# Psychometrics Statistics

## PROF. Andrea Bonanomi

***COURSE AIMS AND EXPECTED LEARNING OUTCOMES***

The course aims at introducing the theory of measurement in psychology and statistical data analysis of psychological data. Together, these would provide the basic knowledge for developing adequate methodological skills and for tackling the study of principal methods and statistical models used in psychological sciences. The course will be strictly introductory with only basic teaching. The course content will explicitly refer to the scientific methods of quantification and measurement.

At the end of the course, students are expected to be able to identify problems regarding research, select different technical methods to tackle the problem, apply statistical procedures and suitable processes, obtain the main results, read and interpret them.

***COURSE CONTENT***

The course programme is divided into 5 units, which cover the basics of descriptive, univariate, and bivariate psychometric statistics, and some keynotes on probability calculus aimed at providing the tools for approaching inferential psychometrics statistics. Practical implications and applications in social sciences are presented throughout the entire course.

In detail, the programme is divided into 5 units:

Unit 1*.* *Univariate Descriptive Statistics*

1.1 Quantification in psychology

Theory of measurement;

Measurement scales;

Meaning and concept of statistical variable.

1.2 Statistical distributions

Statistical records;

Frequency distributions;

Graphical representations.

1.3 Univariate descriptive indices

Central trend and position

Variability;

indices of shape (?);

Standardised scores.

Unit 2. *Bivariate Descriptive Statistics: The relationships between variables*

2.1 Double entry tables.

Relationship between two variables:

connection,

dependence,

linear correlation,

2.2 Spearman’s indices,

Cronbach’s alpha for reliability analysis.

2.3 Linear regression:

Least squares method,

2.4 Parameters estimation of regression lines and goodness-of-fit

predictive use of the model.

Unit 3. *Probability computation*

 Basic concepts of probability computation:

axioms and theorems of probability computation,

3.1. Measurement of probability.

 definition of random variable:

continuous and discrete variables;

binomial distribution

normal distribution;

3.2. Central limit theorem.

Unit 4. *Statistical Inference*

4.1 Population and samples: General notions.

4.2 Parameters estimation:

concept of estimators and their properties,

punctual estimation and interval estimation,

sample distributions and some estimators

4.3 Hypotheses testing:

Basic principles of Null Hypotheses Significance Testing approach

Type I and II errors

Test function, acceptance and rejection areas

Hypotheses testing on mean and proportion

T-test for independent and paired samples

Chi square test

T-test on regression parameters

One-way analysis of variance.

Unit 5. *Psychometrics statistics for Social Sciences*

This unit aims at providing the skills needed for the comprehension of the most common methodologies used in social sciences by using statistical tools and methods. Specifically, it will encourage critical thinking on research practices and methodologies in order to identify and apply the most appropriate statistical methods for the observed data. The examples used for this conceptual and work pathway will refer to descriptive measurement, statistical measurement and hypothesis testing.

***READING LIST***

The reading list for the course will include slides for students, available on Blackboard. Students wishing to do in-depth study are advised to read the following:

Basic text:

A.P. Ercolani-A. Areni-L. Leone, *Elementi di statistica per la psicologia,* Il Mulino, 2008.

Texts recommended for in-depth study, assessment and practical exercises:

A. Areni-T.G. Scalisi-A. Bosco, *Esercitazioni di Psicometria,*Masson, Milan, 2008.

A.P. Ercolani-A. Areni-V. Cinanni, *Problemi risolti di statistica applicata alla psicologia,* LED, Milan, 1999.

***TEACHING METHOD***

Lectures and practical exercises in the lecture room. Some hours of practical exercises using EXCEL are planned, to be held in the Informatics Laboratory.

Attendance of students at lectures in the lecture room is strongly recommended.

***ASSESSMENT METHOD AND CRITERIA***

Students will be assessed on theoretical skills regarding statistical analysis techniques, statistical-mathematical skills regarding the practical execution of certain exercises and methodological-applicative skills for research. There will be a final written test, which might be integrated with an oral test at the discretion of the commission. The written test consists of 12 closed questions (1 mark for each correct answer), open-ended questions to assess students’ ability to interpret output produced by statistical analysis using Excel (3 marks) and structured exercises (16 marks overall).

***NOTES AND PREREQUISITES***

Students are advised to sit the exam after having passed the Methodology of Psychological Research exam. Students should have basic knowledge of research methodology and descriptive statistics.

In case the current Covid-19 health emergency does not allow frontal teaching, remote teaching will be carried out following procedures that will be promptly notified to students.

Further information can be found on the lecturer’s webpage at http://docenti.unicatt.it/web/searchByName.do?language=ENG or on the Faculty notice board.