



Generic Foundational Course

Fundamentals of Biostatistics

NGS Academy for the Africa CDC









Fundamentals of Biostatistics

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Module last updated:

December 2024

Number of sessions	3–4
Total learning time	1–2 days
Target audience	All personas - wet laboratory personnel (i.e., scientists, laboratory technicians, etc.), dry laboratory personnel (epidemiologists, bioinformatics scientists, and bioinformaticians), and managerial personnel (i.e., HODs, laboratory managers, policymakers, etc.).
Format	Lectures, videos
Level of the module	Introductory



Contributors

Siddiqah George and Carolina Matos.



Module description

This module introduces the fundamental concepts and principles of biostatistics, as it applies to public health and biomedical research. The aim of this module is to introduce the theoretical basics of biostatistics so that it can be applied to more advanced topics, such as pathogen genomic surveillance study design and bioinformatic data analyses, in later modules and/or courses. In this module, participants are introduced to the following topics and/or concepts:

- Key terminology used in biostatistics
- The role of biostatistics in public health and biomedical research
- Fundamental concepts in biostatistics such as:
 - Central tendency
 - Central variability
 - Probability
 - Inference
 - Correlation
 - Regression

- Essential concepts underlying hypothesis tests
- Basic statistical analyses and data interpretation
- The basic principles underlying genomic epidemiology study design
- Different types of epidemiological study designs
- Different approaches to sample selection for genomic epidemiological studies
- Aspects of experimental design that are important to successful bioinformatic data analyses
- How assumptions and limitations, in sequencing technologies, can aid in planning experimental designs
- · Applying concepts of study design, such as causal inference, to GWAS analyses and survival analyses



Module learning outcomes

On completion of this module, the participants will have basic knowledge and skills in, or be able to:

- Define basic terminology in biostatistics
- Explain essential principles of biostatistics, including:
 - Central tendency
 - Central variability
 - Probability
 - o Inference
 - Correlation
 - Regression
- Describe how biostatistics is applied in a public health and/or biomedical research context
- Explain the principles of probability and its applications in biostatistics
- Describe and differentiate between common probability distributions
- Interpret probability values and explain their implications in statistical analyses
- List the steps within the hypothesis testing process
- Formulate hypotheses for various types of basic statistical tests
- Interpret and explain the results of basic statistical tests
- Describe the differences between various epidemiological study designs
- Differentiate between methods for sample selection genomic epidemiological studies
- List the strengths and limitations of different study designs and explain their impact on statistical analysis
- Explain the impact of different sampling methods on statistical inference and data analysis



Module assessments

Module practical: Not applicable

Module quiz: Assessment questions available on the ASLM platform



Module resources

- <u>US CDC Archive Principles of Epidemiology in Public Health Practice: An Introduction to Applied</u> Epidemiology and Biostatistics (Third Edition)
- SciELO Article Statistical terms Part 1: The meaning of the MEAN, and other statistical terms commonly used in medical research
- Article Descriptive Statistics: Measures of Central Tendency, Dispersion, Correlation and Regression
- NIH | NLM Article Types of Variables, Descriptive Statistics, and Sample Size
- IJRES Article Role of Biostatistics in Analysing Public Health
- Pubrica Video Role of Biostatistics and Responsibilities of Biostatisticians in Clinical Medical Research
- NIH | NLM Article Basics of statistics for primary care research
- RNJPH Article Bio-Statistical Methods and Bio-Medical Research: Challenges
- NIH | NLM Article A brief introduction to probability
- AJR Article Introduction to Probability Theory and Sampling Distributions
- <u>UCI Open Lecture Video Playlist Introduction to Probability</u> and Statistics (Lectures 1 16)
- SAGE Journals Chapter Introduction to Hypothesis Testing
- US CDC Video Epidemiologic Studies: A General Overview
- SHU Library Webpage Types of Research Designs
- CEBM Resources Study designs
- NIH | NLM Article Sampling methods in Clinical Research; an Educational Review
- NIH | NLM Article Statistics in Brief: The Importance of Sample Size in the Planning and Interpretation of Medical Research
- NJPPP Article How to calculate sample size for observational and experimental nursing research studies?
- Bioinformatics Workbook GitHub Introduction to Experimental Design
- Bioconductor GitHub BiocWorkshops2019: Epidemiology for Bioinformaticians



- OpenAl. (2024). Gemini response on learning objectives for fundamentals of biostatistics module.
 Retrieved July 29, 2024, from Gemini
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