THE INSTITUTE OF ACTUARIES OF AUSTRALIA

INVESTMENT MANAGEMENT **1998 EXAMINATIONS**
SPECIALIST LEVEL PAPER TWO

Answer all 5 Questions

QUESTION 1 **(13 MARKS)**

a) Explain the principal of ***replicating portfolio strategy*** that is used to analyse options

(5 marks)

b) Due to the nature of prepayment behaviour, the term of mortgage-backed securities tend to increase as yields rise, and decrease as yields fall.

(i) Explain what this implies about the convexity of fixed rate mortgage-backed securities.

(4 marks)

(ii) What risk does such convexity pose for investors holding fixed rate mortgage-backed securities, particularly for liability-matched portfolios ?

(4 marks)

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QUESTION 2 **(14 MARKS)**

a) Explain the difference between standard deviation and beta as measures of risk.

(3 marks)

b) Outline the circumstances under which diversification of an investment portfolio can reduce risk

(4 marks)

c) You are give the following information about two asset types (A and B).

	A	B
Mean return % p.a.	20	11
Standard deviation % p.a.	20	5

Correlation coefficient between A and B = 0.25

Use the data to determine :

(i) Assuming that Asset B represents the market, what is the beta of Asset A?

(2 marks)

(ii) What portfolio, comprised of either or both of the two assets (A & B), will have the minimum possible standard deviation of return (short-selling is not allowed)?

(5 marks)

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QUESTION 3 **(16 MARKS)**

You are an asset manager for a large highly-rated life insurance company, managing assets supporting liabilities.

Recently, you purchased a large 15 year floating rate infrastructure subordinated debt asset at an attractive yield. However, due to strategic changes in the underlying life insurance business, this asset is now to be used to support the writing of 2 year term certain annuities.

Briefly describe the risks involved and suggest ways in which each risk could be managed.

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QUESTION 4 **(22 MARKS)**

a) Draw a typical asset mean-variance efficient frontier and label the relative positions of the cash, bond and share asset classes. Assume a normal yield curve.
(3 marks)

b) Typical mean variance analysis can be extended to incorporate expected liability payments by treating the value of the expected liability payments as a negative asset comprised of fixed cashflows. Draw the resulting surplus mean-variance efficient frontier and label the relative positions of cash, bond and share asset classes. Assume that liabilities have an average duration equivalent to the average duration of the bond portfolio, and the yield curve is normal.
(5 marks)

c) You have performed a stochastic asset-liability analysis for a portfolio of participating life insurance policies, focusing on risk and return measures that are meaningful to your management. Your objective is to maximise shareholder value, subject to risk and policyholder reasonable expectation constraints.

The risk of breaching the regulatory capital requirement in the medium term was used to set the risk-based capital requirement. Your analysis produces a different optimal benchmark asset mix to those from the methods described in (a) and (b) above.

Draft a letter to the Chief Actuary explaining :

(i) how asset-liability analysis could be used to determine the optimal benchmark asset mix (set out the steps taken);and
(6 marks)

(ii) why, in this case, your approach is more appropriate than either of the methods described in (a) or (b) above.
(8 marks)

Note :

The Policy Liability of participating life insurance business is equal to the market value of supporting assets. The liability cash flow is dependent on the actual investment experience and other experience as it emerges.

Shareholder value is the value of shareholder distributable earnings discounted at the shareholder opportunity cost of capital, and is a function of future profit margins and the regulatory capital requirement.

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QUESTION 5 **(35 MARKS)**

You manage a portfolio of equities and cash against the following benchmark :
50% equities (measured against All Ordinaries) and 50% cash

Your current portfolio has the following details :

Physical equities	$100ml
Cash	$0

The current market is :

Share Price Index (SPI)	2000
Implied volatility	30%

You are concerned that your current allocation is too aggressive, and choose to move to benchmark using only transactions in 3 month SPI call options with exercise price of 2200.

You have the following information on the price of 2200 SPI call options :

Spot price	Volatility	Delta	Price (pts)
2000	30%	0.316	56.7
2000	33%	0.337	67.5
2100	30%	0.439	94.4
2100	33%	0.450	106.8

a) What option trade is necessary to move to benchmark exposure. Give all details including : amount of options transacted, total premium, whether bought or sold. (4 marks)

b) What is the make-up of the portfolio after the option transaction ? Show the values of equities, cash, and options, as well as the option details. Demonstrate that the portfolio has an effective cash and equity exposure equal to the benchmark. (4 marks)

c) Explain what are the main risks in the portfolio after the option transaction ? (6 marks)

d) Later that day, the market suddenly surged higher. The SPI closed at 2100, and the value of the physical equities in your portfolio increased by 5.5%. Option market implied volatility increased to 33%. Showing all workings, recalculate the make-up of your portfolio. (5 marks)

Question 5 continues over page

Question 5 continued

e) Your manager is concerned about the results of this transaction, and has asked you to present a table clearly showing an analysis of the factors contributing to your performance relative to benchmark since doing the option transaction. Include a clear identification of the impact of market changes - and the interaction of these effects.

(16 marks)

END OF PAPER TWO