

INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

25th March 2022

Subject CP2A – Actuarial Modelling (Paper A)

Time allowed: 3 Hour 30 Minutes (09.30 – 13.00 Hours)

Total Marks: 100

Background

A businessman in the city runs an ice-cream wholesale shop. He is selling gallons of ice-cream and flavored ice-cream syrup bottles. Being a wholesaler, he doesn't sell in loose quantity. He wants to conduct an analysis on the profit he made over the last 10 years. He has approached your firm to do an analysis under different scenarios. For this you have been provided with monthly sales quantity of ice-cream over the last 10 years.

His sales is steadily increasing each calendar year.

Each ice-cream gallon costs him Rs. 150. He sells it for Rs. 250 in winters and Rs. 270 in summers. The winter season in the city is from January to March. He can purchase a maximum of 2,000 gallons of ice-cream in a month and sourcing is done on first day of the month, so per month sale is restricted to a maximum of 2,000 gallons.

For each gallon of ice-cream, he sells 3 bottles of syrup. There are two flavors in syrup- Chocolate and Vanilla.

Chocolate syrup cost is Rs. 50 while Vanilla syrup cost is Rs. 40 and he is selling both flavors for same price of Rs. 70. Chocolate syrup is favourite amongst his customers and is sold twice as much as Vanilla syrups.

In order to run the business, the shopkeeper incurs following additional costs-

Rent of the shop – Rs. 35,000 per month.

Staff salary- Rs. 30,000 per month

Electricity Bill-

- 10,000 per month in summers
- 7,000 per month in winters

The shopkeeper is required to pay income tax on monthly basis. Income tax rate is 25%. Income tax is applicable on net income i.e. revenue less costs.

Above defines the base scenario for the shopkeeper.

In last few years, it was seen that due to global warming, summers are longer, and winters are technically for January and February month only.

The shopkeeper must sell on old price for January to March for competitive reasons but in the month of March the electricity bill is at par with summers and the sales is expected to increase by 20% for March month.

He would like to analyze this scenario as well and understand the profit impact for such a case. This is defined as scenario 1.

The Shopkeeper is considering buying the shop to save on rentals. There is a bank which can finance amount equal to 100% of the property value. The shopkeeper plans to take mortgage equal to 100% of the property value of Rs. 5,000,000 (5 million) from the said bank. The bank will be charging 6% p.a. interest on the monthly outstanding mortgage balance for 10 years. The loan will be repaid in equal monthly installments (EMIs). Calculate the EMI and interest for cashflow projection. Interest paid on mortgage is tax deductible. This is considered as scenario 2. This will be on top of scenario 1 of extended summers.

To calculate the EMI, a monthly installment should be goal seeked which will make loan outstanding 0 at end of 10 year (120 months). The calculation should be performed on monthly basis.

Compare the annual profit for 10 years in a graph under all the three scenarios and calculate net present value of profits at a discount rate of 10% p.a.

Q. 1) Modelling steps and data checks

Read the background document, which describes the scenarios that need to be modelled and documented for this project.

Construct a spreadsheet model that produces the following calculations and charts.

You should ensure that your spreadsheet contains appropriate self-checks and that you have performed (and documented in the audit trail) reasonableness checks at each stage of your calculations.

- i) Carry out checks on the data provided to confirm that the data is complete and fit for use. This should include analysis of the data provided to give reassurance that the data is accurate, correct, and consistent with the instructions provided. (5)
- ii) Calculate the profit for each month under the current situation (base scenario) by:
 - a) Calculating the revenue from the sale of ice-cream and syrups.
 - b) Calculating the following costs:
 - Salaries
 - Rent
 - Cost of ice-cream and syrups
 - Income tax (10)
- iii) Calculate the net profit margin over 10 years under all the three scenarios i.e. (Base scenario, Scenario 1, Scenario 2) (3)
- iv) Calculate the equated monthly installment. (3)
- v) Repeat steps (ii) and (iii) for alternate scenarios. (6)
- vi) Produce suitable chart to illustrate the results in (ii) and (v). (2)

[**Note:** all scenarios outlined above should be modelled separately in your spreadsheet. The user should not need to change the parameters to see the results.]

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Q. 2) Modelling technique and practice:

- i) Auto checks on the modelling steps in all the scenarios. (5)
- ii) Demonstration of good modelling technique and practice. (6)

[11]

Q. 3) Audit trail

Produce an audit trail for your spreadsheet model that includes the following aspects:

- Purpose of the model
- Data and assumptions used
- Methodology, i.e., description of how each calculation stage in the model has been produced
- Explanation of any checks performed
- Explain the graphs preparation

You should ensure that your audit trail is suitable for both a Senior Actuary, who has been asked to approve your work, and a fellow student, who has been asked to peer review and correct your model, or to continue work on it, or to use it again for a similar purpose in the future.

Marks available for audit trail:Audit approach

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| i) Communication skills. | (4) |
| ii) Fellow student can review and check methods used in the model. | (7) |
| iii) Senior Actuary can scrutinise and understand what has been done. | (7) |
| iv) Written in clear English. | (4) |
| v) Written in a logical order. | (3) |

Audit content

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|---|-------------|
| vi) All steps clearly explained. | (7) |
| vii) Reasonableness checks included. | (5) |
| viii) Clear signposting included throughout. | (4) |
| ix) Statement of assumptions made. | (5) |
| x) All model steps accurately covered. | (14) |
| | [60] |
