

BIOSTATISTICS (BST)

BST 3000 - Intro to Statistical Computing

Credit(s): 3 Credits

The purpose of this course is to teach students statistical programming and data management skills in SAS and R to aid their careers post-graduation. To this end, they will learn how to use SAS and R to organize and structure data in order to compute epidemiologic measures, descriptive statistics, measures of association and other statistical tests through homework assignments, projects and in-class exercises. They will organize, prepare, interpret, and present statistical test results derived from SAS and R output to the class and through assignments. (Offered in Spring)

BST 3100 - Applied Biostatistics I

Credit(s): 3 Credits

This course covers the basic tools of applied statistics for describing categorical and numerical data and making inference to populations, including chi-square and t tests, one-way ANOVA, and simple linear regression procedures. Probability is introduced to the extent it is needed to understand statistical applications. Statistical software is used throughout the course. (Offered Fall and Spring)

Prerequisite(s): (MATH 1320 or 1 Course from MATH 1400-4999)

BST 3200 - Applied Biostatistics II

Credit(s): 3 Credits

Linear regression (parameter estimation and tests, confounding, interaction, model building and assessment of fit, diagnostics and remedial measures.); Design of experimental and observational studies (CRD, RCBD, repeated measures, matched pairs, ANOVA, ANOCVA, Contrasts and multiple comparisons, ANCOVA), Logistic Regression (binomial distribution, multinomial distribution, Poisson distribution, and Chi-square test, CMH test, odds, odds ration, relative risk, maximum likelihood, likelihood ratio test, model building and assessment of fit, diagnostics, McNemar's test, conditional likelihood, score test). (Offered in Spring)

Prerequisite(s): BST 3000; BST 3100; (MATH 3110 or MATH 3120)

BST 3930 - Special Topics

Credit(s): 3 Credits (Repeatable for credit)

BST 3980 - Independent Study

Credit(s): 1 or 3 Credits (Repeatable for credit)

BST 4100 - Theory of Biostatistics I

Credit(s): 3 Credits

Introduction to the principles of probability, statistical distributions, and the extension of these concepts to multiple random variables. Transformations of random variables, moment-generating function technique and central limit theorem. (Offered in Fall)

Prerequisite(s): MATH 2530

BST 4200 - Theory of Biostatistics II

Credit(s): 3 Credits

Point estimation, maximum likelihood, regression, sufficient statistics, Bayesian estimation. Interval estimation. Hypothesis testing for one and two samples. Power, likelihood ratio tests. Goodness-of-fit tests, contingency tables. Analysis of variance. (Offered in Spring)

Prerequisite(s): BST 4100

BST 4400 - Introduction to Applied Data Management

Credit(s): 3 Credits

This course is a survey of important data management topics and techniques. Topics include: data programming and manipulation, data storage and security, data cleaning, relational database theory and legal and ethical issues of data management. Software tools covered in the course include SPSS, SAS, R, Excel, MySQL, GIT/GitHub, Hadoop, MapReduce, and Python. A number of guest lecturers will present case studies of real-world data management. A key aspect of the course will be weekly labs by in-class working groups. (Offered in Fall)

Prerequisite(s): BST 3000 and BST 3100

BST 4930 - Special Topics

Credit(s): 3 Credits (Repeatable for credit)

BST 4980 - Independent Study

Credit(s): 1 or 3 Credits (Repeatable for credit)

BST 5000 - Principles of Biostatistics

Credit(s): 3 Credits

This course is designed as an introduction to statistical analysis for students in public health, health administration and research. Topics include basic probability and descriptive statistics, statistical inference and hypothesis tests, linear and logistic regression, and non-parametric statistics. Content is taught for conceptual understanding and application. Statistical software is used throughout the course. (Offered every semester.)

Restrictions:

Students with a classification of Freshman, Junior or Sophomore may **not** enroll.

BST 5020 - Theory of Biostatistics

Credit(s): 3 Credits

This course introduces the principles of probability and biostatistical inferences. Topics covered: role of statistics in scientific research, discrete random variables, continuous random variables, expectation and variance, moments and moment-generating functions, marginal and conditional probability, independence, functions of random variables, sampling distribution, the central limit theorem, methods of statistical estimation, hypothesis testing and confidence interval, and likelihood ratio test. (Offered annually.)

BST 5025 - Theory of Biostatistics II

Credit(s): 3 Credits

Point estimation, maximum likelihood, regression, sufficient statistics, Bayesian estimation. Interval estimation. Hypothesis testing for one and two samples. Power, likelihood ratio tests. Goodness-of-fit tests, contingency tables. Analysis of variance. (Offered each Spring)

Prerequisite(s): (BST 5020 or BST 4200)

BST 5030 - Statistical Programming and Study Planning: SAS

Credit(s): 3 Credits

This course teaches statistical programming for statistical analysis using SAS software. Programming topics may include: working in the Windows environment, syntax development, creating data sets, reading and manipulating external data files, transforming data, formatting variables, statistical analysis and graphical display.

BST 5100 - Introduction to General Linear Modeling**Credit(s): 3 Credits**

This course presents a unified approach to the application of linear statistical models in biomedical and health services research. Topics include simple and multiple linear regression, Pearson's and non-parametric correlation, analysis of variance (ANOVA), and logistic regression. Both the theory and application of the general linear model (GLM) are presented. (Offered annually.)

Prerequisite(s): (BST 5000, PUBH 5040, or BST 5020)*

* Concurrent enrollment allowed.

BST 5200 - Survival Data Analysis**Credit(s): 3 Credits**

This course treats statistical methods for analyzing survival data derived from laboratory, clinical, and epidemiological studies of humans. Both parametric and nonparametric approaches are presented. Focus will be in the practical applications of these methods to clinical and epidemiological research. The SAS and SPSS statistical packages will be used for data management and analysis. (Offered every Fall)

Prerequisite(s): (BST 5000, PUBH 5040, or BST 5020); BST 5030; BST 5100

BST 5210 - Categorical Data Analysis**Credit(s): 3 Credits**

This course introduces the theory and application of methods for categorical data, with emphasis on biomedical and social science applications. The course will cover the following topics: analysis of two-way, three-way, and higher dimension contingency tables using log-linear model, measures and tests of association for nominal and ordinal tables, logistic regression, weighted least squares, generalized linear models, and the use of computer software analyzing categorical data. (Offered every Fall)

Prerequisite(s): (BST 5000, PUBH 5040, or BST 5020); BST 5030; BST 5100

BST 5220 - Multilevel and Longitudinal Data Analysis**Credit(s): 3 Credits**

This course will focus on applications of various statistical methods for analyzing longitudinal, or repeated measures, data. The core concepts will cover multilevel analysis, growth curve modeling, and structural equation modeling.

Prerequisite(s): (BST 5000, PUBH 5040, or BST 5020); BST 5030; BST 5100

BST 5230 - Bayesian Statistics**Credit(s): 3 Credits**

The Bayesian approach to statistics is an alternative to the traditional methods based on hypothesis and significance testing. Bayesian statistics uses prior information and combines it with observable data to quantify knowledge after observing data in what is called the posterior. Simulation is used to approximate this posterior distribution.

Prerequisite(s): (BST 5000, PUBH 5040, or BST 5020); BST 5100

BST 5400 - Applied Data Management**Credit(s): 3 Credits**

This course is an advanced course on data management for graduate students in the College for Public Health and Social Justice. Students will learn advanced concepts and techniques of research data management with particular emphasis on applications in public health. Students will learn to use multiple data management and data analysis software packages including Excel, Access, MySQL SPSS, SAS and R.

Prerequisite(s): (BST 5000, PUBH 5040, or BST 5020)

BST 5420 - Sampling Theory and Survey Design in Public Health**Credit(s): 3 Credits**

This course will provide a survey of the fundamental types of probability sampling designs that are used for data collection with Public Health Surveillance Sample Surveys including: systematic random sampling (including Random-Digit Dialing), simple and stratified random sampling, cluster sampling and multistage sampling. The course will briefly discuss the applications of current survey research methods including web-based surveys and the use cell phones within the context of surveillance systems and registry-based samples. The role of survey design choices in reducing total survey error as well as the role of questionnaire design in reducing non-sampling biases will be discussed briefly. The main topics to be covered in detail include: design-based parameter and variance estimation methods, construction and use of survey weights and statistical models incorporating sample designs as well as the used of survey sampling for registry based samples and matched case/control studies. Methods for evaluating, reducing and adjusting for survey nonresponse will also be covered.

Prerequisite(s): (BST 5000, PUBH 5040, or BST 5020)

BST 5500 - Statistical Learning**Credit(s): 3 Credits**

Algorithms for learning how to classify variables given a set of predictor variables. Linear regression, logistic regression and linear discriminant analysis. Cross-validation and bootstrapping. Model selection. Ridge regression and the LASSO. Nonlinear models, splines and generalized additive models. Tree-based methods, random forests and boosting. Support vector machines. Unsupervised learning methods are also discussed, including principal components and k-means clustering. (Offered in Spring)

Prerequisite(s): (BST 4100 or BST 5020 with a grade of C or higher)

BST 5600 - R for Spatial Analysis**Credit(s): 3 Credits**

Geospatial data structures in R. Plotting and exploring data in R. Using R to manage data. Point process analysis using smoothed kernel density estimation and kriging. Variograms and semi-variograms. Spatial autocorrelation in areal data. Moran's I and Geary's G. Spatial autoregression. (Offered in Spring)

Prerequisite(s): GIS 5010 with a grade of C or higher; (BST 4100 or BST 5020 with a grade of C or higher)

BST 5610 - Spatial Epidemiology and Disease Mapping**Credit(s): 3 Credits**

Statistical methods for disease data that include geographic information. Disease maps and relative risk estimation. Mapping and geographic information systems. Bayesian methods of estimation for conditional autoregressive models. Disease cluster detection. Regression and ecological analysis. (Offered in Fall)

Prerequisite(s): BST 5100 with a grade of C or higher, BST 5600 with a grade of C or higher, and PUBH 5030 with a grade of C or higher

BST 5620 - Spatio-Temporal Models in Public Health**Credit(s): 3 Credits**

Models for the spread of epidemics, including the susceptible – infected – removed (SIR) model and some of its generalizations. Kriging in both space and time. Areal data modeling, including the conditional autoregressive model, across time. (Offered in Spring)

Prerequisite(s): BST 5610 with a grade of C or higher; (BST 4200 or BST 5025 with a grade of C or higher)

BST 5930 - Special Topics

Credit(s): 1-3 Credits (Repeatable for credit)

BST 5960 - Capstone in Biostatistics**Credit(s): 3 Credits**

The capstone course will emphasize practical aspects of being a successful statistician, including communicating with non-statisticians, orally and in writing. Sample size determination, an important problem in biostatistics, will be studied both analytically and using simulation.

Prerequisite(s): BST 5030; BST 5100; BST 5200; BST 5210**BST 5961 - Master's Project****Credit(s): 3 Credits**

This course is an independent directed research project. Students work on an applied research project under the guidance of a biostatistics faculty member. Using the skills developed in the Masters of Science in Biostatistics and Health Analytics, each student poses a research question in public health and uses data to address the problem.

BST 5970 - Research Topics in Biostatistics**Credit(s): 1-3 Credits** (Repeatable for credit)

This course provides direct research experience in biostatistics. Content is developed jointly between the student(s) and a faculty mentor.

BST 5980 - Graduate Reading in Biostatistics**Credit(s): 1-3 Credits**

This course provides specialized study in biostatistics to enhance skills in literature review and problem solving. Content is developed jointly between the student(s) and a faculty mentor.

BST 6100 - Causal Inference**Credit(s): 3 Credits**

This course is an introduction to causal inference with application in public health and social justice. Topics include the potential outcomes model, the theory behind and application of randomized trials, and application of causal inference techniques to observational studies. Students will perform analyses with propensity scores, instrumental variables, and graphical causal models (DAGs) and investigate mediation in the causal framework. The focus of the course will be application of methods as opposed to statistical theory.

Prerequisite(s): BST 5030; BST 5100**BST 6930 - Special Topics****Credit(s): 3 Credits** (Repeatable for credit)**BST 6970 - Research Topics in Biostatistics****Credit(s): 1-3 Credits****BST 6980 - Graduate Reading Course****Credit(s): 1-3 Credits** (Repeatable for credit)