

BIOSTATISTICS (BIOS)

BIOS 6310 - Practical Clinical Research Informatics (3 Credits)
This course provides students with hands on experience in clinical research informatics involving secondary use of electronic health record (EHR) data, clinical informatics databases, and basic clinical data science as preparation for more advanced informatics or data science coursework.

Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Spring.

BIOS 6420 - Data Science and Analytics of Continuous Clinical Data (3 Credits)

The central focus of this course is on the generation, modeling, and analysis of data collected in a clinical or biomedical context, with an emphasis on temporal analysis. Analysis techniques will be anchored to solving real-world clinical and biomedical problems.

Grading Basis: Letter Grade
Typically Offered: Spring.

BIOS 6601 - Applied Biostatistics I (3 Credits)

Applied biostatistical methods including descriptive and statistical inference; odds ratio and relative risk, probability theory, parameter estimation, tests for comparing statistics of two or more groups, correlation and linear regression and overviews of: multiple and logistic regression and survival analysis.

Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall, Spring, Summer.

BIOS 6602 - Applied Biostatistics II (3 Credits)

A continuation of BIOS 6601 extending the basic principles of descriptive and inferential statistics to modeling more complex relationships using linear regression, logistic regression, and Cox regression. The statistical package SAS is used extensively. Multiple optional lab sessions offered. Prerequisite: BIOS 6601

Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Spring.

BIOS 6603 - Statistical Computing - SAS (1 Credit)

This course will emphasize statistical analysis and data interpretation through use of the SAS statistical computing package. Instruction will be provided through laboratory exercises and interactive demonstrations. Prereq/Coreq: BIOS 6601 Restriction: Credit may be counted toward a CSPH degree for only one of BIOS 6603, 6604 or 6605

Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall, Spring, Summer.

BIOS 6606 - Statistics for the Basic Sciences (3 Credits)

This course is designed for those wishing to obtain a basic understanding of statistics and its application in biological research. Students will develop statistical literacy and an ability to perform basic statistical analyses, basic graphical statistics, data summarizations, and estimation and inference using statistical software. Restrictions: Enrollment in UCD-AMC graduate program or permission of the instructor.

Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall.

BIOS 6611 - Biostatistical Methods I (3 Credits)

This first course in applied statistics covers basic descriptive methods and probability; parametric and nonparametric inference for the one- and two-sample location problem; ANOVA, ANCOVA, and multiple linear regression. Matrix notation, R, and SAS are used. Prerequisite: differential calculus or permission of instructor

Grading Basis: Letter Grade
A-PUBH1 BIOS
Typically Offered: Fall.

BIOS 6612 - Biostatistical Methods II (3 Credits)

This is a continuation of BIOS 6611 covering univariate linear modeling and emphasizing multiple regression and analysis of variance. Logistic regression and methods for correlated data are also covered. Matrix algebra and the statistical package SAS will be used. Prereq: BIOS 6611.

Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Spring.

BIOS 6621 - Statistical Consulting I (1 Credit)

Students will gain experience with statistical consulting and common statistical problems and techniques encountered in consulting through a combination of real examples and consultations with investigators. Emphasis will be on methods for effective consulting and communication with investigators. Corequisites: BIOS 6611 and consent of instructor.

Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall.

BIOS 6622 - Statistical Consulting II (1 Credit)

Students will gain experience with statistical consulting and common statistical problems and techniques encountered in consulting through a combination of real examples and consultations with investigators. Emphasis will be on analytic methods, and on interpretation and presentation of analyses. Prerequisites: Bios 6611. Corequisites: BIOS 6612 and consent of instructor.

Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Spring.

BIOS 6623 - Advanced Data Analysis (3 Credits)

This course teaches the students how to be effective collaborators. Students will learn to modify project hypotheses to be statistical hypotheses. The students will identify and perform the appropriate data analyses and communicate their analyses both verbally and in writing. prerequisite: BIOS 6601 and BIOS 6602 or BIOS 6611 and BIOS 6612 or permission of instructor.

Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall.

BIOS 6624 - Advanced Statistical Methods and Analysis (3 Credits)

This second-year graduate level biostatistics/data science course develops advanced data analysis and collaboration skills. The course is based on five projects using methodologies such as Bayesian analysis, simulation, correlated data, missing data, and study design for grant development. Pre-requisite: BIOS 6611, BIOS 6612, BIOS 6631, BIOS 6632 or permission of the instructor.

Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall.

BIOS 6628 - Latent Variable Methods (3 Credits)

Covers statistical approaches commonly used in behavioral sciences research, including reliability analysis, exploratory and confirmatory factor analysis, path analysis, structural equation modeling, and advanced modeling procedures. Students will analyze data using statistical software, interpret results, and write summaries of findings. Prerequisite: BIOS 6601, BIOS 6602 or equivalent. Cross-listed: CBHS 7010
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall.

BIOS 6629 - Applied Survival and Longitudinal Data Analysis (3 Credits)

This course will focus on the application of regression modeling to time-to-event and longitudinal data. Descriptive and inferential methods will be developed for each type of data with an emphasis on graphical inspection at all stages of analysis. Prerequisite BIOS 6601 and 6602 or BIOS 6611 and 6612 and permission of instructor.
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall.

BIOS 6631 - Statistical Theory I (3 Credits)

This course presents an introductory coverage of the theory of discrete and continuous random variables and applications to statistical problems. Topics include probability theory, transformations and expectations, common families of distributions, multiple random variables, and properties of a random sample. Prereq: Differential and integral calculus.
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall.

BIOS 6632 - Statistical Theory II (3 Credits)

This course covers theoretical and applied fundamentals of statistical inference. The course is a continuation of BIOS 6631. The primary topics include point estimation, hypothesis testing, interval estimation and asymptotic methods. Prereq: Differential and integral calculus. Prereq: BIOS 6631
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Spring.

BIOS 6640 - R for Data Science (2 Credits)

Statistical programming in R, including data managing, vectors, matrices, frames, subscripting, loops, functions, input/output, packages, etc. Concepts and methods for reproducible research will be covered as well as computationally intensive statistical methods. These methods are used to analyze data and present results.
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall, Spring.

BIOS 6641 - Causal Inference (3 Credits)

Basic knowledge of and analytic skills in causal inference. Topics include potential outcomes framework for causal inference; experimental and observational studies; identification assumptions for causal parameters; instrumental variable method; regression discontinuity design; propensity score based methods and causal mediation analysis. Prerequisite: BIOS 6611 or BIOS 6602 or permission of instructor; knowledge of R
Restriction: Offered in variable terms and years.
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall, Spring.

BIOS 6642 - Introduction to Python Programming (3 Credits)

This first course in programming using Python covers basic concepts such as variables, data types, iteration, flow of control, input/output, and functions and advanced concepts such as object oriented programming. Statistics related examples, homework and projects may be used.
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Spring.

BIOS 6643 - Analysis of Longitudinal Data (3 Credits)

Theory and application of models appropriate for clustered and longitudinal data are studied. Models for different types of outcome variables (e.g., normal, Poisson, binomial) are covered, with an emphasis on linear mixed models for normal outcomes. Prerequisites: BIOS 6632 and BIOS 6612 or permission of instructor.
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall.

BIOS 6644 - Practical Data Wrangling (2 Credits)

Data Wrangling is the process of getting data into a format which is useful for science. This course will provide students with a diverse set of tools, strategies and practices which can dramatically reduce the pain and wasted time often associated with wrangling and how to leverage the innumerable free resources available to everyone.
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall.

BIOS 6645 - Predictive Analytics (3 Credits)

This course will focus on the development, evaluation and validation of prediction models using observational studies and data, with an emphasis on both model-based and algorithmic approaches. In addition to regular assignments, students will apply their knowledge by developing, evaluating and validating models in three projects.
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Spring.

BIOS 6646 - Survival Analysis (3 Credits)

This course covers the analysis of time-to-event data with applications to biology, medicine, and public health. Nonparametric methods for group comparisons and semi-parametric regression models will be emphasized. Parametric methods and distribution theory for survival analysis will also be included. Prereq: BIOS 6611 & BIOS 6631 or instructor permission
Coreq: BIOS 6612 & BIOS 6632 or instructor permission.
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Spring.

BIOS 6648 - Design and Conduct of Clinical Research (2 Credits)

Design and conduct of clinical research studies. Intended for non-biostatistics students. Topics include: specifying the research question, study endpoints, study populations, study interventions, sample size evaluation, and choice of comparison groups. Common study designs and methods for study conduct are described. Prerequisite: BIOS 6601 or BIOS 6611 or consent of instructor. Offered in odd years.
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall.

BIOS 6649 - Clinical Trials: Statistical Design and Monitoring (3 Credits)
Statistical and scientific design of clinical trials. Intended for biostatistics graduate students. Topics include: scientific and statistical aspects of the research question, endpoints, treatments, sample size evaluation. A wide range of trial designs including group sequential and adaptive trial designs are covered. Pre/Corequisite: BIOS 6612 or instructor permission. Offered spring semester odd years.
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Spring.

BIOS 6650 - MPH Research Paper (1-2 Credits)
Independent research project resulting in a publishable paper. All projects will involve the analysis of primary or secondary data. Permission of Department required.
Grading Basis: Letter Grade with IP
Repeatable. Max Credits: 2.
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall, Spring, Summer.

BIOS 6651 - BIOS MS Research Paper (1-6 Credits)
Masters research paper in Biostatistics is completed under this course.
Grading Basis: Letter Grade with IP
Repeatable. Max Credits: 6.
A-PUBH1 Graduate students and public health certificate students only.
Additional Information: Report as Full Time.
Typically Offered: Fall, Spring, Summer.

BIOS 6660 - Analysis of Genomic Data using R and Bioconductor (3 Credits)
This course provides students with hands on experience in solving real life biological problems using the statistical software R and Bioconductor. Students will work and communicate with participating researchers and clinicians on their case studies of genomics data. Pre/Corequisite BIOS 6602 or 6612, or consent of instructor. Offered variable years and terms. Crosslisted with CPBS 7660.
Grading Basis: Letter Grade
Repeatable. Max Credits: 3.
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Spring.

BIOS 6670 - Special Topics: Biostatistics (1-3 Credits)
Special interest areas of current biostatistics research and practice are presented and analyzed. The course format is lecture and discussion or seminar. Check with CSPH website for offerings and topics for this course each semester.
Grading Basis: Letter Grade
Repeatable. Max Credits: 99.
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall, Spring, Summer.

BIOS 6680 - Data Management Using SAS (3 Credits)
Students will learn how to use SAS software for data management to prepare data for analyses. Main topics include importing and exporting data, variable and dataset manipulations. Introductions to producing reports, basic statistics, figures and SAS macros are also covered.
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall.

BIOS 6681 - Structured Query Language Using SAS PROC SQL (1 Credit)
This course will cover how to use SQL to query data, combine data vertically using set operators and horizontally using joins. Additional topics include incorporating subqueries and how to create and manage tables, views and indexes.
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Summer.

BIOS 6685 - Introduction to Public Health Informatics (3 Credits)
Survey course explores public health informatics topics such as current public health informatics initiatives, data sources, public health information systems, standards, health information exchange, system development/procurement, threats to information security and privacy, and decision support in the public health context.
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Spring.

BIOS 6840 - Independent Study for MPH in Biostatistics (1-3 Credits)
Faculty directed independent study for MPH students in topics related to biostatistics. Restriction: Open only to MPH students. Department Consent Required.
Grading Basis: Letter Grade
Repeatable. Max Credits: 6.
A-PUBH1 Graduate students and public health certificate students only.
Additional Information: Colorado State University; Univ of Northern Colorado.
Typically Offered: Fall, Spring, Summer.

BIOS 6841 - Independent Study for MS in Biostatistics (1-4 Credits)
Resources of the program are available to those MS students who elect to carry out research in chosen topics related to biostatistics. A faculty member will provide guidance throughout the project. Restriction: Open only to MS students or permission of instructor.
Grading Basis: Letter Grade
A-PUBH1 Graduate students and public health certificate students only.
Typically Offered: Fall, Spring, Summer.

BIOS 6950 - Masters Thesis: Biostatistics (1-6 Credits)
Biostatistics Master thesis work is completed under this course.
Grading Basis: Letter Grade with IP
A-PUBH1 Graduate students and public health certificate students only.
Additional Information: Report as Full Time.
Typically Offered: Fall, Spring, Summer.

BIOS 6990 - MPH Capstone Preparation - BIOS (1 Credit)
MPH Capstone Preparation will focus on developing the basis for a strong capstone project, culminating in the finalization of the capstone proposal that meets the expectations of the concentration.
Grading Basis: Pass/Fail with IP
This course is restricted to students with a MPHD-MPH plan of study only.
Typically Offered: Fall, Spring, Summer.

BIOS 7645 - PhD Predictive Analytics (3 Credits)

This course will focus on the development, evaluation and validation of prediction models using observational studies and data, with an emphasis on both model-based and algorithmic approaches. Students will develop, evaluate and validate models in 3 projects. Students should be very familiar with programming in R. Prerequisites: BIOS 6611, BIOS 6612, BIOS 6623, BIOS 6631, BIOS 6632

Grading Basis: Letter Grade

A-PUBH1 Graduate students and public health certificate students only.

Typically Offered: Spring.

BIOS 7659 - Statistical Methods in Genomics (3 Credits)

Analysis of genomic data is an integral component of biomedical research. This course will give an introduction to problems in genomics and review both the pioneering and more recent statistical methods developed for analyzing expression data and molecular sequences. BIOS 6611/6612 or BIOS 6631/6632 or permission of instructor. Offered variable term and year.

Grading Basis: Letter Grade

A-PUBH1 Graduate students and public health certificate students only.

Typically Offered: Fall, Spring.

BIOS 7670 - Advanced Special Topics - Biostatistics (1-3 Credits)

Advanced special interest areas of current biostatistics research and practice are presented. The course format is lecture and discussion or seminar. Check the CSPH Website for offerings and topics for this course each semester.

Grading Basis: Letter Grade

A-PUBH1 Graduate students and public health certificate students only.

Typically Offered: Fall, Spring, Summer.

BIOS 7712 - Statistical Methods for Correlated Data (1 Credit)

This course will cover statistical models and methods for serially correlated data, including autoregressive models, Markov models, and Markov chain Monte Carlo methods. Prereq: BIOS 6643

Grading Basis: Letter Grade

A-PUBH1 Graduate students and public health certificate students only.

Typically Offered: Spring.

BIOS 7713 - Statistical Methods for Missing Data (1-2 Credits)

This course covers methodological research being carried out for longitudinal studies with missing data. Topics may include missing data mechanisms, non-ignorable missing data, multiple imputation, mixture models and sample size determinations. 1 credit or 2 credit course versions offered in variable years. Prereq: BIOS 6643

Grading Basis: Letter Grade

A-PUBH1 Graduate students and public health certificate students only.

Typically Offered: Spring.

BIOS 7714 - Advanced Statistical Computing (3 Credits)

This course covers the theory & implementation of estimation algorithms used in statistical analysis. Possible topics: numerical analysis (quadrature), optimization (Newton/Raphson, EM algorithm, stochastic optimization), and simulation (pseudo-random numbers, rejection sampling, Markov chain methods). Prerequisites: BIOS 6611, BIOS 6612, BIOS 6631, BIOS 6632, or permission of instructor. This course is intended for students in the PHD/Biostatistics program.

Grading Basis: Letter Grade

A-PUBH1 Graduate students and public health certificate students only.

Typically Offered: Fall, Spring.

BIOS 7715 - Stochastic Modeling (2 Credits)

This course covers theory, application and software for stochastic models commonly used in health sciences, including time to event, recurrent event, multi-type recurrent event, and multi-state models. The intended audience is Biostatistics PhD students. Prerequisite: BIOS 6643 and BIOS 6632 or consent of instructor.

Grading Basis: Letter Grade

A-PUBH1 Graduate students and public health certificate students only.

Typically Offered: Spring.

BIOS 7717 - Bayesian Biostatistical Methods (3 Credits)

This course will introduce students to modern Bayesian statistical modeling and inference. Topics include a comparison of frequentist and Bayesian approaches, Markov Chain Monte Carlo (MCMC) methods for simulating posterior distributions, inference for regression, hierarchical models and mixed models. Prerequisites: BIOS 6612 and BIOS 6632 or permission of instructor. Offered variable term and year. Instructor consent required.

Grading Basis: Letter Grade

A-PUBH1 Graduate students and public health certificate students only.

Typically Offered: Fall, Spring.

BIOS 7718 - Introduction to Biomedical Image Analysis (3 Credits)

This course will introduce important topics in biomedical image analysis and provide hands-on training in developing computational methods to analyze biomedical image data. Students will write scientific reports and give presentations. Prerequisite: BIOS 6611 or BIOS 6612, linear algebra, experience with Python/Matlab or permission of instructor. Restriction: Offered in variable terms and years.

Grading Basis: Letter Grade

A-PUBH1 Graduate students and public health certificate students only.

Typically Offered: Fall, Spring.

BIOS 7719 - Information Visualization (3 Credits)

Information visualization studies interactive visualization techniques for analyzing abstract data. This course introduces design, development, and validation approaches with applications in various biological and biomedical domains. Cross-listed with CPBS 7719.

Grading Basis: Letter Grade

Typically Offered: Spring.

BIOS 7720 - Applied Functional Data Analysis (2 Credits)

An introduction to key concepts and methods in functional data analysis and their applications in public health. Topics include penalized regression, smoothing and smoothing parameter selection, generalized additive models, sparse functional data, functional regression and functional mixed effects models. BIOS 6612, BIOS 6632 and programming skills in R or permission of instructor. A background in longitudinal data analysis (BIOS 6643) is strongly recommended but not required.

Grading Basis: Letter Grade

Typically Offered: Spring.

BIOS 7721 - Joint Modeling of Longitudinal and Survival Data (1 Credit)

An introduction to joint modeling of longitudinal and survival data and its application in health research. Topics include linear mixed effects models, survival analysis, random effects joint model, and possibly dynamic prediction. BIOS 6643 Longitudinal Data or permission of instructor.

Grading Basis: Letter Grade

Typically Offered: Spring.

BIOS 7731 - Advanced Mathematical Statistics I (3 Credits)

This course will provide the framework for understanding the formal concepts, models and assumptions in statistical theory. Topics include random variables, parameter estimation, measures of performance, hypothesis testing and asymptotic approximations. Prerequisite: BIOS 6632 or equivalent. This course is intended for students in the Biostatistics PhD program. Offered in odd years.

Grading Basis: Letter Grade

A-PUBH1 Graduate students and public health certificate students only.

Typically Offered: Fall.

BIOS 7732 - Advanced Mathematical Statistics II (3 Credits)

The foundations of the theory of point estimation. A basic introduction to measure-theoretic probability, integration, and convergence. Large sample theory, Interval estimation, and efficient likelihood estimation.

Prerequisites: BIOS 7731 or equivalent.

Grading Basis: Letter Grade

A-PUBH1 Graduate students and public health certificate students only.

Typically Offered: Spring.

BIOS 7749 - Advanced Methods in the Design of Clinical Trials (3 Credits)

Scientific and statistical design of clinical trials including the scientific parameterization of outcome space; frequentist and Bayesian standards for scientific evidence and statistical inference; and fixed-sample, group sequential and adaptive trial designs. The course will primarily use R.

Prerequisite: BIOS 6624 or permission of instructor.

Grading Basis: Letter Grade

A-PUBH1 Graduate students and public health certificate students only.

Typically Offered: Fall, Spring.

BIOS 7899 - Independent Study for PhD - Biostatistics (1-4 Credits)

This course is for the PhD student who wishes to pursue one or more topics in depth. These topics may involve biostatistical material, or biological material necessary to the student's biostatistical work. Supervision by a full-time faculty member is necessary. Prereq: PhD student or permission of instructor.

Grading Basis: Letter Grade

A-PUBH1 Graduate students and public health certificate students only.

Typically Offered: Fall, Spring, Summer.

BIOS 8990 - Doctoral Thesis (1-10 Credits)

PhD Dissertation work is completed under this course.

Grading Basis: Letter Grade with IP

Repeatable. Max Credits: 10.

A-PUBH1 Graduate students and public health certificate students only.

Additional Information: Report as Full Time.

Typically Offered: Fall, Spring, Summer.