

## IDEM 117 Advances in Mortality Forecasting

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Start: 17 January 2022

End: 21 January 2022

Location: Online course. Link tba.

### Instructors:

- Carlo Giovanni Camarda
- Ugofilippo Basellini

### Course description

This course provides an advanced introduction to an ample range of modern statistical techniques to forecast mortality. Stochastic methods to predict the future course of mortality have flourished in the last three decades, improving on previous deterministic and expert-based approaches. In this course, you will learn to master well-established models as well as some recent innovations in mortality forecasting from both theoretical and applied perspectives.

Accurate forecasts of mortality are essential for various reasons. In addition to being an important input for population projections, mortality forecasts can inform researchers, governments and policymakers about our future longevity, the extent of population ageing and the sustainability of pension schemes and social security systems. Several approaches to forecast mortality have been recently proposed, each with their own advantages and limitations. Instead of discussing a broad list of models, the course will provide an exhaustive explanation of the theoretical framework and assumptions underpinning selected approaches. This will be of paramount importance to employ and compare forecasting models on solid bases as well as to handle alternative options.

The course will start by introducing the statistical foundations for all models covered in the course. These include, among others, Generalized Linear and Nonlinear Models, Singular Value Decomposition, Newton-Raphson method, ARIMA time-series models and bootstrap techniques. Next, three main methodologies will be presented in great detail: the Lee-Carter model and several of its extensions, the smoothing  $P$ -splines model and its constrained extension, and the Segmented Transformation Age-at-death Distributions model. Approaches to coherently forecast mortality for a group of populations will be introduced and discussed in the last day. Finally, an overview of the latest developments in the field on mortality forecasting will be presented in an optional one-hour live session.

Handouts and routines to reproduce all outcomes presented in the course will be provided to students, who will be expected to solve related exercises and present their results to the class. The statistical software R will be used throughout the course on publicly available demographic datasets. By the end of the course, students will have acquired both theoretical and practical skills in mortality forecasting.

### Organization

- Each of the five course days will consist of
  - 1 hour of pre-recorded video lecture (available on January 13<sup>th</sup>, four days before the start of the course).
  - 1 hour of live session for discussions, questions and answers, presentation of solution to exercises assigned to participants. The live sessions will be held each day at 15:00-16:00 CET.
- One one-hour optional live session on the latest developments in mortality forecasting is scheduled for January 20<sup>th</sup>, 16:30 to 17:30 CET.
- From January 18<sup>th</sup> (the second day of the course) onwards, 90 minutes of optional office hours will be offered daily for smaller meetings with instructors. In a previous edition of the course, these hours were particularly useful for preparing students' presentations, extending discussions of live sessions on additional topics, and casting light on additional issues. One session will be from 10:00 to 10:45 CET, the second one from 18:00 to 18:45 CET.
- In addition to the live sessions and office hours, an open forum (message board) will be available to encourage dialogue between students and faculty. This forum will display questions and answers about the topics taught throughout the week to facilitate the exchange of open questions and to raise and resolve any doubts.

### Course prerequisites

The course is rather advanced and it is targeted to students and researchers with a preliminary knowledge of statistics and demography. All concepts will be introduced from the basics, but elementary knowledge of demographic analysis (i.e. construction of a life-table) and statistics (i.e. linear models) is required. Preliminary knowledge of mortality forecasting and familiarity with basic concepts in matrix algebra (transposing and inverting a matrix) are helpful but not essential. Participants are expected to have a working knowledge of R because handouts and solutions to exercises will require its use. Prior to each class, participants are expected to watch pre-recorded video lectures, read slides and work on the handouts with R and an associated editor (e.g. RStudio).

### Examination

Participants will be evaluated on the basis of class participation and the presentation of the solution to exercises provided at the beginning of the course.

### General readings

A reading list will be provided as well as pre-recorded videos and slides from the lectures, and handouts for reproducing all examples. All materials will be provided to participants on Thursday, January 13, four days before the course.

### Financial support

There is no tuition fee for this course, which will be held online.

### Recruitment of students

- Applicants should either be enrolled in a PhD program or have received their PhD.
- A maximum of 20 students will be admitted.
- The selection will be made by the MPIDR based on the applicants' scientific qualifications.
- Since there are only 20 seats available, we will initially offer them to our PHDS students as well as MPIDR scientific staff (pre-docs and post-docs). After the PHDS students and MPIDR scientific staff are accommodated, we will offer the remaining seats (if any) to pre-docs and post-docs from elsewhere through our [IDEM website](#).

### Application instructions for PHDS students and MPIDR scientific staff

There is an expedited application procedure for PHDS students and MPIDR scientific staff (pre-docs and post-docs).

- If you would like to enroll for this course, please send an email to [phds@demogr.mpg.de](mailto:phds@demogr.mpg.de). Begin your email message with a statement saying that you apply for course IDEM 117 - Advances in Mortality Forecasting. You must also include a one-page letter of motivation (PDF) that includes the following.
  - A paragraph about how your research relates to the topic of the course (half a page or less);
  - a paragraph about how you meet the prerequisites for this course (half a page or less).
- Application deadline is 17 November 2021.
- Applicants will be informed of their acceptance by 24 November 2021.

Email inquiries about the course, application process, MPIDR, PHDS, and IDEM should be sent to [phds@demogr.mpg.de](mailto:phds@demogr.mpg.de) as well.