**ISPUP**

INSTITUTO DE SAÚDE PÚBLICA
DA UNIVERSIDADE DO PORTO

**INTENSIVE COURSE**

# Joint Modelling of Longitudinal and Survival Data in Health Research

Face-to-face sessions

07th May – 09th May 2024

## Course description

Joint modelling of longitudinal and survival data has received much attention in recent years and is increasingly common in clinical studies. When there is an association between longitudinal outcomes and survival endpoints, many well-established models that analyse the outcomes separately are not suitable, and a joint modelling approach is required.

The purpose of this course is to provide an introduction to the joint modelling of longitudinal and survival data and its practical application to health research. The main objective is to equip participants with the skills they need to begin incorporating this powerful modelling approach into their own work. Throughout the topic of longitudinal analysis, survival analysis, and joint modelling, participants will have the opportunity to work with real data examples in the freely available and documented R software.

## Staff

**Inês Sousa**, PhD in Statistics, is an Associate Professor at the Department of Mathematics, University of Minho. She has research interests in the development of statistical models for real longitudinal data in the biosciences. She is a member of the Centre of Mathematics, University of Minho (CMAT-UM).

**Laetitia Teixeira**, PhD in Applied Mathematics, is an Assistant Professor at the Institute of Biomedical Sciences Abel Salazar, University of Porto. She worked on the joint modelling of longitudinal and survival data in the presence of competing risks during her PhD, with application to peritoneal dialysis. She has an interest in the development of statistical models for use in clinical research.

**Denisa Mendonça**, PhD in Biostatistics, is an Associate Professor at the Institute of Biomedical Sciences Abel Salazar, University of Porto, and a member of the EPIUnit and of ITR at the Institute of Public Health, University of Porto (ISPUP). She has interests in the development of statistical models for joint modelling of longitudinal and event time data, and applying them to a wide range of topics in the biosciences.

**Pedro Miranda Afonso** is a final-year PhD candidate in Biostatistics at the department of Biostatistics, Erasmus University Medical Center (Rotterdam, the Netherlands). Under the supervision of Prof. Dimitris Rizopoulos and Dr. Eleni-Rosalina Andrinopoulou, he works on extended joint modeling approaches to survival and longitudinal data analysis. He is a co-author of JMbayes2, an R package to fit extended joint models.

# Intensive Course
## Joint Modelling of Longitudinal and Survival Data in Health Research – 2nd Edition
### 07th May – 09th May 2024

### Audience

The course is targeted at researchers as well as master's and PhD students in statistics, mathematics, medicine, health, and related areas.

### Requirements

Basic knowledge of statistical concepts, such as standard statistical inference using maximum likelihood and regression models. Basic knowledge of R will be helpful, but not essential.

### Course material

In each session students will receive printed and PDF copies of the slides and practical sheets. Course materials will be available in English.

### Language

English, with the flexibility to switch to Portuguese if all participants prefer.

### Certificate

A certificate of participation will be given to the participants who attend at least 75% of the course.

### ECTS: Not applicable

### Venue

The course will take place in the Computer Room (3rd floor) at the Institute of Public Health, University of Porto

### Duration and Schedule:

07/May - 09.00 am to 12.30 pm; 1.30 pm to 4.30 pm;

08/May - 09.00 am to 12.30 pm; 1.30 pm to 4.30 pm;

09/May - 09.00 am to 12.30 pm; 1.30 pm to 4.30 pm;

### Selection of participants

Maximum of 20 participants, selected by order of registration.
Minimum number of participants: 8

### Fee

300 euros

### Discounts

20% for students from a specialization course in Public Health, master's students in Public Health, PhD students in Public Health, Global Public Health, or Applied Mathematics, and members of SPE or APE, upon presentation of the respective proof.

### Application deadline:

23 April 2024

### Contacts:

Institute of Public Health, University of Porto

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# Program

### DAY 1 (morning) - Longitudinal Analysis

- Introduction to longitudinal data: examples and graphical representation

- General linear model for longitudinal data

- Parametric models for covariance structure: exploring correlation structure

- Likelihood-based methods

- Marginal models

- Random effects models

- Transition models

- Diagnostics for longitudinal models

### DAY 1 (afternoon) - Survival Analysis

- Introduction to survival analysis: main concepts and definitions

- Descriptive approaches to survival analysis

- Regression models of survival analysis

- Introduction to survival analysis in the presence of competing risks: main concepts and definitions

- Descriptive methods for competing risks data

- Multivariable competing risks models

# Program

### DAY 2 (morning) - Longitudinal Analysis and Survival Analysis

- Software training session in R

### DAY 2 (afternoon) - Joint Models

- The basic joint model of time-to-event and longitudinal data
- Extensions to flexible functional forms
- Applications of joint modelling in clinical research
- Software training session in R

### DAY 3 (full day) – Extensions of Joint Models

- Extensions to multiple longitudinal outcomes
- Extensions to competing risks
- Extensions to multi-state models
- Extensions to recurrent events
- Dynamic predictions
- Applications of joint modelling in public health and clinical research
- Software training session in R

# Bibliography

➢ Andrinopoulou, E. R., Harhay, M. O., Ratcliffe, S. J., & Rizopoulos, D. (2021). Reflection on modern methods: dynamic prediction using joint models of longitudinal and time-to-event data. International Journal of Epidemiology, 50(5), 1731–1743.

➢ Andrinopoulou, E. R., Rizopoulos, D., Takkenberg, J. J., & Lesaffre, E. (2014). Joint modeling of two longitudinal outcomes and competing risk data. Statistics in medicine, 33(18), 3167-3178.

➢ Baart, S. J., van der Palen, R. L., Putter, H., Tsonaka, R., Blom, N. A., Rizopoulos, D., & van Geloven, N. (2021). Joint modeling of longitudinal markers and time-to-event outcomes: An application and tutorial in patients after surgical repair of transposition of the great arteries. Circulation: Cardiovascular Quality and Outcomes, 14(11), e007593.

➢ Diggle, P. J., Heagerty, P., Liang, K.-Y., & Zeger, S. (2002) Analysis of Longitudinal Data. Oxford Statistical Science Series, Oxford University Press.

➢ Diggle, P. J., Sousa, I., & Chetwynd, A. G. (2008). Joint modelling of repeated measurements and time-to-event outcomes: The fourth Armitage lecture. Statistics in Medicine, 27(16), 2981–2998.

➢ Henderson, R., Diggle, P., & Dobson, A. (2000). Joint modelling of longitudinal measurements and event time data. Biostatistics, 1(4), 465-480.

➢ Papageorgiou, G., Mauff, K., Tomer, A., & Rizopoulos, D. (2019). An overview of joint modeling of time-to-event and longitudinal outcomes. Annual Review of Statistics and Its Application, 6, 223–240.

➢ Philipson, P., Diggle, P., Sousa, I., Kolamunnage-Dona, R., Williamson, P., & Henderson, R. (2012). joineR: Joint modelling of repeated measurements and time-to-event data. Comprehensive R Archive Network, United Kingdom.

➢ Rizopoulos, D. (2011). Dynamic predictions and prospective accuracy in joint models for longitudinal and time-to-event data. Biometrics, 67, 819–829.

➢ Rizopoulos, D. (2012). Joint Models for Longitudinal and Time-to-Event Data, with Applications in R. Chapman & Hall/CRC.

➢ Rizopoulos, D., Papageorgiou, G., & Afonso, P., M. (2023). JMbayes2: Extended joint models for longitudinal and time-to-event data. Comprehensive R Archive Network, United Kingdom.

➢ Sousa, I. (2011). A review on joint modelling of longitudinal measurements and time-to-event. Revstat, 9(1), 57–81.

➢ Teixeira, L., Sousa, I., Rodrigues, A., & Mendonça, D. (2019). Joint modelling of longitudinal and competing risks data in clinical research. REVSTAT–Statistical Journal, 17(2), 245–264.