

## Half-Day Short-Course

### Latent class mixed modeling using lcmm R package

Cécile Proust-Lima

Inserm, Bordeaux Population Health Research Center , U1219, Univ. Bordeaux, F-33000 Bordeaux, France  
[cecile.proust-lima@inserm.fr](mailto:cecile.proust-lima@inserm.fr)

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In longitudinal studies, the mixed models are routinely used to describe the trajectory of a longitudinal outcome, measured repeatedly over time in the subjects, according to covariates of interest. One limit of this approach is that it assumes the population is homogeneous. This means that, conditionally to the covariates, the population can be characterized by a unique mean profile of trajectory. In practice, it is not unusual to suspect heterogeneity in the population that would not be entirely explained by the observed covariates. This heterogeneity could be linked to unobserved risk factors, gene factors or underlying diseases.

The latent class mixed models consist in exploring and highlighting such latent profiles of trajectories in heterogeneous populations. These models rely on both the mixed model theory to account for the individual correlation in the repeated measures, and the latent class models to discriminate homogeneous latent groups when modelling trajectories of a longitudinal outcome.

This short-course will consist in briefly introducing the mixed model theory, and then detailing its extension to latent class mixed models. Their estimation, the evaluation of their goodness-of-fit as well as the research questions they may address will be described. The latent class mixed models will also be extensively illustrated using real data examples estimated with the R package lcmm. Corresponding code will be systematically given to replicate the analyses.

Depending on the time, some extensions of the latent class mixed models will be mentioned:

- the joint modelling of a longitudinal outcome and a time-to-event using shared latent classes;
- the joint modelling of multiple longitudinal outcomes using shared latent classes.

#### Prerequisite

The short course is intended for a mixed audience including applied researchers. The statistical concepts will be progressively introduced with an emphasis on their usefulness and application. Knowledge of standard regression modelling is expected and a background in longitudinal data analysis is recommended. Although not necessary to attend the short-course, a background in R will help for replicating the analyses and better comprehending the code syntax.

#### References

- Proust-Lima, C., Philipps, V. & Liqueur, B. Estimation of Extended Mixed Models Using Latent Classes and Latent Processes: The R Package lcmm. *Journal of Statistical Software, Articles* **78**, 1–56 (2017).
- Proust-Lima, C., Séne, M., Taylor, J. M. & Jacqmin-Gadda, H. Joint latent class models for longitudinal and time-to-event data: A review. *Stat Methods Med Res* **23**, 74–90 (2014).