

# BIOSTATISTICS

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<http://www.biostat.med.miami.edu/>

## Dept. Code: BST

### Degree Programs

<https://www.publichealth.med.miami.edu/>

- Master of Science in Biostatistics (MS)
- Doctor of Philosophy in Biostatistics (PhD)

The Graduate Programs in the Department of Public Health Sciences at the University of Miami Miller School of Medicine are at the forefront of public health science with emphasis on research, education, and evidence-based public health service. The Graduate Programs promote an environment of learning and inquiry, stressing the scientific method as a way of generating knowledge about common pathways in health and illness. The mission of the Graduate Programs in Public Health Sciences is to develop leaders who can generate and translate knowledge into policy and practice to promote health and prevent disease in human populations.

### Masters Program in Biostatistics

- M.S. in Biostatistics (<http://bulletin.miami.edu/graduate-academic-programs/medicine/biostatistics/biostatistics-ms/>)

### Doctoral Program in Biostatistics

- Ph.D. in Biostatistics (<http://bulletin.miami.edu/graduate-academic-programs/medicine/biostatistics/biostatistics-phd/>)

#### **BST 601. RESEARCH TECHNIQUES. 1 Credit Hour.**

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

#### **BST 603. An Introduction to Probability Theory and Its Applications. 3 Credit Hours.**

This is an elementary introduction to probability theory. Its goal is to present the logic and the mathematics behind the theory, supply it with many examples and techniques, and to infuse these results in the student through many, many, exercises

Requisite: Academic Plan: BSTS\_PHD or BSTS\_MS.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

#### **BST 605. Statistical Principles of Clinical Trials. 3 Credit Hours.**

This course is designed for individuals interested in the statistical aspects of clinical trials. Topics include types of clinical research, study design, treatment allocation, randomization and stratification, quality control, sample size requirements, patient consent, and interpretation of results. This course will additionally cover strengths and limitations of alternative study designs such as quasi-experiments and observational studies. Common sources of bias in these alternative study designs will be described along with design approaches to minimize bias.

Enrollment in MS in Biostatistics Program OR EPH 601 AND EPH 602 AND permission from instructor.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

#### **BST 610. Introduction to Statistical Collaboration. 3 Credit Hours.**

This course gives students exposure to issues arising in biostatistics consulting and collaboration. Students will learn how to identify the scientific objectives of a study and to develop a statistical strategy appropriate for those objectives. The student will become familiar with problems arising in consulting situations, specifically relating to identification of study objectives and framing of research questions, study design, power and sample size determination and choice of analytical approach. The student will learn to communicate through presentation of oral and written reports, and through student and faculty critiques of these reports. This course is open only to MS and PhD Biostatistics students or instructor's permission.

Requisite: Academic Plan: BSTS\_PHD or BSTS\_MS.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Summer.

**BST 623. Software Tools for Manuscript Development and Reproducible Research. 3 Credit Hours.**

The course teaches the practical software tools used by researchers and modern applied statisticians to develop manuscripts. While prior computer programming experience may be helpful none is expected/required. Students are expected to have exposure to published quantitative research articles in their field (e.g., epidemiology, health policy, psychology). Students will be taught how to build analysis pipelines. Topics covered include building data collection instruments using REDCap; importing data into the R programming environment using specialized packages and APIs; data cleaning/processing in the R language using the R Tidyverse ecosystem, conducting exploratory data analysis in R, building publication ready tables and graphics; integrating code with prose to make fully reproducible workflows, software development best practices with version control, packaging code and datasets, and disseminating project packages.

Requisite: Must be in either Program Plan, BSTS, EPID, EPID1, PREV, MDRP, CLIMUN, CLIMMAS, CLIMPH, CLIMT, CLIMA.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**BST 625. Survey of Statistical Computing. 3 Credit Hours.**

This three credit course aims to familiarize students with the basic use of SAS and R for routine statistical analysis and prepare them for more advanced courses and/or thesis research. Statistical computation will be illustrated with examples in medical research, biological study and business. The focus of the course is on the computing environment, therefore a thorough discussion of statistical theories will not be provided. It is expected that students will already be prepared statistically.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**BST 630. Longitudinal and Multilevel Data. 3 Credit Hours.**

This course offers students an introduction to linear and generalized linear models for the analysis of multi-level and longitudinal biomedical data. The course will also provide students with the opportunity to develop the skills necessary to perform analysis of these types of data using statistical software packages.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**BST 640. Modern Numerical Multivariate Methods. 3 Credit Hours.**

This course covers multivariate topics from both a classical as well as modern perspective. Topics to include: Multivariate Normal Distribution; Spectral Decomposition; Principal Component Analysis; Canonical Correlation Analysis; Newton's Method; Steepest Descent; Gradient Boosting; Coordinate Descent Algorithms; Trees; Forests; Discriminant Analysis. The R programming language (<http://www.r-project.org>) will be used extensively throughout the course for computation and statistical analysis.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**BST 649. Advanced Individual Study. 1-3 Credit Hours.**

Individual work on a special project under faculty guidance.

**Components:** IND.

**Grading:** SUS.

**Typically Offered:** Fall, Spring, & Summer.

**BST 650. Topics in Biostatistical Research. 1 Credit Hour.**

The course consists of a series of research level presentations in contemporary biostatistics research (broadly defined) by diverse outside speakers as well as faculty in the Division of Statistics or in other units on campus who are hosting presentations in biostatistics research. The emphasis will be on new methodologies and new developments in existing methodologies. However, recent developments on the implementation and comparison of methodology and on data types may also be included.

**Components:** LEC.

**Grading:** SUS.

**Typically Offered:** Fall & Spring.

**BST 660. Spatial Statistics. 3 Credit Hours.**

Spatial data commonly arise from many fields including business, ecological, and health studies. This course will cover advanced techniques to tackle the spatial correlation. Topics include variogram estimation, spatial prediction, spatial point pattern analysis, estimating function based methods and others. Real data examples will be used to motivate and illustrate the use of the methods.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**BST 665. Design and Analysis of Clinical Trials. 3 Credit Hours.**

This course will focus on the statistical principles and methods used in clinical trials, including phase I to III clinical trials. Although the class will have emphasis on phase III trials, we will also discuss the feature and statistical issues in phase I and II clinical trials. For phase III trials, we will discuss ways of treatment allocation that will ensure valid inference on treatment comparison. Other topics include sample size calculation, survival analysis and early stopping of a clinical trial and noncompliance. We will additionally cover advanced topics in clinical trials including quasi-experimental and crossover designs as well as Bayesian approaches to designing adaptive clinical trials, predicting trials and synthesizing multiple trials through meta-analysis.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**BST 670. Bayes Data Analysis: Theory and Computing. 3 Credit Hours.**

This first part of this course is an advanced and comprehensive treatment of the foundations of Bayesian theory. Beginning with the Bayesian alternative to sampling theory, the course covers Savage's axioms, the standard Bayesian inference procedure, subjective Bayes interpretation and prior selection, the minimax and complete class theorems, a variety of Bayesian principles (likelihood, stopping time etc.), and a selection of standard parametric and non-parametric examples. The second part focuses on the computational implementation of Bayesian inference, namely Gibbs sampling, Metropolis-Hastings, and other Markov-Chain-Monte Carlo techniques for obtaining the posterior and posterior quantities. Computational examples will be illustrated using R and WinBUGS. Special topics will include approximate Bayes computing (ABC) and particle methods.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**BST 675. Intermediate Probability. 3 Credit Hours.**

This course covers the basic foundations of probability to limit theorems at an intermediate level. Topics to include are events, random variables and their distributions, discrete and continuous random variables, generating functions, Markov chains and convergence.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall Odd Years.

**BST 676. Introduction to Generalized Linear Models. 3 Credit Hours.**

This course provides a unifying framework for formulation, estimation and inference using generalized linear models and towards the end examines some modern day extensions. Throughout the course, real data applications from medicine will be used and extensive use will be made of the R programming language.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**BST 680. Advanced Statistical Theory. 3 Credit Hours.**

The first part of this course is a searching treatment of many of the key ideas undergirding hypothesis testing and estimation. In particular, several of the main theorems in mathematical statistics will be stated and proved in full detail. By the end of the course, students will have acquired enough background material for the treatment of a special topic, through a mix of lectures and assignments. Topics will include asymptotic expansions, information theory and non-parametrics.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**BST 690. Theory of Survival Analysis. 3 Credit Hours.**

Survival analysis is an important tool of statistic with many applications. In this course, without losing sight of such applications, we will give special emphasis to the probabilistic foundations, in terms of counting processes and martingales. Topics include: Failure time models, inference in parametric models, Cox models, counting processes and martingales, likelihood, competing risks and analysis of recurrent event data. The R programming language will be used.

Prerequisite: MTH 524, MTH 525, and BST 680.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall Even Years.

**BST 691. High Dimensional and Complex Data. 3 Credit Hours.**

This course will cover some salient topics in high dimensional data analysis focusing on the uniqueness of the problem and discussing various analyses including error rate control methods, model based shrinkage, prediction, set analysis, cluster analysis, bump hunting and (if time permits), graphical models.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**BST 692. Data Science and Machine Learning for Health Research. 3 Credit Hours.**

BST 692 (3-credits) will teach computational data science techniques using end-to-end data processing pipelines. It will focus on applied data analysis problems that the faculty are actively trying to solve. Students will be presented with data that the faculty are working on and will be asked to apply programming knowledge that they have learned in previous classes. They will then study and apply new data acquisition, data processing, and machine learning methods to handle problems that are not well handled by the common techniques. The goal of the class is to give students the opportunity to deploy a complete data science pipeline. Students will apply their data acquisition and exploration skills to real world problems; study modern machine learning methods; contrast traditional and new methods to deal with large, complex and messy data; and learn to disseminate results through online, interactive displays.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Summer.

**BST 830. Doctoral Dissertation (pre-candidacy). 1-12 Credit Hours.**

Required of all candidates for the PhD. The student will enroll for credit as determined by his/her advisor but not for less than a total of 24. Not more than 12 hours of BST 730 may be taken in regular semester, nor more than six in a summer session.

**Components:** THI.

**Grading:** SUS.

**Typically Offered:** Fall, Spring, & Summer.

**BST 840. Doctoral Dissertation (Post-Candidacy). 1-12 Credit Hours.**

Required of all candidates for the PhD. The student will enroll for credits as determined by his/her advisor but not for less than a total of 24. Not more than 12 hours of BST 740 may be taken in regular semester, nor more than six in a summer session.

**Components:** THI.

**Grading:** SUS.

**Typically Offered:** Fall, Spring, & Summer.

**BST 850. Research in Residence. 1 Credit Hour.**

Used to establish research in residence for the PhD. after the student has been enrolled for the permissible cumulative total in appropriate doctoral research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.

**Components:** THI.

**Grading:** SUS.

**Typically Offered:** Fall, Spring, & Summer.