



## **IDEM 101**

### **Foundations in Statistical Demography**

Carlo Giovanni Camarda & Ugofilippo Basellini

**Start:** 5 February 2024

**End:** 9 February 2024

**Location:** Max Planck Institute for Demographic Research. Onsite-only course.

#### **Instructors:**

- Carlo Giovanni Camarda
- Ugofilippo Basellini

#### **Course description**

Demography is a discipline that is deeply rooted in mathematics and statistics. Theoretically, any demographic analysis requires employing some sort of statistical methods; practical knowledge of these methods is however often limited. Demographic processes have historically been studied using mathematical methods, mostly because of limitations in data availability and computing resources. The advent of advanced statistical tools coupled with increasing availability of high-quality data and computational power have given rise to a new era in statistical demographic analysis, characterized by a wealth of opportunities for researchers to conduct more rigorous investigations into demographic trends.

This 5-day course aims to provide doctoral students and researchers with a solid background in the most prominent statistical methods that are employed in demographic analysis. Alternatively, the lectures can be seen as a fundamental statistics course specifically tailored to address demographic applications. We will start from simpler topics and progressively move towards more advanced and complex methods. In the first day, we will cover regression models for Gaussian data, and introduce the framework of Generalized Linear Models and Exponential Family. In the second day, we will study the Binomial and Poisson distributions for probabilities and count data, respectively, and introduce methods that account for overdispersion in the data. The third and fourth day will be devoted to Generalized Non-linear models, including smoothing under a Generalized Additive model setting and within a  $P$ -splines framework. Finally, the fifth day will be devoted to the class of Mixed Effects models, which are particularly useful in the context of panel data.

Handouts and routines to reproduce all demographic applications 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 several statistical methods used for demographic analysis.

## Organization

- Each of the five course days will consist of:
  - 2 hours of lectures in the morning (10:00 – 12:00 CET), covering the theory behind the methodologies presented;
  - 1 hour of practical session in the afternoon (14:30 – 15:30 CET), which will be devoted to programming examples and exercises, questions and answers, discussions, and presentation of solution to exercises assigned to participants;
  - Additional office hours with the instructors in case of need.
- On each of the five days, students should commit about 6-8 hours per day to the course (lectures, practical exercise sessions, readings, assignments).

## Course prerequisites

The course 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. maximum likelihood estimation) is required. Familiarity with basic concepts in matrix algebra (transposing and inverting a matrix) is helpful but not essential. Participants are expected to have a working knowledge of R because handouts and solutions to exercises will require its use. Participants who would like to get acquainted with these prerequisites before the start of the course should refer to the materials listed in General Readings.

## 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

### *Prerequisites material*

- Preston, S. H., Heuveline, P., and Guillot, M. (2001). *Demography. Measuring and Modeling Population Processes*. Blackwell (Chapters 1, 2 and 3)
- Wood (2015). *Core Statistics*. Cambridge University Press (Chapters 1 to 5). Available at: <https://www.maths.ed.ac.uk/~swood34/core-statistics.pdf>
- Any introductory text or guide to R, such as: Zuur, Ieno and Meesters (2009). *A Beginner's Guide to R*. Springer. Available at: <https://link.springer.com/book/10.1007/978-0-387-93837-0>

### *Course material*

Lectures' slides and handouts for reproducing all examples covered in class will be made available to the students during the course or, to the best of our abilities, on Thursday February 1st (four days prior to the course).

## Financial support

There is no tuition fee for this course. Travel and accommodation expenses for admitted PHDS students will be covered by the MPIDR.

### **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 101 - Foundations in Statistical Demography. You must also include a statement 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 **September 29, 2023**.
- Applicants will be informed of their acceptance by October 9, 2023.

### **Recruitment of students external to the IMPRS-PHDS network**

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](#).

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