BIOS Biostatics

BIOS 6135 Topics of Inference in Biostatistics I
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course provides an introduction to the fundamental knowledge of derivatives and integrals found in biostatistical inference. The course will introduce the theory of probability, expectation and variance of discrete and continuous distributions, moment generating functions, bivariate and multivariate distributions, maximum likelihood estimation, and bias. Emphasis will be placed on the development of critical thinking skills and how concepts in this course are used in public health and biomedical studies.

BIOS 6136 Topics of Inference in Biostatistics II
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course will introduce large sample theory, such as law of large numbers and the central limit theorem; sampling distributions of estimators; the basis for inferences derived from hypothesis testing and confidence intervals; and simulation methods. Emphasis will be placed on how these techniques are used in biostatistical problems and applications using examples from the pharmaceutical industry.
Prerequisite(s): A minimum grade of "B" in BIOS 6135.

BIOS 6331 Regression Analysis in Biostatistics
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course introduces the methods for analyzing biomedical and health related data using linear regression models. The course will introduce the student to matrix algebra as used in linear models. The course will involve model selection, diagnosis and remedial techniques to correct for assumption violations. The students will learn how to apply SAS procedures PROC REG, PROC CORR, and PROC GLM and interpret the results of analysis. Emphasis will also be placed on the development of critical thinking skills.

BIOS 6332 Experimental Design in Biostatistics
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course introduces the student to experimental designs commonly used in public health and biomedical settings and the methods for analyzing them. It will introduce the student to the principles of designing an experiment (randomization, blocking and replication), completely randomized designs, factorial design, randomized block designs, nested designs, split-plot designs, crossover designs, Latin squares and analysis of the longitudinal designs, a fixed effect (Model I) single factor and multifactor experiment, a random effect (Model II) single factor and multifactor experiment, a mixed effect (Model III) multifactor experiment, and covariance model . Students will learn how to apply SAS procedures: PROC GLM, PROC MIXED, PROC GENMOD, PROC VARCOMP, PROC RSREG and PROC MULTTEST to public health and biomedical data and interpret the results of the analysis.
Prerequisite(s): A minimum grade of "B" in BIOS 6331.

BIOS 6531 Categorical Data Analysis
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course introduces statistical methods for analyzing both univariate and multivariate categorical and count data in public health, biomedical research, and other health-related fields. The course will introduce how to distinguish among the different measurement scales in addition to the commonly used statistical probability distribution and inference methods for categorical and count data. Emphasis will be placed on the application of the methodology and computational aspects rather than theory. The students will learn how to apply SAS procedures to data and interpret the results.

BIOS 6541 Biostatistics for Biostatistics & Epidemiology Majors
4 Credit Hours. 3 Lecture Hours. 2 Lab Hours.
This course examines statistics in public health with particular emphasis on applications in Epidemiology and other public health and medical fields. Topics will include sampling, basic discrete and continuous distributions, descriptive statistics, hypotheses testing, confidence intervals, two-sample inferences, odds ratios, relative risks, Chi-square tests of independence, non-parametric methods, correlation, regression, ANOVA, and logistic regression. Emphasis will be on the development of critical thinking skills and epidemiologic and other health data analysis applications with computer software.
Cross Listing(s): PUBH 6541.

BIOS 7090 Selected Topics in Biostatistics
1-3 Credit Hours. 1-3 Lecture Hours. 0 Lab Hours.
Allows the student the opportunity to receive specialized and/or focused instruction in a biostatistical topic not generally offered by the department.

BIOS 7131 Survival Analysis
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course introduces statistical methods for analyzing data collected on the time to an event, referred to as survival data, in medical research and other health related fields. Emphasis will be placed on the application of the methodology and computational aspects rather than theory. The students will learn how to apply SAS procedures to data and interpret the results.
Prerequisite(s): A minimum grade of "B" in BIOS 6331 and BIOS 6531.

BIOS 7231 Clinical Trials Methodology
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
Students are introduced to regulatory, scientific, statistical and practical aspects of methods inherent in design, monitoring and analyzing clinical trials. Clinical trials in many areas of drug development are presented, discussed and critiqued.

BIOS 7331 Multivariate Analysis in Biostatistics
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course is designed to provide students in biostatistics with an introduction to multivariate methods commonly found in health related fields. The course will emphasize multivariate regression, multivariate analysis of variance (MANOVA) and co-variance (MANCOVA), discriminant analysis and an alternative to logistic regression and cluster analysis. Students will be introduced to appropriate SAS procedures and be required to interpret and report their results in a form that meets both FDA and the International Committee on Harmonization.
Prerequisite(s): A minimum grade of "B" in BIOS 6332.

BIOS 7431 Statistical Issues in Drug Development
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
Major statistical issues in the federal regulation of drug research and clinical development will be studied. Specifically, summarization, analysis and monitoring of adverse experiences, two treatment crossover designs, active control equivalence studies, optimization in clinical trials and combination drug development, dosing in the elderly, intention to treat in clinical trials, and dual control groups in rodent carcinogenicity studies will be studied.
Prerequisite(s): A minimum grade of "B" in BIOS 6331 and BIOS 6332.

BIOS 7535 Data Analysis with SAS
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
The class is designed to provide skill building and practical experience in using SAS to: create analysis data files; analyze data such as that found in typical biostatistical consulting problems; and assess the validity of analysis methodology assumptions.
Prerequisite(s): A minimum grade of "B" in BIOS 7544.

BIOS 7544 Data Management for Biostatistics
4 Credit Hours. 3 Lecture Hours. 2 Lab Hours.
This course emphasizes data management and software applications using the SAS (Statistical Analysis System) software package. It will introduce the student to SAS codes for: inputting and outputting data, creating temporary and permanent data sets, creating formatted and labeled SAS data sets, merging and connecting SAS data sets, creating output using the TABULATE and REPORT procedures, debugging a SAS program that includes the TABULATE, REPORT and SQL procedures, using character functions in SAS, using a random number generator, probability distributions, arrays, and date and time functions. Students will also write a simple and complex query using the SQL procedure; create, populate and modify a set of tables/views using the SQL procedure; and create a SAS program which includes one or more macros. This course will cover basic relational database design and descriptive statistics in SAS. Particular focus is placed on applications pertaining to public health and biomedical research.

BIOS 7890 Directed Individual Study
1-3 Credit Hours. 1-3 Lecture Hours. 0 Lab Hours.
Provides the student with an opportunity to investigate an area of interest under the direction of a faculty mentor.

BIOS 9130 Biostatistical Consulting
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course is designed to provide the student with the current best practices in biostatistical consulting. Topics include: Identifying and constructing appropriate questions to ask clients regarding their consultation request, an overview of appropriate statistical methods and SAS software procedures to use for specific study designs and statistical analysis of collected data, directing a consultation appointment without faculty lead, conducting exploratory data analyses, conducting effective analyses based on appropriate statistical methods, conduction needed simulation (including Monte Carlos methods and Bootstrap methods) and providing oral and written communication of statistical findings.

BIOS 9131 Advanced Statistical Theory for Biostatistics I
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course provides an advanced study of theoretical statistics. Topics include: an introduction probability and sample space, conditional probability and Bayes Theorem, probability distribution of a random variable, discrete and continuous random variables, functions of random variables, moments and moment generating functions, order statistics and their distributions, discrete distributions, continuous distributions, bivariate and multivariate normal distribution, modes of convergence, limiting moment generating functions, and the central limit theorems.

BIOS 9132 Advanced Clinical Trials
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
Students are introduced to regulatory, scientific, statistical and practical aspects of methods inherent in design, monitoring and analyzing clinical trials. Clinical trials in many areas of drug development are presented, discussed and critiqued.

BIOS 9133 Advanced Statistical Theory for Biostatistics II
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course is a continuation of Advanced Statistical Inference for Biostatisticians I. The additional topics in this course consists of: sample moments and their distributions, the theory of point estimation, the Neyman-Pearson Theory of testing hypotheses, likelihood ratio test, chi-square tests, t-test, F-test, Bayes and Minimax procedures in hypothesis testing, confidence estimation, the general linear hypothesis, and nonparametric statistical inference.
Prerequisite(s): A minimum grade of "B" in BIOS 9131.

BIOS 9134 Stochastic Process for Biological Systems
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course provides the student with an introduction to stochastic processes with emphasis on Markov chains, The Poisson Process, Brownian Motion and other continuous time processes. The theory developed will be used to model and simulate complex biochemical reaction networks and perform network inference given data from the stochastic trajectory of a biological process, typically arising from microarray or next generation sequencing experiments.

BIOS 9135 Advanced Survival Analysis
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This is a course on the study of the theory of survival data. Counting processes and martingale methods will be introduced. Emphasis will be placed on the applications of the theory and on the methodologies for survival data, such as Kaplan-Meier estimate, log-rank test, Cox model, etc. The students will learn how to use R language to setup survival dataset and perform analysis.
Prerequisite(s): A minimum grade of "B" in BIOS 6331, BIOS 6531, and BIOS 7131.

BIOS 9136 General and Generalized Linear Models
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course provides students with a review of the classical General Linear model and an introduction to the Generalized Linear Model. The first half of the course includes a review of the linear model with the necessary matrix algebra and multivariate normal distribution theory, then to the analysis of quadratic forms and the study of the General Linear Model. The second half of the course begins with an introduction of the components of a Generalized Linear Model and methods of fitting these models. It also covers the most widely used types of models, logistic regression, log-linear models and Quasi-likelihood functions.

BIOS 9231 Bayesian Statistics I
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course provides the student with an introduction Bayesian Analysis and compares Bayesian methods to that of frequentists. The course includes selection of prior distributions, computing posterior distributions, conjugate models, Beta-Binomial model, Normal-Normal model, and Gamma-Poisson model. Bayesian inference using point and interval estimation, Bayesian hierarchical models, and exchangeability will be explored. Topics including Empirical Bayes versus a fully Bayes approach, Markov Chain Monte Carlo methods and model checking using Bayes factors and sensitivity analyses will be included.
Prerequisite(s): A minimum grade of "B" in BIOS 9131.

BIOS 9331 Meta-Analysis
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course is designed to address research questions in biomedical and other health-related research using meta-analysis techniques. A survey of past and present challenges of such techniques will be addressed, as will a mixture of Frequentist and Bayesian approaches to meta-analysis. Typical research questions found in health-related issues such as prevention, diagnosis, treatment, and policy will be constructed, followed by the methodologies to analyze such health-related questions. The course will focus on modeling and implementation issues in meta-analysis for biostatistical applications. In particular, this course will emphasize such topics as heterogeneous study results, combining studies with different designs, advantages and disadvantages to using meta-analysis over large trials, meta-analysis for 2x2 tables with multiple treatment groups, meta-analysis of clinical trials, addressing biases, meta-analysis of patient survival data, among additional biomedical applications.
Prerequisite(s): A minimum grade of "B" in BIOS 9131.

BIOS 9333 Applied Longitudinal Data Analysis
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course provides an introduction to longitudinal and clustered data. Topics include the basic concepts of longitudinal data, linear models for longitudinal data, generalized linear models and salient features, generalized estimating equations, generalized linear mixed effects models, missing data and dropouts, sample size and power, repeated measures, and multilevel linear models.

BIOS 9432 Randomization and Bootstrap Methods in Health Data
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course is designed to provide the student with the basics of randomization tests and bootstrap methods. This course will cover the following topics: Randomization tests, the jackknife, the bootstrap and its application to health related data, Monte Carlo tests,considerations when using randomization, jackknife and bootstrap methods, one and two sample tests, analysis of variance, regression analysis, survival data and multivariate data.
Prerequisite(s): A minimum grade of "B" in BIOS 9131.
Corequisite(s): BIOS 9231.

BIOS 9433 Analysis with Missing and Mis-specified Data
3 Credit Hours. 3 Lecture Hours. 0 Lab Hours.
This course is designed to provide the student with the basics of methods for analyzing data with missing data and mis-specified data. This course will cover the following topics: missing data in experiments, complete case analysis, weighted complete case analysis, available case analysis, single imputation methods such as mean, regression, last value varied forward, hot deck imputation, cold deck imputation, Bayes Imputation, Multiple imputation, and nonignorable missing data models.
Prerequisite(s): A minimum grade of "B" in BIOS 9132.
Corequisite(s): BIOS 9231.