

# Advanced Life Insurance Mathematics

Academic Year 2023-2024

KU Leuven



## Instructions for the assignments

You should provide answers in English. Motivate your model assumptions and answers; you get points for the methods you use, for your clear explanation and discussion of the strengths and limitations of these models, and the overall quality of your report, not just for the final answer. You can use R or Python for your calculations and graphics.

Success!

## Deliverables for the assignments

Please hand in on or before May 20, 2024 via TOLEDO:

1. A report or notebook (format: pdf file or html output) in which you answer all the *Assignment Questions* stated below and which contains a selection of relevant figures. The figures should be labeled properly, integrated and discussed in your report.
2. If the code is not integrated in your report or notebook, you should provide a script with the code that you have used for all your calculations. Your code should be well-organized and easy to read.

Please mention the names and student numbers of your team members on both items. It is allowed to work in teams (with three students maximum); it suffices to submit one solution per team.

Each team of students will deliver an (online) pitch presentation in the final week of the course (schedule to be determined). This allows the teaching team to give feedback on the report, the models constructed and the presentation.

## Assignment Questions

- (1) Download mortality data from the Human Mortality Database ([www.mortality.org](http://www.mortality.org)) for a country of your choice. Please keep in mind that this country should also have data regarding 2020 and 2021 available on either the HMD or the Short-term Mortality Fluctuations (STMF) Database (<https://www.mortality.org>) (in light of question (3) and (4) in this assignment). You are free to focus on data for males, females or unisex. Develop and discuss an exploratory data analysis of your data set.

- (2) Build a stochastic mortality projection model using the data up to and including 2019. Describe your model specifications, assumptions and choices, document parameter estimates and illustrate mortality projections with these models. We do not impose a specific methodology; focus is on rigorous explanation, calibration and motivation of your strategy. Demonstrate the evaluation of a selection of insightful metrics (e.g., life expectancy or expected present value of a life annuity) using the mortality estimates and the projections. You select at least three of such metrics.
- (3) How does your proposed model react to the data collected for 2020 and/or 2021? Describe a robustness or sensitivity analysis. Discuss useful insights.
- (4) Define a metric to evaluate excess mortality or excess of deaths during the 2020-2021 pandemic period. Hereto you explore the literature on excess mortality. You select and explain useful insights from this literature. Evaluate the metric using your proposed mortality projection model and the 2020-2021 observations.

Katrien Antonio  
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