

BIOSTATISTICS (BIOS)

BIOS 700 - Introduction to Biostatistics (3 Credits)

Health-related statistical applications. Descriptive statistics, probability, confidence intervals, hypothesis testing, regression, correlation, ANOVA. May not be used as part of a degree program in epidemiology or biostatistics. Three lecture hours and one laboratory hour per week.

BIOS 701 - Concepts and Methods of Biostatistics (3 Credits)

Descriptive and inferential statistical applications to public health. Probability, interval estimation, hypothesis testing, measures of association. Three lecture hours and one laboratory hour per week. Intended for those who will be involved in research applications of biostatistics.

BIOS 709 - Basic Software for Public Health (1 Credit)

Working with public health data using statistical software. Effective ways to store, clean, merge, and format public health data for analysis.

BIOS 710 - Effective Data Management for Public Health (3 Credits)

Statistical data management techniques. Microcomputer applications, communication between microcomputers and mainframe, tape and disk storage, access of large health-related databases.

Prerequisite or Corequisite: BIOS 700.

BIOS 711 - Introduction to R Programming (1 Credit)

Students will learn the software program R for performing data management. The course covers basic to advanced commands for properly formatting output, merging data, working with functions, graphing, using programming loops for preparing data for analysis for public health data.

BIOS 712 - Introduction to Stata Software (1 Credit)

Students will learn the software program Stata for performing data management. The course covers basic to advanced commands for properly formatting output, merging data, working with functions, graphing, using programming loops for preparing data for analysis for public health data.

BIOS 714 - Introduction to MS Access for Public Health (1 Credit)

This course focuses the uses of Microsoft Access for data management in public health. The course takes the student through building tables, forms, queries, reports and finishes with automated scripts for each of use with Access.

BIOS 719 - Advanced SAS Methods for Public Health (1 Credit)

This course focuses on advanced programming for managing and analyzing data using SAS. Building upon skills learned in BIOS 709 (Introduction to SAS), students will learn data management using PROC SQL. Students will also become familiar with the SAS Macro Language which prepares data for conducting efficient statistical analysis.

BIOS 720 - Advanced Data Management in Public Health (3 Credits)

This course teaches advanced techniques for creating and using large data sets. Students will learn advanced techniques for working with data, cleaning data, and preparing it for analysis using three software packages (SAS, STATA, MS Access) for data entry, data management, and presentation. For statistical analysis, students will learn advanced SAS, the primary statistical package used for data analysis in other biostatistics and epidemiology courses.

Prerequisites: C or better in BIOS 710.

BIOS 735 - Machine Learning for Public Health Applications (3 Credits)

This course introduces the fundamental concepts and applications of machine learning (ML) in the context of public health, biostatistics, and related fields (e.g., epidemiology, psychology, neuroscience, genetics). Students will learn how to prepare data, select and implement appropriate machine learning methods, and evaluate model performance—all using R. Emphasis will be placed on conceptual understanding, practical implementation, and interpretation of results rather than on mathematical derivations. By the end of the course, students will be prepared to incorporate ML techniques into their own research projects, with a special focus on the unique challenges and ethical considerations inherent in analyzing public health data.

Prerequisites: B or better in BIOS 757 and BIOS 755 or equivalent.

BIOS 745 - Seminar in Biostatistics (1-2 Credits)

Analysis of current and prospective issues in biostatistics, including historical foundations. Includes student exploration of unsolved problems and examination of central issues in biostatistics.

BIOS 746 - Introduction to Complex Survey Data Analysis (1 Credit)

Students will learn the basics of data collection methods, sampling design for linear, logistic, and survival analysis complex models using survey data. Students will also learn about weight adjustments, imputation methods with an emphasis on both applied models and the theory behind them.

Prerequisites: B or better in STAT 512 and STAT 513 or equivalent.

BIOS 753 - Community Health Studies (3 Credits)

Process, skills, and management of undertaking health studies in the human community.

Prerequisites: BIOS 700, EPID 700.

BIOS 754 - Discrete Data Analysis (3 Credits)

Analysis of discrete data in public health studies. Relative risk, odds ratio, rates and proportions, contingency tables, logistic regression, introduction to other advanced topics. Not for biostatistics majors.

Prerequisites: EPID 701, BIOS 710, BIOS 757.

BIOS 755 - Introduction to Longitudinal Data Analysis (3 Credits)

Introduction to principles and methods for longitudinal & multi-level modeling. Focus on data analysis and interpretation.

Prerequisites: BIOS 757.

BIOS 757 - Intermediate Biostatistics (3 Credits)

Public health applications of correlation, regression, multiple regression, single and multi-factor analysis of variance and analysis of covariance.

Prerequisites: a course in introductory statistics.

BIOS 758 - Advanced Linear Models in Biostatistics (3 Credits)

Public health applications of correlation, regression, multiple regression, single and multi-factor analysis of variance and analysis of covariance. Additional topics in analysis of health data including regression diagnostics, multi-collinearity of observational data, ridge/nonlinear regression, principal components, random/mixed effects, unbalanced designs, repeated measures and sampling and design effects.

Prerequisites: BIOS 701.

BIOS 759 - Theory and Methods of Discrete Data Analysis (3 Credits)

The concepts, principles, and biostatistical techniques necessary to analyze categorical epidemiological data including dose response curves, life tables, and discrete measures of association. Estimation of parameters for logistic and other commonly used epidemiological models.

Prerequisites: EPID 701, BIOS 757.

BIOS 760 - Biostatistical Methods in Clinical Trials (3 Credits)

The basic and advanced statistical techniques necessary for the design, conduct, analysis, and interpretation of results of clinical trials.

Prerequisites: EPID 741, BIOS 757.

BIOS 761 - Survival Analysis (3 Credits)

Methods for the analysis of survival data in the biomedical setting. Underlying concepts; standard parametric and nonparametric methods for one or several samples; concomitant variables and the proportional hazards model.

Prerequisites: BIOS 757 or BIOS 758.

BIOS 762 - Biostatistical Modeling of Genomic Data (3 Credits)

This course is an introduction to important topics and key concepts in statistical genetics, with emphasis on statistics methods and their applications to human complex diseases. The course will cover major concepts and classical statistical methods for the analysis of family and population based human genetic data.

Prerequisites: BIOS 757 or equivalent.

BIOS 765 - Research Design in the Biomedical Sciences (3 Credits)

Fundamentals of constructing, analyzing, and interpreting biomedical studies; internal and external validity, sample size determination, completely random designs, blocking crossover designs, factorial designs, confounding, nested designs, repeated measure designs.

Prerequisites: EPID 741, BIOS 757.

BIOS 767 - Spatial Statistics for Public Health (3 Credits)

Spatial statistics methods commonly used in public health including mapping, tests for spatial correlation, hypothesis tests for spatial clustering, and regression models with spatial random effects.

Prerequisites: B or better in BIOS 700 or BIOS 701.

BIOS 770 - Applied Longitudinal Data Analysis (3 Credits)

Modern methods for the analysis of repeated measures, correlated outcomes, and longitudinal data, including repeated measures ANOVA, generalized linear models, random effects, and generalized estimating equations.

Prerequisites: BIOS 757 or BIOS 758 or STAT 701 or STAT 705.

Cross-listed course: STAT 771

BIOS 775 - Biostatistical Aspects of Bioinformatics (3 Credits)

Bioinformatics analyses related to public health and biomedical research. Gene-gene and gene-environment interaction, phylogeny analysis in disease classification, and clustering for expression data. Data analyses, simulation studies, algorithms, and interpretation of health data.

Prerequisites: BIOS 757.

BIOS 780 - Introduction to Quantile Regression (3 Credits)

Principles and methods of quantile regression, a robust and distribution-free statistical approach that extends the classical mean regression to the analysis of complex treatment effects.

Prerequisites: BIOS 757.

BIOS 790 - Independent Study (1-6 Credits)

Directed research on a topic to be developed by M.P.H. or M.S.P.H. student and instructor. May be repeated.

BIOS 794 - Selected Topics in Biostatistics (1-6 Credits)

Content varies by title. Course may be repeated for a total of 6 credit hours.

BIOS 799 - Thesis Preparation (1-9 Credits)**BIOS 811 - Survival Analysis II (3 Credits)**

Parametric survival analysis, accelerated failure time model, frailty model, competing risk mode and multi-state model. Techniques motivated by applications in epidemiology and clinical medicine research, applications demonstrated using public health data sets.

BIOS 815 - Generalized Linear Models (3 Credits)

Statistical theory and applications extending regression and analysis of variance to non-normal data. An integrated treatment encompassing logistic and other binary regressions, log-linear models, and gamma regression models.

Prerequisites: STAT 713 or STAT 513 and STAT 705 or BIOS 757.

Cross-listed course: STAT 775

BIOS 816 - Advanced R Programming in Public Health (3 Credits)

R is a free and open source software environment for statistical computing and graphics. This course provides the principles and techniques to efficiently design, implement, and execute simulation and data analysis routines in quantitative fields like biostatistics, statistics, engineering, finance, and data science.

Prerequisites: BIOS 711.

BIOS 818 - Advanced Computational Statistics for Signal and Network Analysis (3 Credits)

An overview of advanced computational statistics for signal and network analysis with a wide variety of social, genomic and neuroscientific applications. All course modules include a hands-on component.

Prerequisites: B or better in BIOS 701, BIOS 757, BIOS 711, STAT 512 and STAT 513.

BIOS 820 - Bayesian Biostatistics and Computation (3 Credits)

Bayesian statistical methods including hierarchical modeling and the use of the Markov Chain Monte Carlo (MCMC) methods.

Prerequisites: STAT 705 or BIOS 757.

BIOS 822 - Statistical Methods in Spatial Epidemiology (3 Credits)

A comprehensive introduction to the statistical methods used in the analysis of geo-referenced spatial health data. Topics range from disease mapping to prospective surveillance.

Prerequisites: BIOS 757 and BIOS 759.

BIOS 825 - Multivariate Biostatistics (3 Credits)

Analysis of multivariate data as found in biomedical studies: multivariate linear models, principal component analysis, factor analysis, discriminant and cluster analysis. Other special multivariate topics such as principal component regression.

Prerequisites: STAT 516 or BIOS 757.

BIOS 835 - Biostatistical Machine Learning for Public Health (3 Credits)

The focus of this course will be on using biostatistical models to predict and provide information on complex public health datasets. We will focus more on prediction of outcome(s) than estimation of the impact of a risk factor. However, some inferential methods for risk factors will be reviewed and (for all methods) techniques to measure variable importance will be discussed. Further, unsupervised learning methods (e.g., clustering) will be discussed. Prediction and predictive inference will be main themes in the course along with learning how to implement the methods in R software. See the syllabus course schedule for a full list of topics.

Prerequisites: B or better in BIOS 770 or equivalent.

BIOS 845 - Doctoral Seminar (1-3 Credits)

May be repeated for credit.

Prerequisites: complete at least one semester of course work and consent of instructor.

BIOS 850 - Binary Dose Response Theory and Methods (3 Credits)

Threshold, mass action and target theory; empirical dose response functions; methods in current use among health science researchers.

Prerequisites: STAT 512.

BIOS 890 - Independent Study (1-3 Credits)

Directed research on a topic to be developed by doctoral student and instructor. May be repeated.

BIOS 894 - Selected Topics in Biostatistics (3 Credits)

Discussion on current and emerging issues in biostatistics.

BIOS 898 - Doctor of Public Health Practicum (1-6 Credits)

Students are required to conduct applied public health methods and strategies as a part of their practicum experience. In particular, the student should successfully implement and interpret the results of biostatistical methods in the organization.

BIOS 899 - Dissertation Preparation (1-12 Credits)

Prerequisite: one full year (18 hours) of graduate study beyond the master's level.