

CURSUSSEN STATISTIEK

PERMANENTE VORMING IN DE WETENSCHAPPEN

COURSES IN STATISTICS

CONTINUING EDUCATION IN SCIENCE



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Center for Statistics Centrum voor Statistiek



Krijgslaan 281 – S9, 9000 Ghent
www.cvstat.UGent.be

Institute for Continuing Education in Science



This series includes courses that are embedded in the Doctoral Schools programs. Visit your DS website for more information

Instituut voor Permanente Vorming in de Wetenschappen



Deze reeks omvat cursussen die zijn opgenomen in de UGent Doctoral Schools programma's. Ga naar de DS-website voor meer informatie.

Krijgslaan 281 – S9, 9000 Ghent

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- 1 Fac. of Psychology and Educational Sciences (PP) – H. Dunantlaan 1
- 2 Fac. of Psychology and Educational Sciences (PP) – H. Dunantlaan 2
- 3 Fac. of Sciences (WE) – Campus Sterre, Krijgslaan 281, building S9
- 4 Adviescentrum voor Studenten
- 5 Station Gent-Sint-Pieters



The power of data and the information therein is entering the heart of almost any section of society. We are discovering that processes can be better understood and controlled, predictions made, causal effects estimated and decisions optimized. Reliable results follow when studies have been appropriately designed, data carefully gathered and analyzed. Scientists and professionals stay ahead if they keep learning from their data. They add tremendously to their market value when data analytic skills merge their subject matter expertise.

To prepare for 'big data' in tomorrow's world and to face the facts with statistical skills, the Ghent Center for Statistics joins the Institute for Continuing Education of the Faculty of Sciences (ICES) to organize their yearly series of targeted training modules. We aim to provide insight in the basics of statistical research while developing the technical skills to come to results with statistical software. Blended learning with hands-on sessions on PC's or laptops allows participants to gain firsthand experience in applying the knowledge. Our courses **target professionals** and the academically trained, who wish to become confident data analysts, refresh their knowledge or discover new areas of research. The program's modular architecture facilitates flexible entry and adaptive training trajectories.

The Flemish Community recognizes the value of lifelong learning for the region's economic development. Employers are granted financial support through the government's in-

troduction of the KMO-portfolio. More about this stimulating initiative can be found on the website: www.kmo-portefeuille.be (in Dutch).

Doctoral Schools support young researchers in acquiring the necessary skills. Several modules can, under certain conditions, be incorporated in the program of the Doctoral Schools.

For the 2016-2017 academic year, the program offers basic modules which lay a foundation of statistical knowledge and techniques. We give a basic as well as advanced course in R, the versatile freeware package that gains ground in all domains. More specialized courses follow: 'Data

Visualisation', 'Multilevel Analysis for Grouped and Longitudinal Data' and 'Nonparametric Methods' are offered as short courses. We present also two new practical courses this year: for those who need to perform 'Sample Size Calculations' and handle 'Missing Data'. All mod-

ules are taught in English. Classes take place in a pleasant atmosphere with ample opportunity to interact with lecturers. Keep an eye on our website www.ipvw-ices.UGent.be for more information on additional courses or subscribe to our mailing list. Complementary statistical training and consulting services at Ghent University are found through its Center for Statistics, www.cvstat.ugent.be. Wishing you an enjoyable and rewarding learning experience, we look forward to meeting you,

'SCIENTISTS AND PROFESSIONALS STAY AHEAD IF THEY KEEP LEARNING FROM THEIR DATA'

Professor Els Goetghebeur
Director ICES

ADDITIONAL TRAINING AND CONSULTING SERVICES AT GHEENT UNIVERSITY

Training

FLAMES



Flames, Flanders training network in Methodology and Statistics (www.flames-statistics.eu) is an interuniversity initiative providing further training to young researchers in Ghent and beyond.

Contact: flames@UGent.be

One year Master in Statistical Data Analysis

The UGent advanced Master's program in Statistical Data Analysis leads to a dedicated degree following more intensive training in the methods of practical statistics offered to scientists in diverse areas.

Consulting

FIRE

The FIRE (Fostering Innovative Research based on Evidence) statistical consulting service offers statistical and methodological support for UGent doctoral students and post-docs conducting scientific research. Personalized advice and technical help is provided during all phases of the research including study design (most important !), data collection, statistical analysis, and interpretation and reporting of results.

Book your FIRE consult by filling out the application form at www.cvstat.ugent.be/FIRE or, contact us at fire@ugent.be for more information.

Stat-Gent CRESCENDO

Stat-Gent CRESCENDO unites statistical expert knowledge across the Ghent University Center for Statistics aiming to support applied research. It provides consulting services in collaboration with the private sector, the public sector, and other research groups.

We offer an operational framework for statistics and data analysis contract work. The flexible format includes data analysis projects, customized training and software solutions. Data analysis projects add maximum value when the statistical method is integrated in the complete trajectory from objective setting to report writing. We therefore strive for stable

and sustained relationships with our partners in mutually rewarding research collaborations.

High-quality work is delivered by well-trained and dedicated statistical consultants, under guidance and supervision of UGent statistics professors. Stat-Gent has expertise in a broad range of applications, such as (but not limited to):

- design and analysis of clinical trials
- health economics, epidemiology, electronic health records, quality of care, drug compliance, and evidence-based medicine
- business analytics
- biotech and agriculture
- statistical genetics/genomics: biomarkers,



micro-arrays, dPCR, next-generation sequencing

We use a wide variety of statistical methods going from basic regression, analysis of variance, mixed models and multivariate techniques, to more specific methods in causal analysis, data mining, functional data analysis, experimental design, longitudinal analysis, missing data, multiple testing, robust and non-parametric statistics and survival analysis.

Do not hesitate to contact us with questions or for more information at statgent@ugent.be.



INTRODUCTION TO R

Target audience

- This course targets professionals and investigators from diverse areas with little to no R-programming experience who wish to start using R for their data manipulation, data exploration or statistical analysis.

Teacher

- Ineke van Gremberghe is a post-doctoral fellow at Ghent University. She obtained a master degree in Biotechnology, a PhD in Biology and a master degree in Statistical Data analysis at Ghent Univer-

sity. She works as FLAMES (Flanders Training Network for Methodology and Statistics) coordinator and statistical consultant for Stat-Gent Crescendo. She has experience in statistical data analysis of different types of data (data visualization, linear mixed models, causal mediation analysis, multivariate methods) and in R programming.

- Emmanuel Abatih is post-doctoral fellow at Ghent University and works as statistical consultant for FIRE and Stat-Gent Crescendo.

He served as statistical analyst at the Institute of Public Health in Brussels in 2005 and obtained a PhD in Life Sciences in 2008 at the University of Copenhagen. He worked for the Institute of Tropical Medicine in Antwerp, as post-doctoral assistant on topics including: space-time analysis, diagnostic test evaluation, transmission dynamic modeling and risk analysis. He can rely on several years of experience as teacher in a wide range of courses in statistics and epidemiology. He has

(co-)supervised over 30 masters and 7 PhD students and has experience with R, python, SATSCAN, SAS, SPSS and STATA.

Course prerequisites

- The course is open to all interested persons.
- Knowledge of basic statistical concepts and experience with other programming languages are considered advantageous, but not required for learning the R language.

R is a flexible environment for statistical computing and graphics, which is becoming increasingly popular as a tool to get insight in often complex data. While in some ways similar to other programming languages (such as C, Java and Perl), R is particularly suited for data analysis because ready-made functions are available for a wide variety of statistical (classical statistical tests, linear and nonlinear modeling, time series analysis, classification, clustering, ...) and graphical techniques. The base R program can be extended with user-submitted packages, which means new techniques are often implemented in R before being available in other software. This is just one of the reasons why R is becoming the de facto standard in certain fields such as bioinformatics (Bioconductor) and financial services.

This course introduces the use of the R environment for the implementation of data management, data exploration, basic statistical analysis and automation of procedures. It starts with a description of the R GUI, the use of the command line and an overview of basic data structures. The application of standard procedures to import data or to export results to external files will be illustrated. Creation of new variables, subsetting, merging and stacking of data sets will be covered in the data management section. Exploration of the data by histograms, box plots, scatter plots, summary numbers, correlation coefficients and cross-tabulations will be performed.

Simple statistical procedures that will be covered are:

- comparisons of observed group means (t-test, ANOVA and their nonparametric versions) and proportions
- tests for independence in 2-way cross tables and linear regression (focusing on the R-implementation of methods that form the subject of other modules in the statistics series)

Finally, installing new packages and automation of analysis procedures will also be discussed.

Practical sessions and specific exercises will be provided to allow participants to practice their R skills in interaction with the teacher.

Exam

- There is no exam connected to this module. Participants receive a certificate of attendance at the end of the course.
- To qualify for reimbursement from the UGent Doctoral Schools one must attend all classes. Visit the ICES website and your DS website for more information.

Course material

- Copies of slides.
- Recommended handbook (optional): "R for Dummies", J. Meys & A. de Vries, 2nd ed. (2015), Wiley, ISBN 978-1119055808.

Fees

- The registration fee amounts to 325 EUR. Reduced prices apply to students and participants of nonprofit and public services. These prices are available at the ICES website.
- The book is optional and can be bought at the additional cost of 30 EUR. Please indicate this clearly on the registration form.

Dates and venue

- October 10, 13, 17 and 20, 2016 from 5.30 pm to 9 pm.
- Faculty of Science, Building S9, Campus Sterre, Krijgslaan 281, Ghent.



INTRODUCTORY STATISTICS

BASICS OF STATISTICAL INFERENCE

Target audience

- This course will benefit professionals and investigators from diverse areas, including research scientists and clinical research associates, investing in data handling and wishing to acquire insight into basic statistical methods or to refresh their knowledge and practice of statistics.

Teacher

- Dr. Els Adriaens (Adriaens Consulting bvba) studied biology, obtained a PhD in pharmaceutical sciences and a Master in Statistical Data Analysis at Ghent University.
- She is consultant in statistical data analysis specialized in the field of the development and validation of alternatives to laboratory animals.

Course prerequisites

- The course is open to all interested persons. It is necessary to have an understanding of basic algebra (basic rules of calculation, solving simple equations, ...), and have a working knowledge of exponents and square roots.

Exam

- Participants can, if they wish, take part in an exam. Upon succeeding in this test a certificate from Ghent University will be issued to participants with a university degree at the bachelor level or an equivalent degree.
- To qualify for reimbursement from the UGent Doctoral Schools one must attend all classes and pass the exam. Visit the ICES website and your DS website for further information.

This course aims to provide insight into basic statistical concepts with emphasis on practical applications. Mathematical formulae are kept to a minimum. The theory and the methods of analysis will be extensively illustrated with examples relating to a wide variety of different fields.

We start with concise graphical and numerical descriptions of data obtained from observational or experimental studies. The most common and frequently used probability distributions of discrete and continuous variables will be presented. Statistical inference draws conclusions about a population based on

sampled data. Chance variations are taken into account such that a level of confidence is attached to these conclusions.

We present the reasoning behind significance tests for the comparison of observed data with a hypothesis. We apply this procedure to data obtained either from one or from two populations.

The correct use of the t-test will be discussed. Nonparametric methods are considered as a possible alternative in case the requirements of the t-test are not met.

We cover the basic concepts of hypothesis testing for cate-

gorical data, including the chi-square test.

Quite often the relationship between two variables, where the outcome of one variable is seen as depending on the value of the other, is the focus of scientific interest. We will give an introduction to linear regression analysis, where a regression line based on observations obtained in a sample describes the expected outcome.

Hands-on exercises are worked out behind the PC using the SPSS software. If preferred, participants can use SAS or R.

Course material

- Copies of slides.
- Recommended handbooks (optional):
- Medical field: Book 1: "Fundamentals of Biostatistics", B. Rosner, 8th ed. (2015), Cengage, ISBN 978-1305268920. The examples used in this book are restricted to the field of bioscience. The book is therefore recommended if you have a background in a related research area, such as (veterinary) medicine, biotechnology, biology, pharmacy, a.s.o.
- All fields: Book 2: "Introduction to the Practice of Statistics", D.S. Moore, G.P. McCabe and B. Craig, 8th revised ed. (2014), W.H. Freeman, ISBN 978-1464158933. This book uses examples from a wide range of research areas and is therefore recommended if you have no background in the research areas mentioned for book 1.

Fees

- The registration fee amounts to 800 EUR. Reduced prices apply to students and participants of nonprofit and public services. These prices are available at the ICES website.
- Both books are optional and can be bought at the additional cost of 75 EUR for book 1 and 80 EUR for book 2. Please indicate this clearly on the registration form.
- The examination fee is 30 EUR.

Dates and venue

- October 25, November 8, 22 and 29, December 6, 13 and 20, 2016 from 5.30 pm till 9.30 pm. Each lecture is followed by a hands-on practical session in SPSS.
- Faculty of Science, Building S9/S5, Campus Sterre, Krijgslaan 281, Ghent.



ANALYSIS OF VARIANCE

Target audience

- This course targets professionals and investigators from diverse areas, who need to use statistical methods in the collection and handling of data in their research, in particular for assessing the effect of e.g. different treatments.

Teacher

- Dr. Els Adriaens (Adriaens Consulting bvba) studied biology, obtained a PhD in pharmaceutical sciences and a Master in Statistical Data Analysis at Ghent University.
- She is consultant in statistical data analysis mainly in the field of the development and validation of alternatives to laboratory animals.

Course prerequisites

- Participants are expected to have an active knowledge of the basic principles underlying statistical strategies, at a level equivalent to the "Introductory Statistics" course of this program.
- In the first session on January 10, 2017, these principles will be briefly reviewed. This review session is open to interested participants of subsequent modules. Participants who have recently followed the introductory course are exempt from that first session.

Analysis of variance (ANOVA) is a statistical tool used in the comparison of means of a random variable over populations that differ in one or more characteristics (factors), e.g. treatment, age, sex, subject, etc.

First, we cover **one-way ANOVA**, where only a single factor is of concern. Depending on the type of the factor, the conclusions pertain to just those factor levels included in the study (**fixed factor model**), or to a population of factor levels of which we observed a sample (**random effects model**).

In two-way and **multi-way ANOVA** where populations differ in more than one characteristic, the effects of factors are studied simultaneously. This yields information about the main effects of each of the factors as well as about any special joint effects (**factorial design**). We also consider **nested designs**, where each level of a second (mostly random) factor occurs in conjunction with only one level of the first factor. One special challenge in multi-way ANOVA lies in verifying the assumptions that must be satisfied.

In this course we will focus on correct execution of data analysis and understanding its results. We pay attention to expressing these conclusions in a clear and transparent way. The different methods will be extensively illustrated with **examples from scientific studies in a variety of fields**.

Hands-on **exercises** are worked out behind the PC using the **SPSS software**. If preferred, participants can use SAS or R.

Exam

- Participants can, if they wish, take part in an exam. Upon succeeding in this test a certificate from Ghent University will be issued to participants with a university degree at the bachelor level or an equivalent degree.
- To qualify for reimbursement from the UGent Doctoral Schools one must attend all classes and pass the exam. Visit the ICES website and your DS website for further information.

Course material

- Handouts of slides.
- Recommended handbook (optional): "Applied Linear Statistical Models", M.H. Kutner, C.J. Nachtsheim, J. Neter and W. Li, 5th ed. (2004), McGraw-Hill, ISBN 978-0071122214.

Fees

- The registration fee amounts to 800 EUR. Reduced prices apply to students and participants of nonprofit and public services. These prices are available at the ICES website.
- The book is optional and can be bought at the additional cost of 70 EUR. Please indicate this clearly on the registration form.
- The examination fee is 30 EUR.

Dates and venue

- January 10, 17, 24 and 31, February 7, 14 and 21, 2017, from 5.30 pm to 9.30 pm. Each lecture is followed by a hands-on practical session in SPSS.
- Faculty of Science, Building S9, Campus Sterre, Krijgslaan 281, Ghent.



WORKSHOP ON DATA VISUALISATION

Target audience

- All researchers who need to visualise their research data.

Teachers

- Anders Hast received a PhD in Computerised Image processing from Uppsala University in 2004. Besides computer graphics and mathematics, also parallel programming and visualisation were important parts of his PhD studies. Since 2007 he has been working half time at UPPMAX as an application expert in scientific visualisation. In 2011

he spent one year at IIT, CNR, Pisa in Italy as an ERCIM fellow and after that he received a full time position as associate professor at Uppsala University. Since then the research has focused on computer vision and image processing, especially for cultural heritage applications. Since 2014 Anders is the director of Swedish eScience Education.

Course prerequisites

- The course is open to all interested persons. Some basic programming experience is required. The fundamentals of Python will be covered.

Do you need to visualise your data? Do you want to know how visualisations are done in other fields to get inspired to **make more interesting visualisations**? Then this workshop is for you!

You will learn what you need to make simple but powerful visualisations using **Python** and the **Visualisation Toolkit (VTK)**. Python is a programming language that is much more straightforward to use than C++ and therefore enables you to easily make use of the visualisation capabilities provided by VTK.

The content covers fundamental Visualisation Techniques and

their **relation to Computer Graphics**. The basics of Python and VTK will be explained followed by hands on exercises that will give you the practical experience you need. Then, both **3D and 2D visualisations** are discussed as well as how to use **stereo** efficiently.

Schedule

9 am – 10 am	Computer Graphics & Visualisation
10 am – 12 pm	Python and VTK
12 pm – 1 pm	Lunch
1 pm – 3 pm	Exercises
3 pm – 4 pm	2D, 3D and stereo

Exam

- There is no exam connected to this module. Participants receive a certificate of attendance via e-mail at the end of the course.

Course material

- Copies of slides.

Fees

- The registration fee amounts to 300 EUR. Reduced prices apply to students and participants of nonprofit and public services. These prices are available at the ICES website.

Dates and venue

- January 11, 2017, from 9 am to 4 pm.
- Faculty of Science, Building S9, Campus Sterre, Krijgslaan 281, 9000 Ghent.



SAMPLE SIZE CALCULATIONS

Target audience

- This course targets participants with little to no experience in sample size calculations who want to learn to design a powerful study.

Teacher

- Lizzy De Lobel (Stat-Gent Crescendo, Consulting, UGent) studied Mathematics, Statistical Data Analysis and Statistical Genomics at Ghent University, where she also worked as teaching assis-

tant. She has been consultant for the Stat-Gent consortium for several years. Her experience in teaching and consulting on study design and analysis will contribute greatly to this course.

- Emmanuel Abatih is post-doctoral fellow at Ghent University where he works as a statistical consultant for FIRE and Stat-Gent Crescendo. He served as statistical analyst at the Institute of Public Health in Brussels

in 2005 and obtained a PhD in Life Sciences in 2008 at the University of Copenhagen. He worked for the Institute of Tropical Medicine in Antwerp, as post-doctoral assistant on topics including: space-time analysis, diagnostic test evaluation, transmission dynamic modeling and risk analysis. He can rely on several years of experience as teacher in a wide range of courses in statistics and epi-

miology. He has (co-) supervised over 30 masters and 7 PhD students and has experience with R, python, SATSCAN, SAS, SPSS and STAA.

Course prerequisites

- The course is open to all interested persons. Knowledge of basic statistical concepts and experience with other programming languages are considered an advantage, but not required for following the course.

In the design of scientific studies/experiments, sample size determination is of utmost importance. Large enough samples have to be used so that an effect that is of practical significance has a high chance of being detected from the study.

Whether researchers wish to perform their own sample size calculations or rely on experts to do them, a good **understanding** of the **principles and the necessary input parameters** is important. We aim to help structure the problem, find ways to determine input parameters and show how to perform the necessary calculations in R.

This course starts with a **general introduction** to sample size calculation methods based on the type of outcome or design of interest. In addition different considerations

(such as effect size and power) or other factors affecting sample sizes will be discussed. Sample size calculation **applets** will be presented. A brief introduction to the R software will accompany the set-up and all subsequent computations will be done within the R environment.

The second phase redirects the sample size calculations to 2 classical domains: the design of clinical trials and the design of surveys.

Under **survey design**, different sampling methods will be outlined (probabilistic and non-probabilistic) and sample size calculations adapted to these will be presented for various kinds of outcomes and specific design choices. In addition, sample size calculations will be presented for studies set up to evaluate performance of diagnostic tests as well as

clustered surveys, e.g. of farms or treatment centers.

For **clinical trials**, more stringent requirements are imposed in different phases of research from early safety testing over dose finding and confirmatory studies to postmarketing surveillance. In each phase one balances practical feasibility with the need to control errors and protect patients in and beyond the study that is being conducted. In this course, steps for computing sample sizes for different phases of a clinical trial design will be outlined with practical examples.

Practical sessions and specific simulation **exercises in R** will allow participants to explore different scenarios and software apps.

Exam

- Participants can, if they wish, take part in an exam. Upon succeeding in this test a certificate from Ghent University will be issued to participants with a university degree at the bachelor level or an equivalent degree.
- To qualify for reimbursement from the UGent Doctoral Schools one must attend all classes and pass the exam. Visit the ICES website and your DS website for further information.

Course material

- Copies of slides.

Fees

- The registration fee amounts to 800 EUR. Reduced prices apply to students and participants of nonprofit and public services. These prices are available at the ICES website.
- The examination fee is 30 EUR.

Dates and venue

- February 6, 13, 20 and 27, March 6, 2017, from 5.30 pm till 9.30 pm.
- Faculty of Science, Building S9, Campus Sterre, Krijgslaan 281, Ghent.



APPLIED LINEAR REGRESSION

Target audience

- This course targets professionals and investigators from all areas who are involved in prediction problems or need to model the relationship between a dependent variable and one or more explanatory variables.

Teacher

- Dries Reynders studied Physics and Statistical Data Analysis at Ghent University.
- He is an experienced teacher and is, in that role, well trained in explaining the link between mathematics and the reality it describes. Currently, he works as statistical consultant for the Stat-Gent consortium and FIRE.

Course prerequisites

- Participants are expected to have an active knowledge of the basic principles underlying statistical strategies, at a level equivalent to the "Introductory Statistics" course of this program.
- In the first session of Module 3 'Analysis of Variance', on January 10, 2017, these principles will be briefly reviewed. This session is free and open to interested participants of this year's program.

Linear regression addresses how a continuous dependent variable is affected by one or more predictors. The fact that many practical problems deal with continuous outcomes (e.g. income, blood pressure, temperature, affect) makes linear regression a popular tool, and most of us will be familiar with the concept of drawing a line through a cloud of data points.

The first two sessions of this module introduce the conceptual framework of this method using the simple case of a **single predictor**. Formulas and technicalities are kept to a minimum and the main focus is on **interpretation** of results and assessing model validity. This includes

confidence statements on the predictor effect (hypothesis tests and confidence intervals), using the regression model to **predict** future **results**, and verification of model assumptions.

In session 3 and 4 we allow for **more than one predictor** leading to the multiple linear regression model. We focus on either explanation or prediction. How to come to a **parsimonious model** starting from a **large number of predictors** will be discussed in detail. In these complex linear models special attention will be given to interpreting individual predictor effects, as they critically depend on other terms in the model and underlying relations

between predictors (confounding and interaction).

In the last session a more elaborate data analysis is discussed. We touch on problems where linear regression is not appropriate and replaced by related approaches such as generalized linear models and mixed models.

Different features will be illustrated with case examples from the instructors practical experience, and participants are encouraged to **bring examples** from their own work. Hands-on **exercises** are worked out behind the PC using the **SPSS software**. If preferred, participants can use SAS or R.

Exam

- Participants can, if they wish, take part in an exam. Upon succeeding in this test a certificate from Ghent University will be issued to participants with a university degree at the bachelor level or an equivalent degree.
- To qualify for reimbursement from the UGent Doctoral Schools one must attend all classes and pass the exam. Visit the ICES website and your DS website for further information.

Course material

- Copies of lecture notes.
- Recommended handbook (optional): "Applied Linear Statistical Models", M.H. Kutner, C.J. Nachtsheim, J. Neter and W. Li, 5th ed. (2004), McGraw-Hill, ISBN 978-0071122214. Please note that this is the same book as recommended for Module 3 "Analysis of Variance".

Fees

- The registration fee amounts to 800 EUR. Reduced prices apply to students and participants of nonprofit and public services. These prices are available at the ICES website.
- The book is optional and can be bought at the additional cost of 70 EUR. Please indicate this clearly on the registration form.
- The examination fee is 30 EUR.

Dates and venue

- February 28, March 7, 14, 21 and 28, 2017 from 5.30 pm to 9.30 pm. Each lecture is followed by a hands-on practical session in SPSS or R.
- Faculty of Science, Building S9, Campus Sterre, Krijgslaan 281, Ghent.



MULTILEVEL ANALYSIS

FOR GROUPED AND LONGITUDINAL DATA

Target audience

- This course targets professionals and investigators from diverse areas ranging from researchers in the behavioral and social sciences to whoever deals with data with a hierarchical or multilevel structure.

Teacher

- Prof. dr. Leoniek Wijngaards-de Meij is Professor in Applied Statistics at the Department of Methodology and Statistics of the Faculty of Social Sciences at Utrecht University, the Netherlands. She received a Master in Clinical Psychology and a PhD in Dyadic processes of parents grieving their child in Clinical Psychology at Utrecht University.
- She has worked as statistical consultant on multilevel analysis for numerous social science research projects.
- She has been teaching courses on Multilevel Analysis at both the Graduate and Undergraduate level. These courses include Multilevel for Research Masters, ML Minor courses and a Multilevel Summer School at Utrecht University, and PhD courses for several institutes including the KLI (Research Institute for Social Psychology), the EPP (Research Institute for Psychopathology) and the Erasmus University.

Course prerequisites

- The course assumes reasonable familiarity with analysis of variance and multiple regression analysis, but prior knowledge of multilevel modeling is not assumed.

Social research often concerns relationships between individuals and the social contexts to which they belong. Individuals and their social contexts can be conceptualized as a **hierarchical structure**, with individuals **nested within groups**. Classical examples are educational research, with pupils nested within schools, and cross-national research, with individuals nested within their national units. They involve two level data: group level and individual level variables.

We need multilevel modeling to study the relationships between variables observed at different levels in the hierarchical structure. This can also cover longitudinal research, by viewing measurement occasions as nested within respondents, and extends to situations where data have a more complex multilevel structure, such as cross-classified data or multiple-membership models.

This short course is intended as a basic and **nontechnical introduction** to multilevel analysis. It starts with a description of some examples, and shows why

multilevel models are necessary if the data have a hierarchical structure. It then covers the basic theory of two- and three-level models. Next it explains how multilevel

models can be applied to analyze **longitudinal data**, and why and when this may be an attractive analysis approach, as compared to more classical analysis methods such as multivariate analysis of variance (Manova).

The course includes **three computer labs**, where multigroup and longitudinal data are analyzed. The computer labs in the course use the **multilevel program HLM and the SPSS Mixed procedure**, which is available in SPSS starting with version 11.5.

Exam

- Participants can, if they wish, take part in an exam. Upon succeeding in this test a certificate from Ghent University will be issued to participants with a university degree at the bachelor level or an equivalent degree.
- To qualify for reimbursement from the UGent Doctoral Schools one must attend all classes and pass the exam. Visit the ICES website and your DS website for further information.

Course material

- Copies of course notes.
- The course is based on: "Multilevel Analysis. Techniques and Applications", J.J. Hox (2010), 2nd ed., New York: Routledge, ISBN 978-1848728462.

Fees

- The registration fee amounts to 900 EUR. Reduced prices apply to students and participants of nonprofit and public services. These prices are available at the ICES website.
- The book is optional and can be bought at the additional cost of 45 EUR. Please indicate this clearly on the registration form.
- The examination fee is 30 EUR.

Dates and venue

- April 5, 6 and 7, 2017, from 9 am till 4 pm.
- Faculty of Psychology and Educational Sciences, Dunantlaan 1, Ghent.



R

INTERMEDIATE COURSE

Target audience

- This course is aimed at intermediate R users who want to optimize their workflow. The tools offered are useful both in research and more commercial applications.

Teacher

- Joris Meys is statistical consultant in the Biostatistics Department at Ghent University. He is co-author (with Andrie de Vries) of 'R for Dummies' (Wiley, 2012).
- He is an accomplished R programmer, and produces R packages both for specific research projects and, via R-Forge, for more general application. His statistical expertise is in the areas of ecotoxicology, analysis of environmental data, clinical research and meta-analysis.

Course prerequisites

- Participants need previous experience with R and RStudio, and should have a good insight in how to work with vectors, matrices, data frames and lists. The topics covered in the ICES course 'Introduction to R' are considered as known.

R is a **powerful and extensive language**. In recent years many useful additions have been made. They can facilitate the work substantially, but also make it challenging to find the most optimal workflow. This course aims to give you **more insight in how to work efficiently with R**.

During the course, you get introduced to a number of useful packages that emerged in recent years including reshape, plyr, ggplot2 and XLConnect amongst others.

The following topics will be covered:

- tools for data preparation and manipulation
- text comparison and editing using regular expressions
- working with dates
- automating with scripts, functions and projects
- advanced graphics and reporting tools (ggplot2, RMarkdown)

Exam

- There is no exam connected to this module. Participants receive a certificate of attendance at the end of the course.
- To qualify for reimbursement from the UGent Doctoral Schools one must attend all classes. Visit the ICES website and your DS website for more information.

Course material

- Exercises and slides provided by the instructor.
- Recommended handbook (optional): "R for Dummies"; J. Meys & A. de Vries, 2nd ed. (2015), Wiley, ISBN 978-1119055808. Please note that this is the same book as for Module 1 'Introduction to R'.

Fees

- The registration fee amounts to 325 EUR. Reduced prices apply to students and participants of nonprofit and public services. These prices are available at the ICES website.
- The book is optional and can be bought at the additional cost of 30 EUR. Please indicate this clearly on the registration form.

Dates and venue

- May 8, 11, 15 and 18, 2017, from 5.30 pm to 9 pm.
- Faculty of Science, Building S9, Campus Sterre, Krijgslaan 281, Ghent.



NONPARAMETRIC METHODS

Target audience

- This course targets all researchers who need to analyze small data sets or data for which the common assumptions of parametric methods do not hold.

Teacher

- Prof. dr. Olivier Thas is Professor of Statistics at Ghent University, Department of Mathematical Modelling, Statistics and Bioinformatics. He is chairing the Program Committee of the Advanced Master of Statistical Data Analysis. He teaches courses in

basic statistics, multivariate and high dimensional data analysis, experimental design and statistical genomics. His research focuses on the development and application of nonparametric and semiparametric statistical methods for the bio and life sciences.

Course prerequisites

- Participants are expected to be familiar with the basics of statistical inference, particularly hypothesis testing and linear regression.

Nonparametric methods are often used in situations where the assumptions of parametric methods do not hold or cannot be assessed (e.g. in small samples). The focus of this course is on nonparametric tests for **comparative studies** (e.g. comparing two treatments).

In the first lecture the basics of statistical hypothesis testing are illustrated on the parametric **two-sample t-test**. From there we move on to exact **permutation tests**. The second lecture is devoted to rank tests. After a traditional introduction to **rank tests**, we spend time on some **typical pitfalls** related to the use and the interpretation of rank tests. In particular, the roles of the location-shift assumption and the probabilistic index are explained. The connection between rank tests and effect size estimation is also part of this lecture. An extensive **overview of the most popular nonparametric tests** is the topic of the third lecture. We also stress the relationship between the study design and the choice of the

statistical method.

All tests and their interpretations are illustrated using R and/or SAS. In the fourth lecture some **more advanced methods** are briefly discussed: probabilistic index models (PIM), rank tests for clustered data and sample size calculation. Finally, a few methods for nonparametric regression are discussed in the fifth lecture: basics of smoothers and (generalized) additive models.

The following topics are included:

- rank and permutation tests: general principles (permutation null distribution, asymptotic distributions, power, efficiency, ...)
- some classical rank tests: Wilcoxon-Mann-Whitney, Kruskal-Wallis, Friedman, Mantel-Haenszel, ...
- interpretation of the hypotheses and the effect sizes: location-shift model, probabilistic index
- how nonparametric are nonparametric methods? Assumptions and pitfalls, semiparametric interpretation

- nonparametric estimators for effect sizes: Hodges-Lehman, rank regression, probabilistic index models
- multiple comparisons of means: family wise error rate (FWER), false discovery rate (FDR), permutation methods
- correcting for continuous covariates: rank tests for stratified designs, rank regression, probabilistic index models
- on the relation between the design and the (nonparametric) statistical analysis: Friedman (randomized complete blocks), Mack-Skillings (randomized complete block with recurrences), Skillings-Mack (balanced incomplete block designs), ...
- rank tests for clustered data
- sample size calculation
- nonparametric regression: smoothers, bandwidth selection, generalized additive models

The course consists of 5 theoretic lessons of 2 hours and 5 practicals of 1 hour in which SAS or R can be used.

Exam

- Participants can, if they wish, take part in an exam. A certificate from Ghent University will be issued to participants with a university degree at the bachelor level or an equivalent degree upon succeeding in this test.

- To qualify for reimbursement from the UGent Doctoral Schools one must attend all classes and pass the exam. Visit the ICES website and your DS website for further information.

Course material

- Copies of slides.

Fees

- The registration fee amounts to 600 EUR. Reduced prices apply to students and participants of nonprofit and public services. These prices are available at the ICES website.
- The examination fee is 30 EUR.

Dates and venue

- May 22 and May 23, 2017 from 10 am to 1 pm and from 2 pm to 5 pm, and May 24, 2017, from 10 am to 1 pm.
- Faculty of Science, Building S9, Campus Sterre, Krijgslaan 281, Ghent.



MISSING DATA

Target audience

- The course targets researchers who need to analyse incomplete data sets and are seeking practical tools to handle missing data in their own analyses.

Teacher

- Ineke van Gremberghe is post-doctoral fellow at Ghent University. She obtained a master degree in Biotechnology, a PhD in Biology and a master degree in Statistical Data analysis at Ghent University. She works as FLAMES (Flanders Training Network for Methodology and Statistics) coordinator and statistical consultant for Stat-Gent Crescendo. She has experience in statistical data analysis

of different types of data (data visualization, linear mixed models, causal mediation analysis, multivariate methods) and in R programming.

Course prerequisites

- Participants are expected to be familiar with basic statistical data analysis and linear regression analysis.

Missing data (i.e. data that were intended to be collected, but were not) form an **important problem** in many statistical data analyses, for the following two reasons. First, many statistical software packages include by default only the subjects without missing data in the analysis. They thus make **inefficient use of the observed data** by discarding information from subjects whose data was only partially missing. Second, in many cases, **subjects without**

missing data form a selective subgroup. Statistical results obtained for that group may not generalise to the intended study population. The goal of this course is to **develop an understanding of the fundamental problems** caused by missing data. We will see how overly simplistic methods of correction for missing data (such as single imputation and last-value-carried-forward) may fail, and **provide methods for valid analysis** in the presence of missing data

under more general conditions including likelihood-based model estimation, weighting and multiple imputation. We will emphasize the **distinction between** data missing completely at random (**MCAR**), missing at random (**MAR**) or missing not at random (**MNAR**) and illustrate their implications in standard analyses. In addition, considerable attention will be given to the relative **advantages and limitations of the different** missing data **approaches**.

Exam

- Participants can, if they wish, take part in an exam in the form of a project. A certificate from Ghent University will be issued to participants with a university degree at the bachelor level or an equivalent degree upon succeeding in this test.
- To qualify for reimbursement from the UGent Doctoral Schools one must attend all classes and pass the exam. Visit the ICES website and your DS website for further information.

Course material

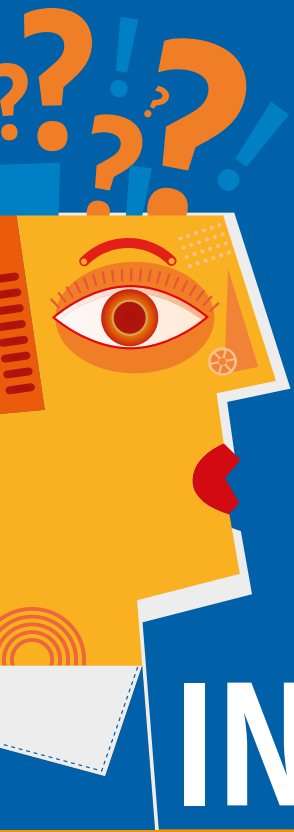
- Copies of slides.

Fees

- The registration fee amounts to 600 EUR. Reduced prices apply to students and participants of nonprofit and public services. These prices are available at the ICES website.
- The book is optional and can be bought at the additional cost of 90 EUR. Please indicate this clearly on the registration form.
- The examination fee is 30 EUR.

Dates and venue

- May 29, 30 and 31, 2017 from 9 am to 12.15 pm and from 1.15 pm to 4.30 pm.
- Faculty of Science, Building S9, Campus Sterre, Krijgslaan 281, Ghent.



PRACTICAL INFORMATION

Please use the registration form on our website:
www.ipvw-ices.UGent.be.

- Your registration is valid from the moment you receive an e-mail confirmation from ICES. If you have not received this mail within a week, please contact ICES to double check. From the moment the confirmation e-mail is sent the payment and cancellation conditions are in effect.
- The registration fee covers tuition, some or all of the course materials, use of auditoria and PCs, drinks and sandwiches. Reduced prices apply to students and participants of nonprofit and public services. These prices are available on the ICES website.
- The examination fee for each module that has an exam connected to it is 30 EUR.
- Visit the ICES website for further information on the payment and cancellation conditions, additional reductions for participants from the non-profit and private sector, support measures from the government, the Doctoral Schools.
- Besides statistical courses ICES offers courses in a range of scientific disciplines as well as further training for secondary school teachers (in Dutch).
- Stay informed about future courses through www.ipvw-ices.UGent.be



IPWV:

VOOR LEERKRACHTEN EN VRIENDEN VAN DE WETENSCHAPPEN

Het IPWV organiseert een divers palet aan opleidingen. Naast de cursussenreeks statistiek zijn ook andere modules gericht op onderzoekers in de industrie en academische instellingen, alumni en bij uitbreiding een breed geschoold publiek. Graag zetten wij twee nieuwere initiatieven extra in de kijker:

Bijscholing voor Leerkrachten Wetenschappen

Elk schooljaar biedt het IPWV een reeks bijscholing aan voor leerkrachten die wetenschapsvakken, wiskunde of informatica geven. De samenstelling en het uitwerken van dit programma mag rekenen op een nauwe samenwerking tussen leerkrachten, medewerkers van de faculteit Wetenschappen en de Specifieke Lerarenopleiding (SLO) van de Universiteit Gent. De focus ligt daarbij steeds op toepasbaarheid in de eigen lespraktijk.

Het aanbod wordt jaarlijks vernieuwd en uitgebreid, zodat de diverse wetenschapsdisciplines aan bod komen. Hierbij horen wij ook van u als leerkracht graag waar uw wensen en noden liggen m.b.t. bijscholing, zodat wij hier zoveel mogelijk kunnen op inspelen.

Contacteer ons via ipwv.ices@UGent.be.

Blijf op de hoogte van deze bijscholing:

- www.leerkrachtenwetenschappen.UGent.be: Onze website wordt regelmatig bijgewerkt met nieuwe bijscholing.
- Schrijf je in op de IPWV-mailinglist en ontvang als eerste bericht over deze bijscholing. Stuur een mailtje naar listserv@lists.ugent.be met in de titel *subscribe wetenschappen*.

Vrienden van de Wetenschappen: actueel onderzoek binnen de Faculteit Wetenschappen

Ben je benieuwd naar de onderzoeksprojecten die vandaag lopen binnen de Faculteit Wetenschappen en de impact die ze (zullen) hebben in de maatschappij? Ook in 2016-2017 laten wij onderzoekers uit de verschillende onderzoeksdisciplines aan het woord. Zij lichten hun onderzoek toe op een wetenschappelijke maar tegelijk begrijpbare manier, en nodigen u en heel bijzonder ook onze alumni uit om na te praten bij een glas in een aangename setting.

Kom langs en ontdek de fascinerende nieuwe ontwikkelingen in de exacte wetenschappen! Blijf op de hoogte van deze voordrachten:

- Schrijf je in op de IPWV-mailinglist en ontvang als eerste bericht over ons aanbod. Stuur een mailtje naar listserv@lists.ugent.be met in de titel *subscribe wetenschapsonderzoek*.
- Schrijf je in als alumnus via www.ugent.be/alumnus/nl/databank.

FLAMES

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