

Life Insurance Mathematics: Computer Assignment 1

Academic Year 2025-2026



UNIVERSITEIT VAN AMSTERDAM

Instructions for the Assignments

You should provide answers in English. You must use `R` or `Python` for your calculations and graphics, but be aware that our support material is only available in `R`. You preferably use a notebook (e.g., `R markdown`, Jupyter notebook or Google Colab) for reporting.

Deliverables for the Assignments

Please hand in on or before September 14, 2025 via **Canvas**:

1. A notebook that you have used for all your calculations, with text, code and output. Your notebook should be well-organized and easy to read. Your text should be brief and guide the reader through your calculations.
2. A readable output format (e.g., `html` or `pdf`, or shared Google Colab) that easily allows us to scan your code, the results obtained and a brief discussion of your findings.

Please mention the names and student numbers of your team members. You should work in teams (with two students minimum, and four students maximum); it suffices to submit one solution per team.

Motivation for the Assignment

To perform calculations in this course you will combine the time value of money with actuarial techniques to value life contingent cash-flow with a long-term horizon. In the first computer lab and assignment you will refresh your knowledge of cash flow valuation. You study the basics of cash flow vectors and their valuation with discount factors. You will evaluate investments based on their net present value and build your own mortgage calculator. Finally, you will learn about fixed and variable interest rates; and annual and monthly rates.

Assignment Questions

- (1) You start with the DataCamp Chapter on Valuation of Cash Flows, see <https://www.datacamp.com/courses/valuation-of-life-insurance-products-in-r>. You watch the videos and solve the exercises. This is an individual assignment question, to be completed by each student. If you struggle with getting access

- (2) Cynthia Rose signs a loan with a Dutch bank. Cynthia receives 30 000 EUR right now ($t = 0$), 10 000 EUR one year later ($t = 1$) and 15 000 EUR another year later ($t = 2$). This loan should be paid back with 25 yearly payments, starting at $t = 3$. The payments reduce every year with 5%. Thus, if the first payment is - say - 1 000 EUR then the next one is 950 EUR, the third one is 902.5 EUR, and so on. Cynthia and her bank agree that the interest rate is 2.5% for the first 5 years, 3.5% in the next 5 years and 4% in the remaining period of time. Calculate the yearly loan payments.
- (3) **Fact check.** Are online mortgage calculators doing the maths correctly? We verify the results obtained with an online mortgage calculator.
- (3.1) We work with the following example: loan amount is 150 000 USD, loan term is 15 years, interest rate is 5.5% fixed, yearly. We settle the loan with monthly repayments that are constant. A printed version of the output produced by an online mortgage calculator is available from **Canvas** or can be obtained from (for instance) <https://edition.cnn.com/business/calculators/mortgage-calculator> (where you can put the property information to 0 or NO). Verify that the monthly payment equals 1 225.63 USD
- (3.2) Using your own built calculator, you will now do some calculations for a (fictitious) housing project that you have in mind. That is:
- find a house that is for sale (at this very moment!); make sure to include the for sale announcement in the solution that you submit
 - to buy this house: how much capital is available (as down payment)? how much capital to borrow from a bank?
 - choose values for: duration of the mortgage, interest rate, ... (be realistic)
- What is the monthly repayment for this project? Verify your own calculation with the result obtained from the online mortgage calculator.