

# **INSTITUTE OF ACTUARIES OF INDIA**

## **EXAMINATIONS**

**30<sup>th</sup> November 2023**

**Subject CP2B – Actuarial Modelling (Paper B)**

**Time allowed: 3 Hour 15 Minutes (14.45 – 18.00 Hours)**

**Total Marks: 100**

### **INSTRUCTIONS TO THE CANDIDATES**

- 1. Mark allocations are shown in brackets.*
- 2. Do save your work in solution template on a regular basis.*
- 3. All the detailed guidelines are available on exam screen.*
- 4. If Any, Data set file(s) accompanying the question paper is available for download on the exam screen.*
- 5. Please check if you have received complete Question Paper and no page is missing. If so, kindly get new set of Question Paper from the Invigilator.*

#### **AT THE END OF THE EXAMINATION**

**Please return this question paper to the supervisor separately. You are not allowed to carry the question paper in any form with you. You are requested to save and submit the work before leaving the examination premises.**

### Exam requirements

Read the background document, which describes the approach that has been used to model and documented for this project and the work that remains outstanding.

Read the audit trail, which has been written by your colleague, another actuarial student, for the calculations performed by him. This will assist you in following and understanding the calculations performed in the Excel model provided.

You are not required to add or amend the audit trail.

You should assume that your colleague's calculations have been checked and are correct. Expand the spreadsheet model to produce the following additional calculations. You should ensure that the additional work you undertake on the spreadsheet contains appropriate self-checks and you should not overwrite the existing calculations.

#### Q. 1) Additional information and modelling steps

- i) Recalculate the sales, expenses, cost, profit and NPV profit margin under each of the scenarios. Impact of each of them has to be separate and independent (i.e. all these changes have to be made on the base projection provided)
- a) The company changes its premium growth rate to 15% p.a. (2)
- b) If the organisation decides to outsource the marketing activity to an external vendor. The vendor will charge INR 1500 lacs for the first 5 years and thereafter charge INR 1800 in years 6 to 10. (3)
- c) The company increases the share of product A and reduces the share of product C as per the table below: (3)

	% of total sales amount		
Year	A	B	C
1	70%	20%	10%
2	70%	20%	10%
3	70%	20%	10%
4	75%	18%	7%
5	75%	18%	7%
6	75%	18%	7%
7	75%	18%	7%
8	80%	18%	2%
9	80%	18%	2%
10	80%	18%	2%

- d) The below given discount curve is to be used, which is set as the applicable risk free rate + risk margin, to discount the projected profit and premium cashflows.

Year	Applicable discount rate (forward rate)
1	7.67%
2	7.91%
3	8.02%
4	8.59%
5	9.01%
6	8.72%
7	8.80%
8	9.23%
9	9.10%
10	9.10%

[Hint : For example : cashflows in year 3 can be discounted as to calculate the Present value at the start of year 1 as :

[Cashflow year 3 / {(1+ Forward rate for year 3)\*(1+ Forward rate for year 2)\*(1+forward rate for year 1)}]

(3)

- e) For each of the above, show a summary of how the NPV profit, NPV premium and % profit margin changes as compared to the base scenario and comment on the same. Also create a graph to show the comparison of % profit margin under different scenarios. For the base scenario, show how the yearly profit amount progress over the years.

(4)

**[15]**

- Q. 2)** Prepare a summary in the specified worksheet within the same spreadsheet capturing the main features and results of the work completed by you and your team member. You can assume that the summary is being written for the head of products of the company, who will use this to decide on its expense allocation and sales strategy

**Your summary should include the following:**

- Purpose of the exercise, inputs, methodology and assumptions used by you and your junior team member.
- Results: including (i) year wise total expense %, total cost % and profit %; (ii) product wise NPV profits and NPV profit %.
- Charts on how the product wise profit % varies by year.
- Summary results (NPV profits and NPV profit % - product wise and total) on how the results change under different scenarios along with relevant rationale.
- Chart summarising the impact of different scenarios.
- Key conclusions.
- Suggested next steps.

**Commentary on the results should cover, but not be limited to:**

- How the components of expense, which are fixed and variable in nature, impact the profitability over the years.
- Profitability of each of the products and the key reasons for varying profit margin between the products.
- How different aspects impact the profitability – business volume, product % mix, outsourcing marketing cost and changing the discount rate.

- Next steps including what are the other aspects the organisation needs to consider and other variables it can change to increase the profitability.

**The summary should cover the full scope of the project, including the additional scenarios, which was modelled in the spreadsheet provided to you.**

**You are not required to add or amend the audit trail.**

**Marks available for the summary:**

i) Purpose, inputs and assumptions	(10)
ii) Methodology	(20)
iii) Input Checks and reasonableness checks	(3)
iv) Results, including charts. Results should include how the profits, premium and % profit margin change with different scenarios.	(10)
v) Commentary on results and conclusions	(17)
vi) Next steps	(15)
vii) Drafting	(10)
	<b>[85]</b>

### **Overview of the project**

A Government organisation wants to launch certain insurance products to the masses. It has designed 3 separate types of products A, B and C.

The products manager has been given a responsibility to estimate the net profit of these over a projection period of 10 years. For the same, the actuarial team has already given the expected insurance cost (the expected claim payouts on the policies). The manager had already asked a junior team member to work on expense calculation for this business and thus estimate the profitability. Insurance cost + Expenses (including commissions) = Total cost of the policies.

The junior team member had completed the calculations required. But now the Product manager wants you to enhance the work done by the junior team member and test a few approaches to show an increase in profitability of the business so that it is easy to get approval from the management of the organisation to launch the business.

For the expenses, there a few components:

1. Commissions it will pay to its agents - The commissions rate has been fixed based on the current market standard for that product category.
2. Fixed set-up cost - the finance team has calculated and provided a number, which the manager had initially planned to run off over a period of 5 years (equal amount each year).
3. Fixed salary cost for the back-office support people has been provided by the finance. This increases every year by a given inflation.

4. Variable salary cost – a % of the yearly sales target has been derived and provided as variable salary cost.
5. Marketing cost – also a % of yearly sales target.

The objective of this exercise to

1. Calculate the expense and commission.
2. Apportion the expenses on the basis of number of policies to be sold under each of the product.
3. Calculate the total and product wise profitability, over the 10 years projection period.
4. Calculate a net present value of the profit and the premium to be earned over the 10 years period and calculate a profit %.

The management will use the profit % (based on NPV profits and premium) to decide whether to launch the products or not (Products which are expected to provide negative profit margin will not get approval for issuance).

**You, being a senior member of the team, think that the profit % may not be sufficient for the organisation to be able to launch all products. Hence, you want to test how the margins would change by changing a few aspects of the calculation.**

- Increasing the size of the business by increasing the yearly premium growth rate.
- Consider outsourcing the marketing activity, moving it from variable to fixed cost.
- Increasing the sales % of the product with a higher profit margin %.
- Using a curve (time dependent discount rate) to discount the Premium and profit cashflows, instead of a single rate.

The Senior Actuary has provided you with the model and Audit trail written by the junior team member. This does not include the calculation based on additional scenarios to be tested. You are required to use the model provided and test the impact of additional scenarios tested. Also, you are required to prepare a summary report which the product manager can use to demonstrate to the management that the potential profit of the business, along with other factors to be considered.

**You are not expected to include the additional modelling you undertake in the audit trail, but the approach and results of all elements of the scenario should be included in the summary.**

## **Audit Trail**

### **Background**

The Government organisation wants to launch certain insurance products to the public and has designed 3 separate types of products : A, B and C.

The exercise is being done to determine the net profitability from these three products (separately as well as combined).

### **Objective**

The Objective of this work is to:

- Calculate the expense cost and commission (total as well as product wise split) over the 10 year protection period based on the inputs provided by the Finance team.
- Combine the above with the insurance cost for these products to calculate total expected outflows from the business.
- Calculate profit cashflows over the projection period using the premium income and the expected cashflows.
- Calculate Present value of profits, Present value of premium and % profit margin for the business.

### **Inputs**

The following inputs were received. These are present in sheet 'Inputs'

- Sales target :
  - Sales target in the first year and thereafter the growth rate assumed in the sales (net premium collected)
  - % premium collected for the three products (A, B and C) in the total sales target year wise

*Check : A check was done to ensure the total product share of A+B+C equals to 100%*

- Expenses :
  - Initial fixed cost and inflation rate for future years
  - Initial set-up cost
  - Variable cost (% of the premium amount to be collected)
  - Commissions rate payable – product wise
  - Other marketing cost (% of the premium to be collected)
- Insurance cost - % of premium which will be used to meet the claims cost under the policy (product wise).

### **Additional inputs/assumptions**

- Average expected premium amount per policy – to determine the size of the policy and average number of policies expected to be sold to meet the sales target.
- Discount rate used to calculate the Present value of profits and of premium.

Besides, it is assumed that

- The premium, expenses, commissions and insurance cost amounts are assumed to be represent the value at the end of the year for simplicity of discounting purposes.
- It is assumed that any additional actuarial reserves required to be held is included in the insurance cost.
- Taxes are ignored while calculating the profits.

### **The calculation and results**

The calculation is done in sheet 'Projection – base'. The calculation is divided into the following parts:

- Projection year – projection is done for 10 years.

- Sales amount – Columns C to F show the expected premium to be collected each year. For the first year, this is directly taken from the inputs. For Subsequent years, it is grown at the given growth rate. The total amount is then split into the three products using the ratio provided in inputs.
- Commissions – present in columns H to K. This is calculated by directly multiplying the commission rate for the product to its expected premium amount. Total commission is calculated by adding the commissions for the three products.
- *Commission amount = Commission rate \* Sales amount*
- Expenses
  - In column M, the fixed cost is calculated – Year 1 directly from the input. Year 2 onwards inflating the previous year number by the given inflation %.
  - In columns N to P variable cost is calculated – the salary component varies year wise and accordingly the % is looked up using the Vlookup function of the excel. The marketing cost % is directly taken from the inputs. The total % is then multiplied by the total sales to get the variable cost in amounts.
  - Initial set up cost is provided in shows in column Q. Given it has to be run off within 5 years, in columns R for year 6 onwards the amount is set as zero. For year 1 to 5, the amount is set to be initial set up cost amount / 5. For calculation of the total expenses to be accounted – only column R will be used.  
*Allocated expense every year = Initial set up cost / Run off period*  
*A check was done to ensure the total in column R is equal to total in column Q*
- Number of policies sold – This is required to apportion the total cost between the products and shown in columns T to W. First product wise number of policies are calculated by dividing the total sales value by the average premium size per policy. Care is taken of the units as the total premium (sales is in INR lacs). The total for products A, B and C is then added.
- Total expenses– In column Y, the total expenses is calculated using the fixed expenses and variable expenses calculated previous. This is then apportioned between the products in columns Z to AB using the number of policies sold calculated earlier.
- Insurance cost –Product wise insurance cost is calculated using the % provided in the inputs and multiplying it with the total sales (premium) to be collected for each product for each year. This is done in columns AE to AG. The total is then added up in columns AD.
- Total cost – This is shown in columns AI to AL – where the insurance cost is added to the total expenses and commissions cost, calculated in the earlier columns. This represents the net outflow from the policies.
- Profit – In columns AN to AQ, profit amount is calculated by deducting the total cost from the total premium to be collected for each year and for each product. This is done for each product separately and also on combined basis.
- Profit % - In rows 17 and 18, a present value of the expected profits and expected premium income is calculated. For this excel NPV function is received. Profit margin % is calculated as NPV profit / NPV premium.

\*\*\*\*\*