

INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

28th July 2022

Subject CP2A – Actuarial Modelling (Paper A)

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

Total Marks: 100

Exam requirements**Q. 1) Modelling steps and data checks**

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

Construct a spreadsheet model that produces the following calculations:

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 appropriate checks on the salary data provided, making any adjustments wherever necessary. (6)
- ii) For Course A, carry out the following projections for next 15 years:
 - a) Salary that Mr. A is expected to draw. (2)
 - b) Loan schedule, i.e. loan outstanding at the end of each year. (3)
 - c) Expenses that Mr. A is likely to incur (annual personal expenses, tax on salary, loan repayments). (3)
 - d) Investment income that Mr. A is expected to earn on bank deposits. (2)
 - e) Mr. A's accumulated wealth. (1)
- iii) Repeat the above calculations for Course B. (3)
- iv) For Course A, determine Mr. A's wealth at the end of 15 years in a scenario where he does not take a loan and instead uses his savings to finance the course fees. (4)
- v) Produce a graph showing accumulation of wealth over 15 years in the following scenario: (2)
 - a) Course A with loan
 - b) Course B with loan
 - c) Self-funded course A

Mr. A has applied for scholarship at the university and is hopeful to get one for course B.

- vi) Determine the scholarship amount that Mr. A should get such that his accumulated wealth at the end of 15 years is same irrespective of the course chosen (under scenario where Mr. A opts to fund the course fees through loan). (3)

[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 completed in stages 1(ii) to 1(vi). (3)
 - ii) Demonstration of good modelling techniques and practice. (7)
- [10]**

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 checks performed

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, to continue work on it or to use it again for a similar purpose in the future.

Marks available for audit trail:

Audit approach

- Communication skills (the audit trail provides enough detail to be read as a stand-alone document). (4)
- Fellow student can review and check methods used in the model. (7)
- Senior Actuary can scrutinise and understand what has been done. (7)
- Written in clear English. (4)
- Written in a logical order. (3)

Audit content

- All steps clearly explained. (8)
 - Reasonableness checks. (3)
 - Clear signposting included throughout. (4)
 - Statement of assumptions made. (5)
 - All model steps accurately covered. (16)
- [61]**

Background

Mr. A has been working as a technical IT professional for 7 years. He feels stagnated in his current role and believes that going for higher education might open new career avenues for him.

Post researching numerous universities and courses, Mr. A has decided to pursue one of the following two courses at college X:

Course A: 2-year course with annual fees of ₹60,000

Course B: 1-year course with annual fees of ₹70,000

He is confused between the two options and wants to objectively decide one of two courses, purely basis expected financial outcomes. Given his academic and professional background, Mr. A has limited understanding of financial modelling and intends to seek expert opinion to conclude his search for ideal course to pursue.

He has reached out to your employer, XYZ Actuarial Consultants, to help him evaluate which course to consider. Your manager has asked you to do the cash flow projections for Mr. A and provide the decision based on financial analysis.

Mr. A has supplied you the following facts to carry out cash flow projections:

- The decision would be based on accumulated wealth of Mr. A at the end of 15 years from the date of decision making.
- He intends to take a loan to pay for his course fees. Loan shall be availed at time of payment of the fees, equivalent to the amount of fees.
- He has negotiated flexible loan repayments with the bank; interest rate will be applicable at the rate of 10% p.a. on the outstanding principal amount.
- Loan would have a moratorium period equal to the tenure of the course. Nonetheless, compound interest on outstanding amount shall accrue during the moratorium period.
- Estimate of his yearly personal expenses are ₹20,000.
- Through his 5 years of service, Mr. A has accumulated a corpus of ₹150,000.
- Mr. A intends to pay 20% of his respective years' gross salary as repayment of the bank loan in case he opts for a two-year course and 15% in case he opts for a one-year course.

Your manager has provided you with following additional data points which might be required for completing the project:

- Assume inflation rate to be 5% p.a.
- Assume interest rate on bank deposits to be 6% p.a.
- Starting salary of 100 students graduating from college X (50 from course A and 50 from course B) over last 3 years is available on college website (provided in the attached excel). Estimate for starting salary in current year is equal to the average starting salary of students in a course over latest 3 batches.
- Tax rate applicable is 20% for individuals with salary less than or equal to ₹100,000 and 30% for individuals with salary greater than ₹100,000. No tax shall be paid on investment income earned on bank deposits.

Alternative Scenario:

Given Mr A, already accumulated wealth enough to meet his college fees in either of the programs, your manager intends to suggest Mr. A that he can go for self-funding instead of taking a loan. He wishes to show the mathematical outcome of the suggestion to Mr. A and hence has asked you to model the same (for course A only).
