

Life Insurance Mathematics: Home Assignment 1

Academic Year 2021-2022



UNIVERSITEIT VAN AMSTERDAM

Instructions for the Assignments

You should provide answers in Dutch or in English. You must use R for your calculations and graphics. You must use R markdown for reporting, see <http://rmarkdown.rstudio.com/>.

Deliverables for the Assignments

Please hand in on or before September 12, 2021 via Canvas:

1. An R markdown script that you have used for all your calculations. Your script should be well-organized and easy to read. Your text should be brief and guide the reader through your calculations. An example of an R markdown script is available on Canvas. A general outline for the solution of the first assignment is also available from Canvas. You should use RStudio to create and compile your markdown file.
2. An html or pdf file that is the compiled version of your R markdown script. Relevant results should be printed in the html or pdf file.

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 of 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, as developed (among others) in the first year's course on *Finance for AE*. 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.

- (2) Cynthia Rose signs a loan with a Dutch bank. Cynthia receives 10 000 euro right now ($t = 0$), 20 000 euro one year later ($t = 1$) and 30 000 euro another year later ($t = 2$). This loan should be paid back with 20 yearly payments, starting at $t = 3$. The payments reduce every year with 5%. Thus, if the first payment is - say - 1 000 euro then the next one is 950 euro, the third one is 902.5 euro, and so on. Cynthia and her bank agree that the interest rate is 6% for the first 5 years, 7% in the next 5 years and 8% 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. 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**. Verify these calculations:
- (3.1) the monthly payment of 1 225.63 USD
- (3.2) (a bonus question, should only be solved if you want to earn bonus points) the balance at the end of the year.