THE INSTITUTE OF ACTUARIES OF AUSTRALIA
LIFE INSURANCE MARKING GUIDE & SOLUTIONS

PAPER 2 **2000 EXAMINATIONS**

The purpose of this document (which should be read in conjunction with the corresponding examination) is to assist candidates in their preparation for future examinations. It is emphasised, however, that the solutions herein are not necessarily the only solutions or the best solutions, especially for those questions testing judgement. They should be regarded as illustrative only. However, a candidate who covered all the points in the specimen solution in the examination would have scored a very comfortable pass. This document should be used in conjunction with the 2000 Examiner's Report which is on the IAAust web site**.**

QUESTION 1 **(16 Marks)**

Question Part	Aim	Difficulty	Marks
(a)	4	A	2
(b)	4,9	A	5
(c)	9	B	3
(d)	3	A	6

Suggested grade cut-offs

Grade	**Cut-off**
A (clear pass)	13-16
B (pass)	7-12
C (below standard)	4-6
D (weak)	2-3

a)
The problem is that the mix of different types of risks will be different (i.e. worse) than that assumed in the mortality assumptions. In particular, people who know that they have a higher risk of claiming than the average for that premium rate will be more likely to apply for insurance as it is relatively cheaper than other companies or not available at other companies.

Marking Guide
- **1 mark for saying that the mix of business could be different to that assumed in the mortality assumption**
- **1 mark for referring to higher rate/refused at other companies**
- **do not give a mark for just saying substandard lives will apply – need to say why this is bad.**

b)
Features that the product can have are:
- accident only benefits for the first two (or so) years
- low sum insured in the first two (or so years) increasing to full amount thereafter
- exclusions (for two years) on death due to certain causes (especially common illnesses)
- low maximum for insurance e.g. $100,000
- low maximum entry age e.g. 40 years and low maximum age for coverage e.g. 50 years
- price for a worse mix of risks than for a product that has full underwriting (although this may make the problem worse as standard lives will be less likely to apply)
- a waiting period for trauma benefits
- exclusions for pre existing conditions
- exclusions for certain occupations and pastimes.

Marking Guide
1 mark for each reasonable (AND DIFFERENT) suggestion maximum 6 marks (although it is out of 5)

Question 1 continued

c)
Additional information

- competitiveness of the product to determine market share
  e.g.
  - how do the product features, especially the premiums, compare to the rest of the market
  - the advertising/marketing budget for the product
  - how successful have other ventures been, both in Australia and overseas, for similar products or for other financial services products

- Financial capability to see if have sufficient financial resources
  - the capital adequacy requirements to support the new business growth
  - current free capital or access to capital or reinsurance plans
  - reinsurance arrangements

- administrative capability to see if can handle volumes
  - number of processing staff
  - skills of the processing staff

Marking Guide

- **0.5 mark for each NEW general item**
- **0.5 mark for each reason**
- **maximum of three marks**

d)
For the existing company, the business can be written straight away without any approval from APRA or additional capital (beyond the capital adequacy requirements).

For a new company:
the company will need to be registered with APRA with the following details:

- company name
- related company details
- managerial structure
- operational structure
- new business plans
- distribution agreements
- investment policy
- administration functions
- various documents must be lodged

Capital (probably beyond the capital adequacy requirements) will need to be required for a new company as:

- The share capital plus share premium account must exceed $10m.
- For companies limited only by shares, eligible assets outside statutory funds must exceed the non-statutory fund assets by $5m

Question 1 continued

The company name must not closely resemble that of another registered life company

The company must have at least one statutory fund and a shareholders' fund.

Marking Guide

- **1 mark for saying requirements for existing company**
- **1 mark for registration**
- **2 marks for (all or most of) information required for registration**
- **1 mark for more capital required**
- **1 mark for new statutory fund**

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QUESTION 2 **(20 Marks)**

Question Part	Aim	Difficulty	Marks
All	7, 8	B	20

Suggested grade cut-offs

Grade	**Cut-off**
A (clear pass)	15 – 20
B (pass)	11 – 14.5
C (below standard)	7 – 10.5
D (weak)	0 – 6.5

Mortality:

- The assumption of 100% of IA90-92 is high compared with recent experience.
- The assumption of 90% selection effect in year 1 is inappropriate because, even with the best underwriting, there will be accident claims in the first year.
- The mortality assumption should be differentiated by smoking status.

Additional requirements:

- internal mortality experience studies, including review of trends and the effect of any change in business mix;
- industry mortality experience, including review of trends;
- details of current underwriting and claims philosophies; and
- details of any changes to underwriting or claims management approach which might impact the experience.

Marking guide:
½ mark per point, maximum 1½ mark for each of discussion and additional requirements (include any other good points)

Question 2 continued

Commission:

- Assume that the commission rates are correct.
- The override percentage does not look unreasonable.

Additional information:

- commission bases;
- experience analysis underlying override percentage.

Marking guide:
½ mark per point, maximum 1 mark for each of discussion and additional requirements (include any other good points)

Expenses:

- The level of expenses does not seem unreasonable.
- However, there should be an assumed inflation rate.

Additional information:

- internal expense analyses;
- projected budgets for both expenses and sales volumes.

Marking guide:
½ mark per point, maximum 1 mark for each of discussion and additional requirements

Interest:

- Depending on the company's investment strategy, the interest rate assumed is not unreasonable.
- There is no assumption regarding investment expenses so assume that the return is net of expenses.
- The student has not specified whether the assumption is gross or net of tax. Assume that it is gross of tax.

Additional information:

- company's investment strategy;
- information on company's investment expenses;

Question 2 continued

- consider outlook for the various investment markets in which the company invests;
- confirm whether assumed return is gross of tax or net.

Marking guide:
½ mark per point, maximum 1½ markof each of discussion and additional requirements

Lapses:

- The lapse assumptions appear low given the competitiveness of the YRT market.
- In particular, assuming no lapses in the first year is inappropriate.

Additional information:

- historic lapse analysis, including trends;
- industry lapse experience, including trends;
- details of distribution strategy;
- details of competitive position.

Marking guide:
½ mark per point, maximum 1½ mark for each of discussion and additional requirements

Reserves:

- The use of policy liabilities means that no account is taken of the cost of capital. This is inappropriate.
- The projection should make allowance for the way in which the company allocates capital to products, which would mean that the reserves used should be at least equal to capital adequacy reserves, perhaps with some allowance for target surplus.

Marking guide:
1 mark per point, maximum 2 marks

Question 2 continued

(b)
Mortality:

- less selection effect as the underwriting will not be as rigorous
- Non smoker may have more non disclosure but this will probably result in more denied claims (i.e. there will be more non smokers who are subsequently found to be smokers but who did not disclose this)
- the target market may be different demographically to the market for the standard product which may also exhibit different mortality

1 mark per point, maximum 2 marks

Commission:

- expect that the commission expense will be lower for a direct marketed product and may well be zero

1 mark per point, maximum 1 mark

Expenses:

- Need to allow for mailing costs and processing costs
- Need to allow for processing of rejected cases. Billing options may be limited.

1 mark per point, maximum 1 mark

Lapses:

- Experience should be good as mailing is to existing policyholders
- Probably only monthly business

1 mark per point, maximum 1 mark

Bonus Point: channel conflict may effect sales of agent produced products.

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QUESTION 3 **(23 Marks)**

Question Part	Aim	Difficulty	Marks
(a)	9(c)	A	2
		B	2
(b)	9	B	4
(c)	12	A	3
(d)	13,14,15	C	5
(e)	13,15	C	7

Suggested grade cut-offs

Grade	**Cut-off**
A (clear pass)	15-23
B (pass)	9-14.5
C (below standard)	6-8.5
D (weak)	0-5.5

(a)
Best two measures of profitability

Single Premium unit linked superannuation

Premium profitability. This is calculated by setting up a profit test with reserves set at say capital adequacy level and earning interest at fund earning rates. The annual surplus is calculated after allowing for transfers to and from reserves. The profit test is used again and the present value of annual surpluses is expressed as a percentage of the single premiums, using the risk discount rate.

At t=0: PP = PV (annual surpluses) / Single Premium @ risk discount rate.

(Alternatively, the denominator could be the present value of a measure of the annual assets).

The method is suitable as it is not affected by the small amount of capital invested in this type of product.

Interpretation:
The total value to the company as a proportion of the sale.

Margin on services profit margin. All cash flows are projected and the present value of all cash flows, including profit, is equated to zero.

At t=0: PM = -BEL / PV (profit driver) @ MoS discount rate.
The profit driver can be premiums, claims, funds under management.

This method is suitable as it is consistent with the reported profit

(Other methods are appropriate except for internal ate of return and the break even point as these methods assume there is significant capital invested in the business.)

Interpretation:
The annual MoS profit relative to the provision of the key service underlying the product.

Question 3 continued

Yearly renewable term insurance

Internal rate of return. This is calculated by setting up a profit test with reserves set at say capital adequacy level and earning interest at fund earning rates. The annual surplus is calculated after allowing for transfers to and from reserves. The present value of the annual surpluses is calculated using a risk discount rate. The IRR is the rate at which the PV of annual surpluses is zero.

At t=0: IRR is rate i for which PV (annual surpluses) = 0 using interest rate i.

This method is suitable as there is significant capital invested in this type of product due to risks of the business an also there is usually very high commission in the first year. This method looks at the return on this capital

Interpretation:
The return the company gets on its investment in the business.

Premium profitability. The profit test is used again and the present value of annual surpluses is expressed as a percentage of the present value of annual premiums, using the risk discount rate.

At t=0: PP = PV (annual surpluses) / PV (annual premiums) @ risk discount rate.

This method is suitable as it allows for capital requirements and the cost of that capital.

Interpretation
The annual profit as a proportion of the annual premium.

(alternative)

Margin on services profit margin.
(as described above)

Breakeven point. This is the point at which the accumulated negative surpluses (i.e. capital invested), allowing for interest, turn positive.

At duration t: FV (annual surpluses) = 0 @ risk discount rate.

Interpretation:
The number of years it takes for the company to generate the target return on its investment n the business

Marking Guide
0.5 mark for each method including description and formula
0.5 mark for each reason
0.5 mark for interpretation
Total of 4 marks

Question 3 continued

(b) Additional Information

- copy of policy documents and marketing literature to ensure that all policy benefits have been included in the pricing;
- details of the company's distribution strategy to determine appropriateness of assumed sales volumes;
- details of experience investigations
- competitor benefits and premium rates to assess competitive position;
- confirm company's profitability criteria;
- details of distribution of business assumed in projections by age, sex, smoking status, policy size and details of the actual business mix;
- understanding of policy limitations eg maximum and minimum ages;
- details of company's capital position, administrative capabilities, resources to ensure it has the capacity to write the business;
- details of the proposed reinsurance arrangements.
- investment strategy

Marking guide: 0.5 mark per point, maximum 4 marks

(c) Capital Invested.

The company must meet or exceed the capital adequacy level at all times. It may prefer to hold additional capital as a buffer to protect the capital adequacy position. This buffer is often called target surplus.

The capital will be the excess of the capital adequacy requirement over policy liabilities and other liabilities. The components of capital will be:

- excess of capital adequacy liability over policy liability
  ½ mark
- resilience reserve to cover asset / liability mismatching
  ½ mark
- reserve for inadmissible assets
  ½ mark
- target surplus to act as a buffer above the capital adequacy
  ½ mark
- new business reserve to ensure company can meet the solvency requirement in the next 3 years, based on expected new business
  ½ mark

Question 3 continued

The actuary should be able to allocate the total capital between the products, as part of the analysis of product performance. The resilience and inadmissible assets reserves would need to be split arbitrarily amongst the products, based on a notional asset mix for each product. ½ **mark**

Total of 3 marks

(d) Profitability of products and return on capital

This is an open question and different approaches are possible. The solution below is one of several ways of answering the question. Markers should consider a range of possible solutions.

Profitability of products

- Review the amounts of MoS profits by product over the past 3 years and the profits forecast for the current year. Split these profits into planned profit margins and experience variations to show the stability or otherwise of the assumptions.

- Calculate an average annual MoS profit margin, allowing for the experience variations, for each product. Profit margins may be a percentage of premium or funds under management. Compare the average profit margins of the products where possible. This is best achieved by comparing similar product types e.g. risk products (YRT term, tpd, trauma, disability, group life, GSC), single premium products (immediate annuities, bonds, allocated pensions) and regular premium products (investment account and unit linked business).

- Calculate profit margins, using pricing assumptions, for a block of new business. Compare the profit margins for the new business and inforce business and reconcile any differences. Differences may arise due to higher average premium size for new business, lower expenses used in the pricing basis, more aggressive mortality assumptions for new business or lower premium rates or charges for new business.

- The combined profitability of current inforce business can then be determined for each product and discussed with the company.

Return on capital

- The capital invested in each product should be determined each year for the past 3 years and for the current year. This is the excess of the capital adequacy requirement over the policy and other liabilities for each product, plus any target surplus.

- The MoS profits by product for the past 3 years and for the current year are obtained from above and we then need to add interest earned on the capital. We can then calculate average rates of return on capital, by product. This ROC will be equal to:

$$\text{ROC} = \frac{\text{(average annual planned profit + experience variation + interest on capital)}}{\text{Average annual amount of capital for the product}}$$

Question 3 continued

- The combined return on capital for current inforce business can then be determined for each product and discussed with the company.

Marking Guide:
2½ marks for "Profitability of Products" and 2½ marks for "Return on capital". Suggest 1 mark for first 2 bullets and ½ mark for 3rd bullet in each section.

Total 5 marks for part (d).

(e) Actions to improve return on capital.

- Revise the product structure to reduce the amount of new business financing. Capital is required to finance the excess of the capital adequacy liabilities over the policy liabilities. This could be achieved by reducing the upfront commission and increasing the renewal commission or by changing the commission clawback provisions.
1 mark

- Change the new business mix by discouraging the products with low return on capital (e.g. perhaps this could be risk business with high upfront commission, investment account business) and encouraging products with a the high return on capital (eg this might be single premium business, low commission regular premium business, unit linked business).

1 mark

- Change the asset mix of the capital guaranteed business to become less risky e.g. increase cash and reduce equity and property assets. This will reduce the resilience reserves for the statutory fund.

1 mark

- Increase the profitability of products by increasing fees and charges and premium rates, where the market will allow it
1 mark

- Review the amount of target surplus required by re-evaluating the amount of capital required to protect the capital adequacy position under potential adverse scenarios.
1 mark

- Convert the inadmissable assets into admissable assets, where possible.
½ mark

- Reduce the amount of currency mismatching i.e. where assets and liabilities are in different currencies. Again, this will reduce the resilience reserve.
½ mark

- Review the capital adequacy margins over best estimate assumptions in the capital adequacy valuation basis. Where the margins are unnecessarily conservative, after considering the nature of the business inforce, they could be revised downwards (become less conservative).
1 mark

Question 3 continued

- Consider converting capital guaranteed business to unit linked by offering incentives to policyholders. This would then reduce the resilience reserve.

  1 mark

- Consider financial reinsurance solutions, where the amount of capital adequacy reserves can be sharply reduced by reinsuring the "upper tail" of the risks with a registered Australian reinsurer.

  ½ mark

- Take on traditional reinsurance to reduce the amount of capital support.

  ½ mark

- Consider selling higher volumes of low capital intensive products to achieve lower unit costs by spreading the fix costs over a larger base

  ½ mark

Maximum of 7 marks for part (e)

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QUESTION 4 **(29 Marks)**

Question Part	Aim	Difficulty	Marks
(a)	13(a)(b)	A	4
		C	2
(b)	13(c)	B	4
(c)	13(c)	B	5
(d)	12 (c),(d)	B/C	4
(e)	13 (c)	C	10

Suggested grade cut-offs

Grade	**Cut-off**
A (clear pass)	22-29
B (pass)	17-21.5
C (below standard)	12-16.5
D (weak)	4-11.5

(a)
(i)
Appraisal values are used in Australia for a variety of purposes. These include:

Shareholder value management, including pricing

Financial reporting eg for balance sheet, investor reporting

Purchase/sale of life companies

Marking guide:
0.5 mark for each of the above points plus 0.5 mark for any other sensible other uses of appraisal values that are not repetitions of the above to a maximum of 2 marks

(ii)

An appraisal value is the present value of amounts distributable to shareholders of the company. Distributable profits are profits that can be released from the company after regulatory capital requirements have been met. Therefore in Australia, the distributable profit is the profit after the capital adequacy requirements have been met.

In order to calculate the appraisal value, it is usual to perform a projection of the future distributable profits of the company using a model that reflects the cashflows emerging from the products and the ongoing capital requirements. Usually all the existing policies of the company are represented by model points to speed up the calculations.

Marking guide:
1 mark AV PV of distributable profits and definition
1 mark for details of calculation method

Question 4 continued

(iii)
The appraisal value is not necessarily an estimate of the sale price. It is a present value of future distributable profit and typically, in Australia at the moment, the actual sale price has exceeded the appraisal value. Purchasers may be willing to pay in excess of appraisal value for a number of reasons, including a desire to enter the market, or the ability to achieve revenue or expense synergies which cannot be generated by the company on a stand alone basis.

Marking guide:
0.5 mark AV not the sale price
1 mark for sale price typically exceeding the AV
0.5 mark for reasons why

(b)
Information that can be used to prepare such an estimate includes:

Commissioner's Rules 21 – for the present value of future profits, expenses.

Product Brochures – to get a description of current products sold

Published Financial Statements – to get the net assets, profitability

Market Share Information (eg: ASSIRT, Rice Kachor) – for sales volumes, lapse analysis to assess run off pattern for existing business.

Marking guide:
1 mark for each of the above points plus 1 mark for any other sensible item that are not repetitions of the above to a maximum of 4 marks

(c)

Reports / information

- Internal appraisal work (if any)
- Capital adequacy returns
- Projections from model
- Financial Condition Report
- Business Planning Projections
- Sensitivity Analysis
- MoS assumption and experience analysis.

Question 4 continued

The highest priorities are:

- internal appraisal work
- MoS assumption and experience analysis
- Financial Condition Report.

The reasons why these are the highest priority are that contain information that is not publicly available but would be very useful to value the company (i.e. to set assumptions and the starting position) and they should be easy to get a hold off.

Marking guide:
0.5 mark for each of the pieces of information
0.5 mark for any other item that are not repetitions of the above plus
1 mark for the most important
1 mark for reason for priority
to a maximum of 5 marks

(d)

Statutory requirements being the capital adequacy and solvency requirements

Purpose of solvency is to protect policyholders in a wind up situation
1/2 mark

Purpose of capital adequacy is to ensure adequacy on an ongoing basis
1/2 mark

Significantly higher new business growth rates could mean that capital requirements increase markedly over current levels and any initial strain will need to be funded by the shareholder. Will depend on the nature of business sold as to whether this is an important issue for a purchaser.
2 marks

Capital adequacy requirement must allow for additional capital required to meet expected new business sales. Therefore additional capital, if any, will be required soon after any purchase.
1 mark

(e)

Net Assets = Assets less Capital Adequacy Requirement = 100 – 85 = 15m
1.5 marks

Present Value MoS Profit Margins = 75 – 55 = 20
1 mark

PV Profits from In Force Business = Present Value MOS Profit Margins @ RDR + Present Value Release of Capital Adequacy @ RDR
1 mark

Present Value MoS Profit Margins @ RDR = 20 * .75 = 15
1 mark

Question 4 continued

Current Capital Adequacy = 10
Present Value Release of Capital Adequacy @ RDR = 10 * .75 = 7.5
Assumes pattern of CA release similar to Profits

2 marks

Value of In Force = 15 + 7.5 = 22.5m

0.5 marks

(Alternative for these 4.5 marks:
PV Profits from In Force Business = Present Value of Distributable Profit @ RDR

1.5 marks

Face Value of distributable Profit = Capital Adequacy Requirement– Best Estimate Liability (or equivalent formula)

1.5 marks

PV Profits from In Force Business = (85 – 55) * 0.75 = 22.5

1.5 mark)

Value of New Business = Value of Future Years Sales at RDR = 50m
Assuming future year's sales represents an appropriate set of growth rates from current volumes – multiplier of approximately 10 implied in calculations – high but not surprising given next year growth expected from (d)

2 marks

Appraisal Value = Net Assets + PV In Force + Value of New Business = 15 + 22.5 + 50 = 87.5m

1 mark

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QUESTION 5 **(12 Marks)**

Question Part	Aim	Difficulty	Marks
(a)	11(d)	B	3
(b)	12(b)	C	3
(c)	12(a)	B	3
(d)	11(c)	C	3

Suggested grade cut-offs

Grade	**Cut-off**
A (clear pass)	9-12
B (pass)	6-8.5
C (below standard)	3-5.5
D (weak)	1-2.5

(a)

Need to check that the model accurately represents the underlying policy data and product conditions

1 mark for what needs to be checked

Checks that need to be performed include:

1. Verifying all policy statistics are the same in the model and in the full data
2. Verifying that projected cash flow items are the same in the model as if the full data were used and also that calculated on a policy by policy basis the model produces results consistent with the data and product
3. Verifying present value items are the same in the individual policy results and in the model

1 mark for details of checks

These checks can be performed within a reasonable level of materiality – should be identical (or reconcilable) for statistical items, and within predetermined materiality for calculated items.

1 mark for materiality considerations

(b)
(Note for students: This is the only answer that was changed to include recommendations from the markers)

Policy Liabilities
Tax is one of the assumptions used to determine the best estimate liability. If future tax payments increase then the best estimate liability will increase (in this example the increase will be $5m for each of individual life and group life). The present value of future profit margins will decrease (as long as they remain positive) to offset the increase in the BEL. In the example, the Individual PVPM will still be positive after the change and so the total policy liability will be unchanged. For group, there are no profit margins and so the policy liability will increase by $5m.

0.5 mark for increase in BEL
0.5 mark for decrease in profit margins but check for cap losses

Question 5 continued

Solvency

The total solvency liability can be thought of as two main parts: the present value of future cashflows using the solvency assumptions plus the additional components like resilience and admissible assets and the various minimum test. The present value of future cashflows will increase by about $5m for each of individual and group for similar reasons as the increase in the BEL but not by exactly the same amount as the experience assumptions are different. The other components should not change but they should still be checked.

0.5 mark for comment on present value similar to BEL
0.5 mark for comment on additional components

Capital Adequacy

Like solvency, the total capital adequacy requirement can be thought of as two main parts: the present value of future cashflows using the capital adequacy assumptions plus the additional components like resilience and admissible assets and the various minimum tests. The present value of future cashflows will increase by about $5m for each of individual and group for similar reasons as the increase in the BEL but not by exactly the same amount as the experience assumptions are different. The other components should not change but they should still be checked.

0.5 mark for comment on present value similar to BEL
0.5 mark for comment on additional component

(c)

Major components of the MoS liability are as follows:

BEL = present value of benefit obligations and expenses less any future premium

1 mark for BEL

PVFP = present value of future profits expected on current assumptions to accrue to shareholders.

0.5 mark for PVFP

In the example, we see that:

1. Group has no future profits for shareholders on current assumptions but Individual does.
2. BEL for Individual is negative, indicating that this block currently is effectively an asset rather than a liability for the company.

1.5 marks for commentary from example, including which products have future profits on current assumptions, what a negative BEL implies

(d)

Before the change

BEL = Policy Liability (PL) less Present Value of Future Profit Margins (PVPM)

PVPM (INDIV) = 8	PL (INDIV) = (10)	BEL(INDIV)=(10)–8= (18)
PVPM (GROUP) = 0	PL (GROUP) = 16	BEL (GROUP) = 16

Question 5 continued

After change:
BEL new = BEL old + tax change
Increase in BEL = tax change

PVPM new = Max(PVPM old – increase in BEL, 0)

PLnew = BEL new + PVPM new

PVPM (INDIV) = 8-5=3	BEL (INDIV) = (18)+5 =(13)	PL (INDIV) = (10)
PVPM (GROUP) =Max(0-5,0)= 0	BEL (GROUP) = 16+5=21	PL (GROUP) = 21+0=21

Summary
BEL (indiv) = (13)
BEL (Group) = 21

PVPM (indiv) = 5
PVPM (group) = 0

Marking guide:
- **0.5 mark for Indiv BEL**
- **0.5 mark for Group BEL**
- **0.5 mark for Indiv PVPM**
- **1 mark for Group PVPM**

MoS net assets = Assets (no change) – Policy Liabilities
= 110-11
=99m

Marking guide:
0.5 mark for answer

END SOLUTIONS PAPER 2