

INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

November 2025

Subject CP2 – Actuarial Modelling (Paper B)

Time allowed: 3 Hour 15 Minutes

Total Marks: 100

Exam requirements

Read the background document, which describes the approach that has been used to model and the additional work to be done.

Read the audit trail, which has been written by your team members for the calculations performed by them. 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 team'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 net cashflows for ABC Group Limited over next 10 years and the corresponding Internal rate of return (IRR) and Multiple on invested capital (MOIC) for the following additional scenarios. Create a scenario 'b' for each of the Options.
 - a) Option 1 – Scenario b:
Splitting the investment of INR 1200 Cr as INR 600 Cr for equity and INR 600 Cr zero interest debt financing with royalty payments till twice of this amount is paid back. (4)
 - b) Option 2 – Scenario b:
40% of the stake of ABC Limited in the Highway project to be sold at the end of year 5 (partial exit) and then full exit at the end of year 10 (3)
 - c) Option 3 – Scenario b:
Valuation of the InsurTech at the end of 10th year to be done as 10 times the accumulated profits at the end of 10th year. (3)
- ii) Present a summary of results containing net cashflows, IRR and MOIC for all Options and scenarios. For all the three Options, prepare graphs showing how the net cashflows in the alternate scenario differ from the scenario prepared originally. Also, create graphs to show the comparison of IRR and MOIC across all six cases modelled. (7)
- iii) Perform a few reasonableness checks on the working done for the additional scenarios. (2)

[19]

- Q. 2) Prepare a summary document outlining the key features and results of the analyses conducted by you and your team. The summary should be addressed to the Client Investment Officer ("CIO") of ABC Group Limited and should provide sufficient insight to help the CIO identify which investment opportunities appear most attractive for discussion with the Group's management.

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) net cashflows for ABC Group Limited (ii) IRR and MOIC for each of the Options and their Scenarios considered.
- Charts on how the net cashflow projection looks for each of the Options and their corresponding scenarios.
- Summary results IRR and MOIC; Observation on the results across all options and scenarios tested and how the results change under different scenarios for each of the Options along with relevant rationale.
- Key conclusions.
- Suggested next steps.

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. | (15) |
| ii) Methodology. | (15) |
| iii) Any reasonable check performed on the calculations (excluding any comments on the reasonableness of the results). | (2) |
| iv) Results, including charts. These should include how the net cashflows, IRR and MOIC change with different Options and scenarios. | (7) |
| v) Commentary on results and conclusions. | (14) |
| vi) Next steps. | (16) |
| vii) Drafting. | (12) |
| | [81] |

Overview of the project

ABC Group Limited, a large diversified business house, is exploring opportunities to expand into new business segments. To support this initiative, the Group's Chief Investment Officer (CIO) has tasked his team with conducting detailed due diligence and providing key financial insights on potential investment options. The Group intends to take a **10-year investment view** while evaluating these opportunities.

As a senior member of the CIO's team, you are reviewing the analyses prepared by the junior team members for further evaluation and presentation to the CIO.

The team has shortlisted **three potential investment opportunities**, all of which have yielded positive results from preliminary due diligence. ABC Group Limited is prepared to invest in the range of INR 1,200–1,600 crore across these opportunities.

Option 1:

Background: A mid-sized manufacturing company engaged in the production of industrial consumables is experiencing strong and growing demand. To capitalize on

this growth, the company requires substantial capital to expand its operations and establish a new manufacturing unit. The current promoters have limited capacity to fund this expansion and are therefore open to external investment.

Investment of ABC Group Limited: ABC Group Limited to invest INR1,200 crore for a 30% equity stake in the company.

Revenue and Exit: ABC Group plans to make a partial exit from the business after five years by selling 40% of its equity stake in the manufacturing company, followed by a complete exit at the end of ten years.

Additional assumption: The Valuation of the manufacturing company grows by 15% p.a.

Option 2:

Background: A road development company has recently completed a long stretch of toll road under the Hybrid Annuity Model. Revenue comes from Fixed annuity payments from the government, which ensures stable cash flows.

Investment of ABC Group Limited: The business group to invest INR1,575 crore for a 45% equity stake in the project. For initial investment, the project is valued at the net cost of the building the road at the project completion date.

Revenue and Exit: There are fixed yearly payments at a rate of 9% every year of the net cost of the road at its completion date. ABC Group will receive the payment corresponding to its share in the stake. ABC Group will then completely sell its stake after 10 years.

Additional assumption: The Valuation of the road development company will grow by 10% p.a. The exit value of ABC Group out of the project will also grow at the same rate

Option 3:

Background: An InsurTech based start-up, which primarily uses AI bots to sell Health insurance and offer preventive care facilities to its customers. This is currently loss making and needs capital to fund its business.

Investment of ABC Group Limited: The start-up is valued at INR1,300 pre-money valuation and ABC Group to invest 1200 Cr in it, leading to a 48% equity stake in the health start-up.

Revenue and Exit: The InsurTech has shared their assumption of revenue growth and profitability. For simplicity, valuation of the InsurTech firm can be assumed to be driven by these numbers. ABC Group will completely exit from the venture after 10 years. The yearly revenue projection of the health start-up is provided below:

Additional assumptions:

It is assumed that once the revenue of the start-up has been stabilised, the start-up shall be valued as 2.5 times its annual revenue. It is assumed that at the end of 10th year, this assumption shall hold true (i.e. Start-up value is 2.5 times its annual revenue at the end of 10th year). The revenue projection of the InsurTech start-up is assumed as under:

Year	Annual Revenue of the Start-up (INR Cr)
1	700
2	952
3	1,238
4	1,572
5	1,949
6	2,378
7	2,877
8	3,452
9	4,142
10	4,970

The objective of this exercise is to:

1. Project the cashflows for ABC Group
2. Calculate the exit value for ABC Group Limited under each of the three scenarios
3. Based on the above, calculate Internal rate of return (IRR) and Multiple on Invested Capital (MOIC) for each of the scenarios

$$[MOIC = \text{Total cashflow inflows from the investment} / \text{Total capital invested}]$$

The management will use these numbers to evaluate which business deal the most favourable for ABC Group

As a senior member of the team, you intend to conduct a detailed analysis of the various scenarios and prepare a report for the CIO comparing their assumptions, structures, and outcomes. Additionally, you believe that certain considerations have been overlooked by the junior team members and wish to incorporate the following points:

- In Option 1 – You believe that the manufacturing company has significant cash crunch and there is a possibility that the manufacturing company might agree for to pay royalty payments in return of zero interest debt finance.. Hence, you propose that the investment be split into equity and zero interest debt. ABC Group will continue investing INR1200 Cr, but only INR 600 Cr as equity and valuation of the company unchanged. For the balance INR 600 Cr offered as zero interest debt, ABC group will demand annual royalty payments equal to 5% of annual sales of the manufacturing company. Royalty payments will continue till the total payments are twice the initial investment (i.e. twice of 600). The manufacturing company has recorded an sales of INR 2600 Cr. Once the investment is made by ABC Group, the annual sales is expected to grow at a rate of 10% p.a. for next 5 years and at 7% p.a. thereafter.
- In Option 2: Similar to Option 1, you propose that 40% of ABC Group Limited's stake be divested at the end of Year 5, with a full exit at the end of Year 10. This adjustment reflects the likelihood that ABC Group would prefer a partial exit earlier, given the business's stable returns.
- In Option 3: You consider that valuing the health start-up based solely on a revenue multiple may not be appropriate once profitability stabilizes. Therefore, you propose using the projected profitability data provided below. Based on these projections, you believe that at the end of Year 10, the start-up could reasonably be valued at 10 times the accumulated value of its profits/losses, with profit

accumulation assumed at 7% per annum and Accumulated value of losses at the start of the projection is INR 200 Cr

Year	Yearly profit as a % of revenue (Negative denotes loss)
0	
1	-15%
2	-10%
3	-5%
4	-3%
5	-1%
6	4%
7	7%
8	9%
9	12%
10	13%

The junior team members have shared the model and accompanying audit trail with you. However, the model does not incorporate the additional scenarios you wish to evaluate. You are required to use the provided model to test the impact of these additional scenarios and prepare a summary report for the CIO. This report should enable the CIO to present to the management the potential profitability of the business, along with other relevant considerations.

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 and objective

The Objective of this model is to project the cashflows for ABC Group Limited assuming a 10-year investment period, if it were to invest in either of the below Options and calculate expected return under these.

Option 1 – Buying stake in a mid-sized manufacturing company which sells industrial consumables

Option 2 – Investing in a road development company, which has recently completed a long stretch of toll road under the Hybrid Annuity Model to gain benefit under this project, including regular annual payments from the government.

Option 3 – Putting money in an InsurTech based start-up

Inputs

The following available information have been used as Inputs in the model. These are present in sheet 'Inputs and assumptions.

- Initial Investment required for each of the three Options
- Valuation of the target companies at the beginning for Option 1 and Option 2
- Pre-Money Valuation for Option 3

- Partial exit information under Option 1 – the % to be exited and the year of partial exit
- Final exit under for each of the three Options

Where a particular Input does not apply to an Option, it is mentioned as ‘n/a’ in the Excel model.

Additional inputs/assumptions

The following additional assumptions are used for the projection. These are also present in sheet ‘Inputs and assumptions’.

- Assumed Growth rate for valuation of the manufacturing company under Option 1 and of the road development company for the Highway project.
- For Option 3, valuation is assumed to be a multiple of the revenue of the InsurTech company. The multiple and the projected revenue of the InsurTech company are also taken as in assumption based on the available information.

The calculation

The calculations for all three investment options have been prepared in separate worksheets named after each option.

- Sheet ‘Option 1 – Manufacturing’:
Contains the key cash flows and results for Option 1, i.e., investment in a manufacturing company.
- Sheet ‘Option 2 – Highway’:
Presents the key cash flows and results for Option 2, i.e., investment in a newly constructed 200 km highway project.
- Sheet ‘Option 3 – Start-up’:
Shows the projections and results for Option 3, i.e., investment in an InsurTech start-up.

In each worksheet, the top section (Rows 2–8) contains the relevant input parameters, linked directly from the ‘Inputs and Assumptions’ sheet. Below the inputs, the cash flow projections for ABC Group are presented, followed by the calculation of IRR and MOIC at the bottom.

All projections have been carried out for a 10-year period, reflecting the Group’s 10-year investment horizon and assuming a complete exit at the end of Year 10. All cashflows are assumed to occur at the end of the projection year.

Sheet ‘Option 1 – Manufacturing’

- Cells C2, C3, C5:C8: Contain the input parameters for Option 1, linked from the ‘Inputs and Assumptions’ sheet.
- Cell C4: Calculates the initial valuation of the target company. Calculated as *[Valuation of the target company = Amount Invested by ABC Group / % stake acquired]*.
- Cells B12:B22: Represent the 10-year projection period, labelled from Year 0 to Year 10. Year 0 denotes the commencement of the deal, i.e., the point at which ABC Group acquires its stake, and the investment is assumed to continue for the full 10-year horizon.

- Cells C12:C22: Show the company's valuation trajectory, beginning with the initial valuation at Year 0 and increasing annually at the specified growth rate.
- Cells D12:D22: Reflect ABC Group's investment amounts, shown as negative cash flows (outflows).
- Cells E12:E22: Capture any recurring annual income or revenue received by ABC Group from the investment. For Option 1, this value is zero.
- Cells F12:F22: Record the proceeds received from any stake sale by ABC Group. For years in which a sale occurs, this is calculated as:
Original Stake % × Proportion of Stake Sold × Company Valuation at the Time of Sale.
- Cells G12:G22: Present the net cash flows for ABC Group at each time period, calculated as the sum of:
Investment Outflows + Regular Income + Proceeds from Stake Sale.
- Cell C25: Displays the Internal Rate of Return (IRR) for ABC Group's investment, computed using Excel's IRR function applied to the net cash flow series.
- Cell C26: Displays the Multiple on Invested Capital (MOIC) for the proposed deal, calculated as:
Total Inflows during the Projection Period / Absolute Value of Total Outflows.

Sheet 'Option 2 – Highway'

A copy of the 'Option 1 – Manufacturing' sheet was used as the base, and the following modifications were made to adapt it for Option 2 – Highway cash flows:

- Cells C2, C3, C5:C8: Input links were updated to reference the parameters for Option 2.
- Cell F2: Linked to the assumption for the annual dividend rate (%).
- Cell F3: A new variable, 'Cost of the Road,' was introduced and set equal to the project's initial valuation.
- Cells E12:E22: The Regular Revenue column was calculated as:
Cost of Road × Annual Dividend % × ABC Group's Stake (%).

All other calculations remain consistent with those in the Option 1 model.

Sheet 'Option 3 - Start up'

A copy of the 'Option 1 – Manufacturing' sheet was used as the base, and the following modifications were made to adapt it for Option 3 – Start-up cashflows:

- Cells C2, C4:C8: Input links were updated to reference the parameters for Option 3. In particular, Cell C4 was updated to use the start-up's pre-money valuation.
- Cell C3: The equity stake for ABC Group is calculated as:
Investment by ABC Group / (Investment by ABC Group + Pre-Money Valuation of the Start-up).
- Cell F2: Linked to the revenue multiple assumption used to determine the start-up's valuation at exit, sourced from the 'Inputs and Assumptions' sheet.
- Cells C12:C22: A new column was added to capture the annual revenue of the start-up.
- Cells D12:D22: The company valuation formula was updated to calculate valuation only in Year 10 as:
Annual Revenue × Revenue Multiple, with the value set to zero for earlier years due to lack of data.

All other calculations are consistent with those in the Option 1 model.
