UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Medical Statistics

2627-4-H4101D261

Aims

This course aims to provide the basic tools of medical statistics that are at the basis of a proper methodological approach to a research project in medicine. The student will be able to calculate the main descriptive indexes and to appreciate the characteristics of a sample by descriptive statistics and plots. The student will be able to evaluate the accuracy of a diagnostic test by the sensitivity, specificity and predictive value indexes. The student will be able to calculate specific probabilities from Gaussian and Binomial distribution. The student will be able to calculate and interpret statistical tests for means and proportions and confidence intervals. The student will be able to interpret the results of a linear regression model. The student will know how to critically read the methodology and results paragraphs of a clinical paper.

Knowledge and Understanding

By the end of the course, students should be familiar with the fundamental concepts of descriptive statistics (measures of central tendency and variability) and inferential statistics (hypothesis testing, confidence intervals), as well as regression models (linear and logistic models). Students should also be able to distinguish between different study designs.

Ability to Apply Knowledge and Understanding

Students must be able to plan a study by determining the appropriate sample size. They must also be able to apply the main methods of statistical analysis for data processing (descriptive statistics, confidence intervals, and hypothesis testing).

Making judgements

Students must be able to select a study design based on the objective, minimizing expected biases wherever possible, and navigate among statistical analysis techniques to evaluate which are most appropriate for the study data. They must also be able to understand and assess, from a statistical perspective, the robustness of the results of studies published in scientific journals.

Communication Skills

Students must be able to communicate the design and results of a clinical study.

Learning Skills

Students will be able to independently keep up to date by consulting and critically evaluating the international scientific literature (Evidence-Based Medicine) and recognizing the adequacy of the study design and the main methods used.

Contents

Uncertainty in medicine. Methods for data description. Probability. Statistical inference: hypothesis testing, sampling and introduction to modelling. Sample size calculation. Type of studies. Effect measures.

Detailed program

DESCRIPTIVE STATISTICS FOR BIOLOGICAL VARIATION: Statistical unit, target population, sample, variables and data. Types of variables. Summary indicators (central tendency and dispersion). DATA COLLECTION AND PRESENTATION OF DATA: Methods for collecting and coding data; quality control; Data-bases for statistical analysis; Presentation of data in graphs and tables. ERROR IN THE MEASURE OF BIOLOGICAL PHENOMENA: Reliability evaluation of measurement methods; Random error and measurement accuracy; Systematic error and accuracy of the measure. RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS: definitions of probability; conditional probability and independence; probability distributions and random variables (examples of Gaussian and Binomial distribution). DIAGNOSTIC PROCESS EVALUATION: sensitivity, specificity; clinical decision: probability as uncertainty measure; predictive value of a test. EVALUATION OF RESULTS IN A CLINICAL STUDY: population parameter, sample estimate and standard error; confidence intervals; statistical hypothesis test, significant level and power; application of a statistical test, p-value; sample size calculation; statistical inference; basic concepts of regression and correlation; different types of studies in clinical and epidemiological research, observational and experimental studies; efficacy measures (relative risk, odds ratio, hazard ratio); meta-analysis.

Prerequisites

specific preliminary knowldge is not required

Teaching form

Lectures will be interspersed with practical exercise.
Critical reading of clinical papers.

- 22 2-hour lectures conducted in in-presence delivery mode in the initial part that is aimed at engaging students interactively in the later part.
- 8 lessons of 2 hours conducted delivered remotely (asynchronously) with individual exercises supervised by

the instructor.
- 8 2-hour tutorial activities conducted in interactive mode (group work on scientifical articles and final exercise)

Through lectures, students develop knowledge and understanding of the main tools of medical statistics and research methodology.
Practical exercises and group work guide students in actively applying biostatistical methods to the analysis of clinical data. Particular attention is given to fostering critical thinking, training students not only to interpret results but also to critically evaluate the validity, limitations, and relevance of the methods used in scientific studies.
Through critical analysis and group work on scientific articles from the biomedical literature, students learn to independently assess the methodological soundness of the evidence, identifying potential biases or errors in the interpretation of statistical data. Working in small groups and engaging in constructive discussion helps students become accustomed to communicating, arguing, and synthesizing quantitative information and biostatistical concepts, both within peer teams and in the classroom with interdisciplinary faculty.
The final practical exercise and active discussion of scientific papers encourage self-directed learning and independent study, equipping students with the critical thinking skills necessary for continuous medical education (Evidence-Based Medicine)..

Textbook and teaching resource

Marc M. Triola, Mario F. Triola, Jason Roy. Fondamenti di statistica Per le discipline biomediche 2nd Edition, published by Pearson Education 2022.

Martin Bland. An Introduction to Medical Statistics, Oxford 2015

Stanton A.Glantz. Primer of Biostatistics, McGraw-Hill Education / Medical 2011

Martin Bland. An Introduction to Medical Statistics, Oxford 2015

Bossi Anna, Cortinovis Ivan Statistica medica : esercitazioni Milano [poi] Torino : CittaStudi edizioni, 1996. ISBN 88-251-7163-3

Semester

First semester

Assessment method

Final written test including:

-3/4 exercises to test the ability of the student in the application of statistics

-4/5 questions with closed answer to evaluate the preparation on the overall program

-1 test on an extract of a clinical paper to evaluate the interpretation of basic statistics in medical literature

Office hours

Tuesday 10-12 am on appointment.
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Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION | GENDER EQUALITY