UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Introductory Statistics

2627-118R-IntrStat

Learning objectives

The aim of the course is to introduce students to basic concepts and methods of probability theory, mathematical statistics and statistical inference.

The course is preparatory to the course on quantitative social research methods and it is aimed at students who lack the necessary statistical background.

Contents

Introduction to the fundamentals of probability and statistics.

Detailed program

Data organization: qualitative data; quantitative data; paired data.

Descriptive statistics: measures of center; measures of variation; sample percentiles; skewness; kurtosis; sample covariance and correlation.

Probability: sample space and events; union and intersection of events; complement of an event; Venn diagrams; basic properties of probability; joint and marginal probabilities; conditional probability and independence; Bayes' theorem; counting principles.

Random variables and probability distributions: probability density functions and cumulative distribution functions; some common discrete distributions (Bernoulli; discrete uniform; binomial; Poisson); joint, marginal and conditional

distributions; measures of central tendency: measures of variability; standardized random variables; some useful continuous distributions (uniform, normal, log-normal, Chi-square, Student's *t*, *F*); analysis of conditional distributions; analysis of joint distributions.

Mathematical statistics and inferential statistics: statistical inference and sampling: random sampling; parameters, estimators and estimates; finite sample properties of estimators (unbiasedness and efficiency); large sample properties of estimators (consistency; law of large numbers and properties of the probability limit; central limit theorem and asymptotic normality).

Confidence Intervals (CIs) and hypothesis testing: CIs for one population mean; critical values; margin of error; asymptotic confidence intervals; Type I and II error probabilities, size and statistical power of a test; one-tailed and two-tailed tests for one population mean; *p*-value approach to hypothesis testing; pooled and non-pooled two-sample *t* tests for inference on two population means using independent samples; inference for population proportions.

An introduction to non-parametric statistics: kernel density estimator; rank-based tests (sign test; Wilcoxon signed-rank test; Mann-Whitney test; Kruskal-Wallis test).

Prerequisites

Algebra and basic notions of calculus.

Teaching methods

Lectures and training sessions.
Self-assessment tests and Q&A forum.

Assessment methods

Problem sets and exercises.

Textbooks and Reading Materials

Compulsory readings:
- Weiss, N.A., *Introductory statistics*, 9th ed., Addison Wesley, 2011, ISBN: 9780321691224, Chapters 1-10, 12, (16).
- Wooldridge, J.M., *Introductory Econometrics: A Modern Approach*. 5th ed., South-Western, Cengage Learning, 2013, ISBN: 9781111531041, Appendixes A-C.
Slides, additional references, exercises, and further material available at the course page on the e-learning platform.

Additional (not compulsory) readings:
Huff, D. (1993), *How to Lie with Statistics*, W. W. Norton & Company Inc.

Angrist, J.D. and Pischke, J.-S. (2015), *Mastering 'Metrics: The Path from Cause to Effect*, Princeton, NJ: Princeton University Press.
Ross, S. (2014), *A first course in probability*, 9th ed., Pearson, Chapters 1-8.

Sustainable Development Goals

QUALITY EDUCATION