Target Group

This is the ninth in a series of annual Summer schools which target people interested in planning and analyzing, e.g. clinical studies.

Prerequisites

Throughout the course, it is assumed that the participants are familiar with basic statistical modeling, including linear models (regression and analysis of variance), as well as generalized linear models (logistic and Poisson regression). Moreover, pre-requisite knowledge should also include general estimation and testing theory (maximum likelihood, likelihood ratio, etc.).

As the annotated programs, output, and illustrations are based on SAS and R, a working knowledge of these software packages is required.

Time and Date

Monday 2 June until Thursday 5 June 2025

- Please arrive on Monday by 14:00
- Course finishes Thursday by 12:30

Location

Bundesinstitut für Erwachsenenbildung (bifeb)

Bürglstein 1-7

5360 Strobl, Austria

Registration / Waiting List

Please submit your **request for registration by 1 February 2025** via email to:

Andrea Baumgartner, **Andrea.Baumgartner@plus.ac.at**

Registration Fees

Membership in one of the sponsoring societies is mandatory. Please note that some of the societies offer free student membership.

Academic / Government: 450 Euro

Business / Industry: 590 Euro

Student: 300 Euro

Accommodation

Accommodation and food are ***included*** in the registration fees. Depending on room availability, student participants may need to be accommodated in double rooms.

How to Get There

Please see the description (in German) at
http://www.bifeb.at/das-bifeb/kontakt

Contact & Information

For questions, please ask

Andrea Baumgartner or Arne Bathke

Universität Salzburg,

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Hellbrunner Str. 34

5020 Salzburg, Austria

Tel. +43 (0)662 8044 5302

Andrea.Baumgartner@plus.ac.at

Cancellation

Your registration will become binding on **15 April 2025**.

If you have to cancel, we will try to admit someone from the waiting list. However, if this it not possible and your cancellation is on 16 April 2025 or later, your registration fees cannot be returned.

Deutsche und Österreich-Schweizer Region der Internationalen Biometrischen Gesellschaft (IBS-DR, -ROeS)
Österreichische Statistische Gesellschaft (ÖSG)
Research Center Trustworthy Data Science and Security
Intelligent Data Analytics Lab, Universität Salzburg

Summer School 2025

Longitudinal and Incomplete Data

2 – 5 June, 2025
Strobl am Wolfgangsee, Austria

Instructors

Geert Molenberghs (Hasselt & Leuven)
Anna Ivanova (Hasselt & Leuven)

Name and address of presenters

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Course Outline

1.
We begin by presenting **linear mixed models** for continuous hierarchical data. The focus lies on the modeler's perspective and on applications. Emphasis will be on model formulation, parame-ter estimation, and hypothesis testing, as well as on the distinc-tion between the random-effects (hierarchical) model and the implied marginal model. Attention will be given to the issue of negative variance components.

2. & 3.
Then, models for non-Gaussian data will be discussed, with a strong emphasis on **generalized estimating equations (GEE)** and the **generalized linear mixed model (GLMM)**. To usefully intro-duce this theme, a brief review of the classical generalized linear modeling framework will be presented. Similarities and differen-ces with the continuous case will be discussed. The differences between marginal models, such as GEE, and random-effects models, such as the GLMM, will be explained in detail.

4.
Extending the framework of the linear mixed model and the generalized linear mixed model, we will briefly discuss **nonlinear mixed models**.

5.
Both SAS and R will be used to illustrate the practical implementation of mixed models and their extensions. Similarities and differences will be highlighted and some key issues will be discussed.

6.
When analyzing hierarchical and longitudinal data, one is often confronted with **missing data**, i.e., scheduled measurements have not been made, due to a variety of (known or unknown) reasons. It will be shown that, if no appropriate measures are taken, missing data can seriously jeopardize results, and interpretation difficulties are bound to occur. Precisely, a framework will be sketched to handle incomplete data. Simple and simplistic methods will be commented on. Methods to properly analyze incomplete data, under flexible assumptions, are presented. These include ignorable likelihood analysis, ignorable Bayesian analysis, weighted estimating equations, and, in particular, **multiple imputation**. To conclude, the issue of sensitivity to non-verifiable assumption is discussed, and addressed through **sensitivity analyses**.

7.
Attention will be given on computationally feasible methodology when longitudinal data are multivariate, potentially high-dimen-sional, and/or when very large sample sizes are available.

Developments will be illustrated with worked examples using the SAS System and the R software.

Presenters

GEERT MOLENBERGHS is Professor of Biostatistics at the Universiteit Hasselt and Katholieke Universiteit Leuven in Belgium. He received the B.S. degree in mathematics (1988) and a Ph.D. in biostatistics (1993) from the Universiteit Antwerpen. Dr Molenberghs published methodological work on surrogate markers in clinical trials, categorical data, longitudinal data analysis, and on the analysis of non-response in clinical and epidemiological studies. He served as Joint Editor for *Applied Statistics* (2001-2004), Co-editor of *Biometrics* (2007--2009) and as President of the International Biometric Society (2004--2005). He was Co-editor of *Biostatistics* (2010--2012). He is currently Executive Editor of *Biometrics*. He was elected Fellow of the American Statistical Association and received the Guy Medal in Bronze from the Royal Statistical Society. He has held visiting positions at the Harvard School of Public Health (Boston, MA). He is founding director of the Center for Statistics at Hasselt University and currently the director of the Interuniversity Institute for Biostatistics and statistical Bioinformatics, I-BioStat, a joint initiative of the Hasselt and Leuven universities. He held government advisory body position in Belgium during the COVID-19 pandemic.

GEERT MOLENBERGHS and GEERT VERBEKE are editor and author of several books on the use of linear mixed models for the analysis of longitudinal data (Springer Lecture Notes 1997, Springer Series in Statistics 2000, Springer Series in Statistics 2005, Chapman Hall/CRC 2007), and they have taught well over a hundred short and longer courses on the topic in universities as well as industry, in Europe, North America, Latin America, and Australia. They received several Excellence in Continuing Education awards for courses offered at the Joint Statistical Meetings.

ANNA IVANOVA received a master degree in mathematics (1998) from Brest State University (Belarus), a master degree in statistics (2004) and a doctoral degree in biomedical science (2018) from Katholieke Universiteit Leuven (Belgium). Her research interests are with modeling repeated, overdispersed and multivariate ordinal data, missing data analysis using classical techniques applied to ordinal data -- a less investigated data type -- and alternative techniques involving pseudo-likelihood. She has also been teaching courses on basic statistics and practice sessions using different statistical packages (R, SAS, SPSS). Dr Ivanova is a statistical consultant in repeated data analysis of Gaussian and non-Gaussian type, with incompleteness, if present, at Data Science Institute of the Universiteit Hasselt. She is currently teaching introductory courses on statistics at medical school as well as tailored-made courses for the consulting clients.