 Years

Asset Class	Correlation
Australian equities	0.54
International equities hedged	0.63
Australian fixed interest	-0.57
Australian listed property trusts	0.25
Australian Cash	-0.19

Figure 1--Rolling 3-year Correlations with Hedging Return

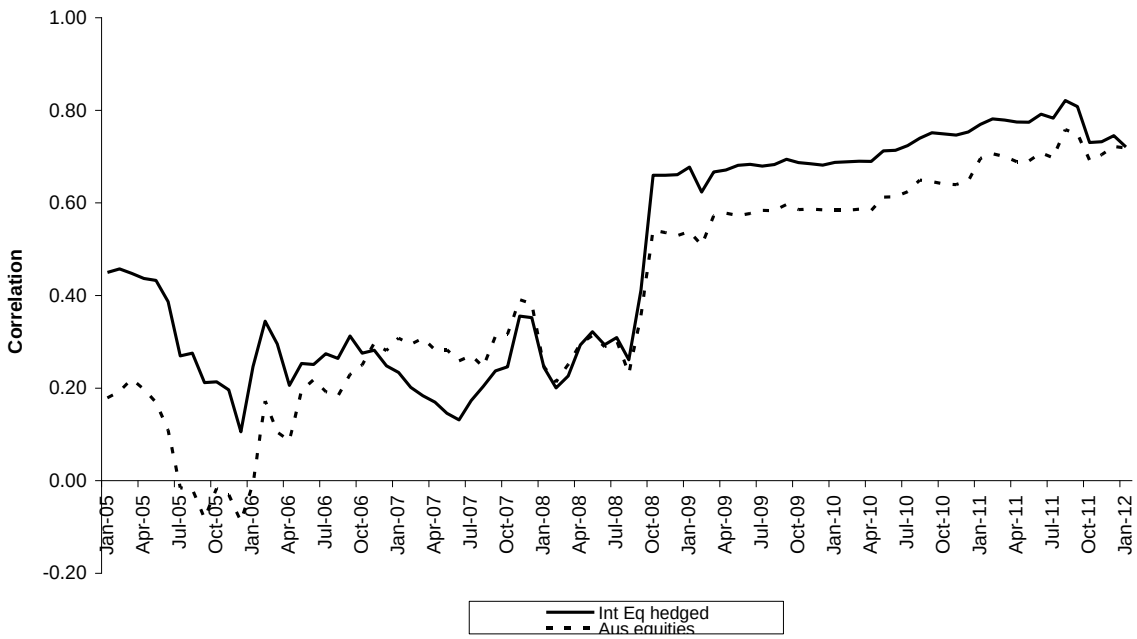

Figure 2--Rolling 3-yr Average Hedge Return

a) **Discuss the issues arising from the variation in correlations over time that will have to be dealt with when the model is expanded to include the hedging return. (3 Marks)**

b) **Based on the information given above, what conclusion on hedged international equities is likely for a typical balanced portfolio, assuming the model is based on long term statistics? Do you have any reservations with this conclusion? (5 Marks)**

c) **What are three other modelling approaches using historical data that might be used to avoid dependence on a fixed covariance structure? Give brief reasons supporting these alternatives. (5 Marks)**

d) **Acknowledging that a hedging model with stationary parameters might not explain historical returns satisfactorily, list four factors which might affect nonstationarity in the means and covariance structure. (2 Marks)**

e) **If a satisfactory model cannot be found to explain hedging returns alongside other asset returns, list two reasonable ways to manage currency hedging policy. (2 Marks)**

QUESTION 4: SOLUTIONS

(a)
Discuss the issues arising from the variation in correlations over time that will have to be dealt with when the model is expanded to include the hedging return. (3 Marks)

A number of issues arise. These are common to most applications of mean-variance models.

- The assumptions cannot be regarded as constant and applicable equally over all future time periods. Short term projections should be based on more recent measurements, but it is reasonable to expect reversion toward long term averages over time.
- Any conclusions based on the model should be tested for sensitivity to changes in the assumptions.
- Estimation of optimal hedge ratios from mean-variance models is known to be very difficult and sensitive to variation in the assumptions.

Marking Guide: (3 CJ)

- **1 mark per point above (3 CJ)**

(b)
Based on the information given above, what conclusion on hedged international equities is likely for a typical balanced portfolio, assuming the model is based on long term statistics? Do you have any reservations with this conclusion? (5 Marks)

From Tables 1 and 2, we note that:

- Hedged international equities have a higher mean return than unhedged. A decrease in the hedge ratio would decrease the portfolio mean return.
- The correlation between the hedging return and international equities hedged is positive, so that a reduction in the hedge ratio is likely to reduce the portfolio volatility for portfolios with a large weighting to international equities.
- The correlation between the hedging return and Australian fixed interest is large and negative, so that a reduction in the hedge ratio may increase the portfolio volatility for portfolios with a large weighting to fixed interest.

Thus any reduction in the hedge ratio would decrease the portfolio mean, but its effect on portfolio volatility would depend on the asset allocation. If the portfolio volatility decreased, the effect on mean-variance efficiency would depend on whether the decrease in volatility was sufficient to offset the decrease in the mean. If not, the benchmark hedge ratio based on the model will stay at 100%.

This conclusion depends on the assumptions that:

- All correlations are stable over time, and
- All means are stable over time. Figure 1 shows that the mean of R_C has varied considerably over time.

It is therefore difficult to place any confidence in the results from a mean-variance analysis using a model fitted from historical data.

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Also, the Australian Dollar has appreciated strongly over the last 10 years. It would be unwise to build this into the model without economic justification.

Marking Guide: (1 KU, 2 SJ, 2 CJ)

- **Observations from Tables 1 and 2 (1st mark awarded KU, subsequent 2 marks awarded SJ)**
- **Assumptions required for conclusions (2 CJ)**

(c)
What are three other modelling approaches using historical data that might be used to avoid dependence on a fixed covariance structure? Give brief reasons supporting these alternatives. (5 Marks)

- Possible alternative models would include a GARCH model, a regime switching model, or an economic disaster model. The first two of these can represent a time-varying covariance structure more realistically than a classical mean variance model. A disaster model makes specific allowance for the failure of a historical pattern.

- GARCH models in particular have no separately specified covariance structure, and the time-varying covariance structure is an output, not an input, of the model.

- An economic disaster model can explain persistent high hedging returns, which are in violation of open interest parity. According to the disaster model, countries with higher disaster risk have higher interest rates and appreciating currencies, but the exchange rate is likely to fall sharply in an economic disaster.

- Either model should include time series dependence for the hedging return, because we see from Figure 1 that the mean varies over time.

Marking Guide: (2 KU, 3 SJ)

- **2 marks for models mentioned (2 KU)**
- **3 marks for elaborations (3 SJ)**

(d)
Acknowledging that a hedging model with stationary parameters might not explain historical returns satisfactorily, list four factors which might affect nonstationarity in the means and covariance structure. (2 Marks)

Factors indicating changes in exchange rates include:

- Monetary and fiscal policy.

- Changes in the risk appetite of foreign investors for Australian currency, such as the debt position in Europe.

- Government debt levels in Australia.

- The private debt level in Australia. This is sensitive to housing demand and migration policy

Marking Guide: (1 SJ, 1 CJ)

- **First two half marks awarded (1 SJ)**
- **Second two half marks awarded (1 CJ)**

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(e)

If a satisfactory model cannot be found to explain hedging returns alongside other asset returns, list two reasonable ways to manage currency hedging policy. (2 Marks)

If the model cannot explain the hedging return satisfactorily, then a reasonable approach would be to:

- As an Australian super fund, liabilities are in AUD therefore it would be reasonable on asset liability matching grounds to be 100% hedged. The historical data shows this would have been successful in the past but given the strong trend in AUD over the past 10 years, this would not be sufficient reason of itself to be 100% hedged without an understanding of the economic factors that gave rise to the appreciation and the likelihood of these factors continuing into the future.
- Vary the benchmark from time to time according to changes in economic factors. Without specialist knowledge, the best way would be to engage an active manager.

Marking Guide (1 SJ, 1 CJ):

- **First point above (1 SJ)**
- **Second point above (1 CJ)**

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QUESTION 5 **(23 Marks)**

a) You are asked to calculate the annualised monthly performance of 2 portfolios. Portfolio 'A' is an equity portfolio where investors can freely buy and sell investment units priced daily. Portfolio 'B' is a 5 year fixed term private equity investment closed to further investment where existing investors can only redeem their investment at the conclusion of the 5 year investment period.

Which monthly portfolio performance calculation methodology would you use for portfolio 'A' and portfolio 'B'? Give brief reasons for your answer. (2 Marks)

b) The Unit Price (net asset value) of an investment portfolio is calculated daily for a month. Assume that the unit price was U_0 at the beginning of the month and U_{31} at the end of the month. Show the formula used to calculate the geometric portfolio return for the month. (1 Mark)

c) You wish to analyse the performance of a managed equity portfolio. The fund has 2 active management styles. Individual Stock Selection where stocks are actively weighted in the portfolio and Sector Selection where industry sectors are actively weighted in the portfolio. Describe (no formula required) the technique you would use to separately calculate the performance of these active management styles in the equity portfolio. (2 Marks)

d) One of the following risks is not necessarily classified as an operational risk that could occur to an investment manager. Identify which risk is not necessarily an operational risk and give a brief reason for your selection.

1. Information technology failure.
2. Internal and external fraud, money laundering.
3. Back office transaction processing errors, unit pricing errors.
4. Poor investment performance resulting in an outflow of funds under management.
5. Unauthorised activities, unauthorised trading, insider trading, fund trader/broker collusion.
6. Flawed valuation and risk models for derivatives and complex financial products.

(2 Marks)

e) Carhart (1997) showed that stock price momentum, the continuation of stock price trends over short to intermediate time horizons, is an important factor in stock returns. What are the implications of this research with reference to the Efficient Market Hypothesis (EMH)? (2 Marks)

f) Grinold and Kahn propose the following conceptual model of the information ratio of a managed investment portfolio, $IR = IC\sqrt{BR}$, where *IR* is the Information Ratio, *IC* is the Information Coefficient and is a proxy for manager skill and *BR* is the Breadth or number of independent investment decisions in the portfolio. With reference to the formula above; what are the expected relative information ratios of an Industry Sector Rotation fund manager and a Stock Selection equity fund manager? Assume both fund managers have equal investment skill. What is a common criticism of the Grinold and Kahn conceptual information ratio formula? (3 Marks)

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g) Eugene Fama and Kenneth French (1992) found that over the long term (1926-1992) a well-diversified equity portfolio of small capitalisation stocks has higher returns than a well-diversified portfolio of large capitalisation stocks. With reference to the fact that market capitalisation and market turnover (volume) have a high positive correlation, suggest a reason for the higher return of the well-diversified portfolio of small capitalisation stocks. (3 Marks)

h) An actuarial consultant is engaged to review the ex-ante (future) performance of an active investment fund manager. The consultant's report focuses on a qualitative analysis of the managers' investment processes and personnel. The report does not perform a quantitative analysis of the managers' ex-post (previous) investment performance. Enumerate reasons why. [Hint: You should include a discussion of t-statistics in your answer.] (5 Marks)

i)

Table 1

Asset Class	Active Risk (ex ante)	Active Return (ex ante)	Management Expense Ratio	Portfolio Weight
Australian Equities	2%	0.8%	0.25%	35%
International Equities	2.5%	1%	0.4%	20%
Listed Property	2%	0.25%	0.25%	15%
Bonds	1%	0.1%	0.1%	20%
Cash	0.1%	0%	0.1%	10%

Table 1 above details the composition and expected performance of a multi-asset class portfolio. Each asset class is actively managed by an external asset class manager and the Management Expense Ratios (MER) of each of the external managers are also tabulated. Assuming that asset class active management styles are uncorrelated, calculate the ex-ante (future) information ratio after fees for each asset class and the information ratio of the combined portfolio. How would you increase the ex-ante information ratio of the portfolio without increasing portfolio active risk by re-allocating the active risk of the existing external managers? (3 Marks)

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QUESTION 5: SOLUTIONS

(a)
You are asked to calculate the annualised monthly performance of 2 portfolios. Portfolio 'A' is an equity portfolio where investors can freely buy and sell investment units priced daily. Portfolio 'B' is a 5 year fixed term private equity investment closed to further investment where existing investors can only redeem their investment at the conclusion of the 5 year investment period.

Which monthly portfolio performance calculation methodology would you use for portfolio 'A' and portfolio 'B'? Give brief reasons for your answer. (2 Marks)

Investors in portfolio 'A' can buy or redeem equity investment units daily. Therefore the investment manager does not control cash flows in and out of the equity portfolio. The Association for Investment Management and Research Global Investment Performance Standards (AIMR-GIPS) specifies that Time Weighted Rates of Return (TWRR) should be used to calculate investment portfolio returns to remove cash flow effects from the portfolio returns.

Since portfolio 'B' is closed to additional investment and existing investors must hold to conclusion of the fixed 5 year investment period there are no investor cash flows in portfolio 'B'. Therefore Money Weighted Rates of Return (Internal Rate of Return) should be used to calculate investment portfolio as this methodology calculates the actual investment returns of the portfolio.

Marking Guide: (2 KU)

- **1 mark per paragraph above. Note that TWRR to remove cash flow is sufficient for the first point and MWRR-IRR as there are no investor cash flow effects and MWRR-IRR accurately calculates true portfolio investment returns is sufficient for the second point (2 KU)**

(b)
The Unit Price (net asset value) of an investment portfolio is calculated daily for a month. Assume that the unit price was U_0 at the beginning of the month and U_{31} at the end of the month. Show the formula used to calculate the geometric portfolio return for the month. (1 Mark)

To calculate the geometric return we calculate the 31 daily arithmetic returns and compound them as a monthly geometric return r_M.

$$r_M = \left(\left(\frac{U_1 - U_0}{U_0} + 1\right) \times \cdots \times \left(\frac{U_{31} - U_{30}}{U_{30}} + 1\right)\right) - 1 = \left(\frac{U_1}{U_0} \times \cdots \times \frac{U_{31}}{U_{30}}\right) - 1.$$

= (U(31)/U(0)) - 1

Marking Guide: (1 KU)

- **The expression above (1 KU)**

(c)
You wish to analyse the performance of a managed equity portfolio. The fund has 2 active management styles. Individual Stock Selection where stocks are actively weighted in the portfolio and Sector Selection where industry sectors are actively weighted in the portfolio. Describe (no formula required) the technique you would you would use to separately calculate the performance of these 2 active management styles in the equity portfolio. (2 Marks)

Arithmetic (Brinson) or geometric (Bacon) performance attribution are portfolio performance analytics that classify active portfolio performance into performance due to industry sector (asset class) selection and performance due to stock selection.

Marking Guide: (2 SJ)

- **2 for above point (2 SJ)**

(d)
One of the following risks is not necessarily classified as an operational risk that could occur to an investment manager. Identify which risk is not necessarily an operational risk and give a brief reason for your selection.

1. **Information technology failure.**
2. **Internal and external fraud, money laundering.**
3. **Back office transaction processing errors, unit pricing errors.**
4. **Poor investment performance resulting in an outflow of funds under management.**
5. **Unauthorised activities, unauthorised trading, insider trading, fund trader/broker collusion.**
6. **Flawed valuation and risk models for derivatives and complex financial products.**

(2 Marks)

Operational risks are generally those risks associated with the running of the company which are not a source of profit but need to be managed to avoid losses. Those risks which are taken on and managed to make profit are not classed as operational risks. So, to the extent that item 4, "Poor investment performance" is caused by bad investment strategy or adverse market outcomes, it is not operational risk.

Marking Guide: (2 SJ)

- **Choice (1 SJ)**
- **Reason (1 SJ)**

(e)
Carhart (1997) showed that stock price momentum, the continuation of stock price trends over short to intermediate time horizons, is an important factor in stock returns. What are the implications of this research with reference to the Efficient Market Hypothesis (EMH)?

(2 Marks)

Under EMH weak form efficiency future prices cannot be predicted by analysing past prices. Therefore the research by Carhart is evidence *against the hypothesis that markets are weakly efficient*.

Marking Guide (2 SJ):

- **One mark per point above (2 SJ)**

(f)

Grinold and Kahn propose the following conceptual model of the information ratio of a managed investment portfolio, $IR = IC\sqrt{BR}$, where *IR* is the Information Ratio, *IC* is the Information Coefficient and is a proxy for manager skill and *BR* is the Breadth or number of independent investment decisions in the portfolio. With reference to the formula above; what are the expected relative information ratios of an Industry Sector Rotation fund manager and a Stock Selection equity fund manager? Assume both fund managers have equal investment skill. What is a common criticism of the Grinold and Kahn conceptual information ratio formula? (3 Marks)

The selection and active trading universe (number of stocks) for Stock Selection is much larger than the trading universe (number of industry sectors) for Sector Rotation, therefore the opportunity for independent investment decisions is larger for Stock Selection than Sector Rotation. Thus the expected Breadth (BR) will be larger for Stock Selection than Sector Rotation, and since IC (investor skill) is assumed to be equal for both styles, the expected IR (information ratio) will higher for Stock Selection than Sector Rotation.

A common criticism of the Grinold and Kahn conceptual information ratio formula is that it encourages fund managers to maximise their Breadth (BR) by over-trading their investment portfolios with resultant increased transaction costs and increased tax liabilities.

Marking Guide (3 SJ):

- **Two marks for first paragraph (2 SJ)**
- **One mark for second paragraph (1 SJ)**

(g)

Eugene Fama and Kenneth French (1992) found that over the long term (1926-1992) a well-diversified equity portfolio of small capitalisation stocks has higher returns than a well-diversified portfolio of large capitalisation stocks. With reference to the fact that market capitalisation and market turnover (volume) have a high positive correlation, suggest a reason for the higher return of the well-diversified portfolio of small capitalisation stocks. (3 Marks)

If market capitalisation and market turnover (volume) have a high positive correlation then small capitalisation stocks have a lower turnover and lower liquidity.

Since investors must accept liquidity risk when buying small capitalisation stocks they require compensation for this additional liquidity risk in the form of higher return.

Marking Guide (3 CJ):

- **Two marks for first paragraph (2 CJ)**
- **One mark for second paragraph (1 CJ)**

(h)

An actuarial consultant is engaged to review the ex-ante (future) performance of an active investment fund manager. The consultant's report focuses on a qualitative analysis of the managers' investment processes and personnel. The report does not perform a quantitative analysis of the managers' previous investment performance. Enumerate reasons why. [Hint: You should include a discussion of t-statistics in your answer.] (5 Marks)

Research on mutual fund performance in the U.S. (Carhart (1997), Berk and Green (2004)) has discovered only very weak evidence of the persistence of mutual fund performance. In light of this research an analysis of ex-post (previous) manager investment performance will not be predictive of ex-ante (future) manager investment performance. A qualitative analysis of process and personnel is likely to be more predictive of future investment performance.

The formula for a t-statistic to test a sample mean against the null hypothesis (the probability that the population mean is zero) is as follows:

$$t = \frac{\bar{S}}{\bar{\sigma}}\sqrt{n} = IR\sqrt{T}$$

where
t is the t-statistic.
$\bar{S}$ is the sample mean.
$\bar{\sigma}$ is the sample standard deviation.
n is the number of samples.
IR is the manager information ratio.
T is the years of investment performance (samples) used to calculate the IR.

The sample mean over the sample standard deviation is simply the ex-post manager information ratio. So if we observe n independent information ratio outcomes from an active manager (T years of investment performance) then we can generate a t-statistic and calculate the probability that the positive information ratio over n periods (years) was due to chance or skill. A t-statistic of 1.6 implies a 90% confidence level that the information ratio is non-zero and due to investment skill rather than luck (randomness). For an unusually high 0.5 observed information ratio this implies that we must observe 10 years of investment performance to separate skill from luck using quantitative analysis. This is impractical in an analysis of ex-post manager performance.

$$1.6 = 0.5\sqrt{T} \Rightarrow T \approx 10$$

Marking Guide (5 CJ):

- **Two marks for first paragraph (2 CJ)**
- **Three marks for t-statistic properly explained (3 CJ)**

(i)

Table 1

Asset Class	Active Risk (ex ante)	Active Return (ex ante)	Management Expense Ratio	Portfolio Weight
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The after fee ex-ante information ratio for each asset class is:

$$\text{Australian Equities IR} = \frac{0.8 - 0.25\%}{2\%} = 0.275$$

$$\text{International Equities IR} = \frac{1\% - 0.4\%}{2.5\%} = 0.24$$

$$\text{Listed Property IR} = \frac{0.25\% - 0.25\%}{2\%} = 0$$

$$\text{Bonds IR} = \frac{0.1\% - 0.1\%}{1\%} = 0$$

$$\text{Cash IR} = \frac{0\% - 0.1\%}{0.1\%} = -1$$

The after fee ex-ante information ratio for the combined portfolio is (to 2 decimal places):

$$\text{Active Risk}$$
$$= \sqrt{(0.35 \times 2\%)^2 + (0.20 \times 2.5\%)^2 + (0.15 \times 2\%)^2 + (0.2 \times 1\%)^2 + (0.1 \times 0.1\%)^2}$$
$$\approx 0.93\%.$$

$$\text{Active Return}$$
$$= 0.35 \times (0.8\% - 0.25\%) + 0.2 \times (1\% - 0.4\%) + 0.15 \times (0.25\% - 0.25\%) + 0.2 \times (0.1\% - 0.1\%)$$
$$+ 0.1 \times (0\% - 0.1\%) \approx 0.30\%$$

$$\text{Portfolio IR} = \frac{0.3\%}{0.93\%} = 0.32$$

By inspecting the individual asset class after fee ex-ante information ratios it is immediate that Listed Property, Bonds and Cash do not contribute to the portfolio information ratio. Therefore the active management of these asset classes should be suspended (active risk should be zero) and the active risk of Australian and International Equity optimised to maximise the information ratio subject to the constraint that portfolio active risk remains at 0.93%.

Marking Guide (3 CJ):

- **0.5 marks for after fee ex-ante information ratio for each asset class (0.5 CJ)**
- **After fee ex-ante information ratio for the combined portfolio (0.5 CJ)**
- **Final paragraph (2 CJ)**

END OF PAPER

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