UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Elements of Psychometrics With Software Lab 1

2627-1-E2403P004

Learning area

Knowledge about qualitative and quantitative research methodology

Learning objectives

Knowledge and Understanding
By the end of the course, students will have acquired a solid and structured understanding of the fundamental principles of descriptive and inferential statistics, including the main parametric and non-parametric techniques used in psychological sciences. They will be able to distinguish between different measurement scales, understand the concept of sampling distribution, the fundamentals of probability, and the most common inferential tests (Z test, t-test, ANOVA, chi-square, correlations). They will also be familiar with essential notions such as confidence intervals, effect size, and power analysis.

Applying Knowledge and Understanding
Students will be able to effectively apply their knowledge to:

- analyze psychological data using open-source statistical software (e.g., Jamovi);
- select and implement appropriate data analysis techniques according to the research question, variable types, and study design;
- report results clearly and accurately, following APA conventions and integrating numerical, textual, and graphical information.

Making Judgements
Through classroom exercises and hands-on practice with statistical software, students will develop the ability to critically evaluate the methodological coherence of selected data analysis techniques, interpret statistical outputs, and choose the most suitable approach for a given research problem among multiple options. The examination

format—which may include practical exercises, open-ended questions, and, if required, an oral interview—encourages independent judgement and critical thinking in applying and assessing inferential statistical methods.

Communication Skills
The course fosters the development of communication skills through the drafting of short interpretive texts based on statistical results (according to APA style), in-class discussion of exercises and analytical procedures, and the ability to explain methodological choices. The exam includes open-ended questions requiring the use of appropriate technical language and the ability to convey results clearly and coherently, both in written form and, if required, during an oral interview.

Learning Skills
The course provides a strong theoretical and practical foundation that enables students to continue learning more advanced statistical techniques independently. The use of open-source software such as Jamovi supports the development of an active and self-directed learning approach, which is also beneficial for future specialized courses, as well as for professional or research practice.

Contents

This course aims at providing the basic knowledge on descriptive and inferential statistics. Furthermore, it addresses some techniques of statistical analysis and introduces the use of *jamovi* (or of another statistical software).

Detailed program

- Descriptive statistics: measurement scales, central tendency and variability indices, standardized measures;
- Graphical synthesis and graphical exploration of the data;
- Introduction to probability;
- Basic inferential statistics: sampling distribution, hypothesis testing, confidence intervals;
- Parametric techniques: Z test; t-test for the difference between means (single sample, independent samples, paired samples); linear correlation (Pearson's)
- Non-parametric techniques: Chi-squared test (equally-probable categories, independence, test of a model), Spearman correlation
- Effect size and its use
- Introduction to the concept of power analysis

Prerequisites

As this is a compulsory first-year course, the only prerequisites are basic knowledge of mathematics/algebra and computer use. Possible specific lacunae will be handled during the lessons.

Teaching methods

Teaching with Different Didactic Methods:

- 21 lessons of 2 hours each, delivered in person (lecture based teaching), generally divided into logical blocks corresponding to the chapters of the textbook. The lessons will cover the theoretical aspects of the program. For some blocks, self-assessments or exercises might be provided on the e-learning platform;
- 18 hours of interactive exercises (interactive teaching), organized in sessions of 2 or 3 hours each, during which students will have the opportunity to practice the statistical techniques learned in class using one or more statistical software programs.
  The teaching activities will take place in-person.

Assessment methods

The exam is written and consists of multiple-choice questions, open-ended questions, and statistical analysis exercises.
Additionally, by performing analyses on a data file assigned at the beginning of the exam, the competence in using the statistical software (or statistical softwares) learned will be assessed, as well as the ability to interpret the results obtained through the software.
A minimum score of 18/30 in the multiple choice part is required for the remaining parts to be assessed.

The questions are aimed at verifying the actual acquisition of theoretical knowledge, the ability to perform statistical analyses (with and without the aid of statistical software), and the interpretation of the results of these analyses. The assessment of learning outcomes takes into account:

- acquisition and mastery of the theoretical content of the course;
- ability to correctly select and apply the statistical techniques presented;
- proper use of statistical software for data analysis;
- ability to interpret and critically discuss the results obtained;
- clarity of expression and appropriate use of technical and scientific language.

There are no midterm or partial exams.

For students who request it (or at the instructor's request), an oral interview on all the topics of the course is also provided, which can lead to an increase or decrease of up to a maximum of 2 points on the written exam score.

The final grade reflects the overall score obtained across the different parts of the exam, according to the following scale:

18: barely sufficient knowledge, minimal applied and interpretive skills;
19-22: sufficient knowledge of the core content, with some uncertainty in application;
23-26: good knowledge, sound applied skills with occasional inaccuracies;
27-30: solid knowledge, good command of statistical techniques and critical thinking;
30 cum laude: fully adequate and thorough knowledge, complete mastery, excellent command of technical language.

Textbooks and Reading Materials

For lessons (theory):

- Slides (in Italian)

- Aron, A., Coups, E. J., & Aron, E. J. , Cooley, E. (2024). Fondamenti di Psicometria per la ricerca. Milano: Pearson. (Capp. from 1 to 9 included, 11 and 13)

For *jamovi*
Danielle J. Navarro and David R. Foxcroft, Learning Statistics with jamovi: A Tutorial for Beginners in Statistical Analysis. Cambridge, UK: Open Book Publishers, 2025, https://doi.org/10.11647/OBP.0333
An additional text for the use of the jamovi software might be made available on the course website before the start of the lessons.

Sustainable Development Goals

QUALITY EDUCATION