PhD PROGRAM IN PSYCHOLOGICAL SCIENCES

AA 2023-2024 TEACHING MODULES

October 2023 – September 2024

MODULES LIST:

MANDATORY COURSES

- **Methodology for the behavioural sciences**
- **Current issues in statistical inference for psychology**
- **Basics of statistical inference with R**
- **Linear and mixed effects models**
- **Generalized linear models - Part A**
- **How to publish in high impact journals**
- **MATLAB – Part A**

PRACTICAL SKILLS

- **How to win research grants**

MINI COURSES

- **Psychoneuroendocrinology**
- **How to investigate cognitive and perceptual abilities in non-verbal minds**
- **Data visualization with ggplot2**

PROGRAMMING

- **MATLAB - Part B**

METHODOLOGY AND STATISTICS

- **Generalized linear models - Part B**
- **Power and design analysis**
- **Structural equation modeling**
- **Evaluation of outliers and influential cases in a multivariate perspective**
- **Relevance, use and application of meta-analysis**
- **Psychological measurement**
- **Questionable measurement practices and how to avoid them**

Course: ## Methodology for the behavioural sciences

Lecturer: Simone Cutini

Hours: 10

Abstract

Methodological issues are fundamental aspects that need to be taken into account in every phase of the experiment, starting from its planning up to the analysis of the data collected. In this course, we will study the most important methodological practices that must be performed in each phase. We will also see some of the most common and dangerous pitfalls that need to be avoided. We will tackle some topics in cognitive psychology, cognitive neuroscience that will be used as examples that can be applied in other research fields, together few statistical issues which all should be aware of.

Skills you will learn during the course

1) How to plan and perform an experiment (including how to select the best experiment for your needs)
2) Use some tip and tricks to improve experiments and analyses
3) How to avoid common mistakes and bad practice

Course: ## Current issues in Statistical Inference for Psychology

Lecturer: Massimiliano Pastore

Hours: 10

Abstract

The course is organized into four parts. It begins by addressing the primary challenges associated with statistical analysis in psychology, with a specific focus on the difficulties in using and interpreting statistical significance. The third part discusses both the replicability crisis and the reproducibility crisis. Finally, it presents new strategies for enhancing the quality of psychological research.

Skills you will learn during the course

1) Enhancing the awareness of best practices in psychological research
2) Understanding the history of the replicability crisis and its ongoing consequences
3) Acquiring knowledge about current research practices related to open data and reproducibility

Course: ## Basics of Statistical Inference with R

Lecturer: Umberto Granziol

Hours: 20

Abstract

Statistical inference does not involve only the ability to read a p-value. It requires knowledge of what is being analyzed and how to program it properly. This course is designed to provide doctoral students with a comprehensive understanding of statistical inference by actively engaging them in practical exercises. It places a strong emphasis on how to find solutions to specific problems through the application of the R programming language. Furthermore, this course will enhance students' computational proficiency in the field of data science, covering key topics such as probability calculus, estimation, inference, and planned comparisons within the context of linear models.

Skills you will learn during the course

1) Critical thinking for solving some statistical issues
2) Implementation of the R code for these solutions

Course: ## Linear and mixed effects models

Lecturer: Jeffrey Kiesner

Hours: 15

Abstract

This course will focus on theoretical and practical application of the general linear model with specific emphasis on the overlap between ANOVA/ANCOVA and parallel analyses conducted within a multiple regression context. The course will include both theoretical explanation and practical application using SPSS.

Skills you will learn during the course

1) Understand the parallels and differences between ANOVA/ANCOVA and multiple regression
2) Perform ANCOVA/ANOVA in the context of multiple regression

Course: ## Generalized linear models - Part A

Lecturer: Filippo Gambarota

Hours: 10

Abstract

Generalized linear models (GLMs) are generalizations of ordinary linear regression where the data are assumed to be not normally distributed. In psychology, it is common to have categorical (e.g., binary) or strictly positive (e.g., counts or reaction times) variables that require appropriate models. In this course, we will see how GLMs are defined and formalized from a statistical point of view. Then we will implement the model in R with a particular focus on parameter interpretation. Moreover, we will implement Monte Carlo simulations to better understand the data generation process and estimate statistical properties (e.g., type-1 error and power).

Skills you will learn during the course

1) Understand the statistical theory of GLMs
2) Fit and interpret a GLM using R
3) Implement Monte Carlo simulations for the most common GLMs

Course: ## How to publish in high impact journals

Lecturer: Mara Cadinu

Hours: 15

Abstract

Practical exercises - using each student's own area of research as training ground - will accompany traditional teaching in order to help doctoral students develop the basic skills needed for publishing in top international journals. Students will be asked to bring to class the following parts of one of their own unpublished manuscripts: abstract, first paragraph of introduction, aims & hypothesis section of introduction, first and last paragraph of discussion section.

Skills you will learn during the course

1) To write a good first paragraph of an introduction
2) To write a good abstract
3) To write aims & hypothesis section of introduction

Course: ## MATLAB – Part A
Lecturer: Luca Stefanutti
Hours: 10
Abstract
Like Python, R, and still other languages, MATLAB is a high level scientific programming language that inherits the power of the C language, still remaining much simpler in its structure. The course introduces the student to the logic of "solving problems by programming" through the MATLAB programming language. Procedural programming mostly consists of applying algorithms to data structures. Basic data structures (like vectors, matrices, strings and lists) and fundamental algorithms (the pieces of code that "do the things") are illustrated in theory and through a series of practical examples. In a later step, algorithms and data structures are applied within the most important abstraction mechanism of the whole procedural programming framework, namely functions.
Skills you will learn during the course
1) Using MATLAB on-line from virtually any device
2) Elementary programming skills for data analysis, text and string manipulation
3) Code debugging and testing
4) Managing large and complex data structures through vectors and matrices
5) Develop your own MATLAB functions

Course: ## How to win research grants
Lecturer: Christian Agrillo
Hours: 5
Abstract
Publish or Perish? Not only. We can especially perish by the lack of funds. While we continuously focus on paper writing, we often neglect the importance of grant applications, especially at the beginning of our academic career. This course aims to fill this gap, showing different types of grants, and providing tips for a successful grant application. At the end of the course, PhD students will be invited to present a short grant application, with a particular focus on the budget.
Skills you will learn during the course
1) What is the proper grant for my purpose?
2) Which is the language I have to use for grant panels and for the reviewers?
3) What is the structure of ERC-like grants?
4) Grant interview: how does it work?
5) How do we prepare the budget section?

Course: ## Psychoneuroendocrinology
Lecturer: Jeffrey Kiesner
Hours: 5
Abstract
This short course will focus on the links between psychological states and experiences, endocrinological changes, and neurological changes. One specific model that will be examined are the hormonal, neurological, and psychological changes across the menstrual cycle.
Skills you will learn during the course
1) Understand the basic structures and functions of the steroidal signaling and how it effects the neurological system
2) Understand the complexity of steroid changes on neurological and psychological functioning

Course: How to investigate cognitive and perceptual abilities in non-verbal minds

Lecturer: Rosa Rugani
Hours: 5
Abstract
This course offers a critical approach to comparative cognition: the scientific study of perceptual and cognitive abilities and their underlying mechanisms across species. The attention will be focused on the experimental approaches to studying cognitive processes in behaviour, mainly in non-verbal subjects. The course has a strong emphasis on the cognitive experiments that have allowed scientists to discover what we now know about non-verbal minds, and how these discoveries have enhanced our understanding of human minds. At the end, you will apply what you have learned by designing a task that allows you to demonstrate a perceptual or cognitive ability in non-verbal subjects
Skills you will learn during the course
1) Apply the scientific method to questions about comparative cognition and behavior
2) Design proper experiments to unveil cognitive and perceptual abilities in non-verbal subjects
3) Appreciate reasoning from a comparative perspective

Course: Data visualization with ggplot2

Lecturer: Michele Vicovaro
Hours: 5
Abstract
Proficiency in performing statistical analyses with R is a crucial skill for researchers in behavioral sciences. This skill should be complemented by the ability to construct informative and visually appealing graphs, as graphs are increasingly important for transparent and effective communication of scientific study findings. The ggplot2 package serves as a potent and adaptable tool within the R environment, facilitating the creation of meaningful and aesthetically pleasing graphs. Although its logic may initially appear complex, once you grasp the fundamentals, you will appreciate the high degree of control it offers over the graphs that you are planning to create for your forthcoming research papers.
Skills you will learn during the course
1) Evaluation of the strengths and weaknesses of different graphical representations
2) Mastery of the ggplot2 programming language basics
3) Proficiency in crafting various types of graphs using ggplot2.Inizio modulo

Course: Generalized linear models - Part B

Lecturer: Filippo Gambarota
Hours: 5
Abstract
In this course, we will practically implement a GLM analysis using real data with categorical and numerical predictors. We will see several examples with real data from psychological research presenting a common analysis workflow. Starting from importing and exploring data to model fitting. Then we will evaluate model assumptions and diagnostics. Finally we will present the model results with appropriate tables and figures.
Skills you will learn during the course
1) Autonomy in a GLM analysis workflow
2) Evaluate model assumptions and diagnostics
3) Knowledge about the most important R packages for GLMs

Course: ## MATLAB - Part B
Lecturer: Debora De Chiusole
Hours: 10
Abstract
MATLAB is a programming platform designed for scientists to analyze and build different types of systems. In this course, the computerized version of a psychological experiment is developed, step by step, by using the MATLAB language. This computerized version will allow visualizing and administering a set of 3D stimuli, registering and storing various aspects of the responses provided by a participant, and make some statistical analysis on the collected data. Skills required for participating in the course are those provided by Part A of the course, namely writing and evaluating (mathematical) expressions, using and creating variables, using relational (e.g., "<", ">") and logical (e.g., AND, OR, NOT) operators, using and creating vectors and matrices, using the main control flows (e.g., if-else, for-loop, and while-loop).
Skills you will learn during the course
1) Building, visualizing, and moving 3D stimuli
2) Building the interface of an experiment that administers stimuli and collects data
3) Running statistical analyses in MATLAB

Course: ## Power and design analysis
Lecturer: Gianmarco Altoè
Hours: 4
Abstract
Power analysis is a fundamental statistical method for planning the sample size of a study. Its importance has recently been highlighted in addressing the replicability crisis in psychological research. This course aims to explain the theoretical foundations of power analysis and provide practical tools using the R software. Additionally, both the theoretical and practical aspects of design analysis, which can be seen as a useful extension of power analysis, will be discussed.
Skills you will learn during the course
1) When and how to plan the sample size of a study
2) How to evaluate the results of a study taking into account several inferential risks
3) Implement power and design analysis using the R software

Course: ## Structural Equation Modeling
Lecturer: Tommaso Feraco
Hours: 16
Abstract
Structural equation modeling (SEM) is a powerful statistical technique that enables the analysis of multivariate data and latent variables. In this course, we will delve into the theoretical and statistical underpinnings of latent variables, explore the fundamental principles of SEM, and equip you with the skills to specify, evaluate, and test SEM models in R, primarily utilizing the 'lavaan' package. Key topics covered in the course also include confirmatory factor analysis (CFA), the assessment of measurement invariance, path analysis, and power analysis for structural equation models.
Skills you will learn during the course
1) Understand the principles of structural equation modeling and latent variables
2) Write, fit, and analyze a structural equation model in R
3) Implement a power analysis for structural equation models via simulation

Course: **Evaluation of outliers and influential cases in a multivariate perspective**

Lecturer: Gianmarco Altoè

Hours: 4

Abstract

Outliers (i.e., single observations that are distant from the others based on the variables of interest) and influential cases (i.e., single observations with a huge impact on the estimated parameters of a model) are ubiquitous in statistical analyses in psychology. In this course, based on practical examples, we will see how to define, identify, and handle univariate and multivariate outliers as well as influential cases. On a practical level, various statistical methods will be presented using the R software. These methods can easily be extended to other statistical software as well.

Skills you will learn during the course

1) Evaluate the presence of outliers and influential cases in a statistical analyses
2) Handle outliers and influential cases appropriately
3) Implement the various methods learned using the R software

Course: **Relevance, use and application of meta-analysis**

Lecturer: Gianmarco Altoè

Hours: 4

Abstract

Meta-analysis is a statistical method that allows for the quantitative synthesis of the results from multiple studies. These studies can involve existing literature or can be pre-planned studies following the same protocol (i.e., multi-lab studies). Currently, meta-analysis has assumed a crucial role in science and is indispensable in the toolkit of a psychologist researcher. This course will present various statistical models of meta-analysis from both a theoretical and applied perspective (using R software). Special emphasis will be placed on the critical interpretation of meta-analysis findings.

Skills you will learn during the course

1) Approach scientific questions with a meta-analytical mindset
2) Use the most appropriate meta-analysis models and create their associated graphical representations through the R software
3) Evaluate the critical aspects of a meta-analysis

Course: **Psychological Measurement**

Lecturer: Luca Stefanutti

Hours: 15

Abstract

The course is about measurement, both in general, across disciplines and in the special case of psychology. Naive psychological measurement is still in use, almost oblivion of the existence of a mathematical theory, named representational measurement theory (RMT), which offers a rigorous and comprehensive framework for measurement, valid for any empirical science. Extensive measurement (measurement in the physical sense) can only occur if a well specified set of conditions, known as the Hölder's conditions, hold true empirically. Such conditions do not hold with psychological attributes like intelligence, motivation, anxiety, emotional feelings, etc. Several alternatives to extensive measurement are offered by the RMT framework. Some of the most important for psychology (like

ordinal measurement and conjoint measurement) are illustrated, both theoretically and in practice, with the help of examples taken from experimental, clinical, and social psychology.

Skills you will learn during the course

1) Recognize and avoid the typical and pervasive biases of naive measurement
2) Establish artifact-independent (thus, meaningful) measurements
3) Apply various types of ordinal measurement to your data
4) Carry out a conjoint measurement study

Course: ## Questionable Measurement Practices and How to Avoid Them

Lecturer: Tatiana Marci

Hours: 4

Abstract

Although questionable measurement practices (QMPs) are common in psychological research and pose a potential threat to the validity of a study's conclusions, they have been largely neglected in the literature. In this course we will define QMPs, analyse examples of QMPs in the psychological literature, and highlight a series of questions that researchers can consider to identify and avoid them. We will discuss how measurement practices can be improved, and how transparency in measurement practices promotes rigorous research, allows careful evaluation of study conclusions, and is necessary for sound replication studies.

Skills you will learn during the course

1) Assess the degree of validity of a psychological instrument
2) Identify and avoid questionable measurement practices