### Biostatistics (BSTA)

**BSTA 511 Biostatistics in Practice**
- Taught by: Russell T. Shinohara
- Course usually offered in fall term
- Prerequisites: Open to Biostatistics student only.
- Activity: Lecture
- 0.5 Course Units

**BSTA 550 App Reg and Anal of Var**
- Also Offered As: PSYC 611, STAT 500
- Activity: Lecture
- 1.0 Course Unit

**BSTA 620 Probability I**
- This course covers Elements of (non-measure theoretic) probability necessary for the further study of statistics and biostatistics. Topics include set theory, axioms of probability, counting arguments, conditional probability, random variables and distributions, expectations, generating functions, families of distributions, joint and marginal distributions, hierarchical models, covariance and correlation, random sampling, sampling properties of statistics, modes of convergence, and random number generation.
- Course usually offered in fall term
- Prerequisites: Two semesters of calculus (through multivariable calculus), linear algebra; permission from the instructor.
- Activity: Lecture
- 1.0 Course Unit

**BSTA 621 Statistical Inference I**
- This class will cover the fundamental concepts of statistical inference. Topics include sufficiency, consistency, finding and evaluating point estimators, finding and evaluating interval estimators, hypothesis testing, and asymptotic evaluations for point and interval estimation.
- Course usually offered in spring term
- Prerequisites: BSTA 620, permission of instructor.
- Activity: Lecture
- 1.0 Course Unit

**BSTA 622 Statistical Inference II**
- This class will cover the fundamental concepts of statistical inference. Topics include sufficiency, consistency, finding and evaluating point estimators, finding and evaluating interval estimators, hypothesis testing, and asymptotic evaluations for point and interval estimation.
- Course usually offered in fall term
- Prerequisite: BSTA 621; permission of instructor
- Activity: Lecture
- 1.0 Course Unit

**BSTA 630 Statistical Methods and Data Analysis I**
- This first course in statistical methods for data analysis is aimed at first-year Biostatistics students. It focuses on the analysis of continuous data. Topics include descriptive statistics (measures of central tendency and dispersion, shapes of distributions, graphical representations of distributions, transformations, and testing for goodness of fit); populations and sampling (hypotheses of differences and equivalence, statistical errors); one- and two-sample t tests; analysis of variance; correlation; nonparametric tests on means and correlations; estimation (confidence intervals and robust methods); categorical data analysis (proportions; statistics and test for comparing proportions; test for matched samples; study design); and regression modeling (simple linear regression, multiple regression, model fitting and testing, partial correlation, residuals, multicollinearity). Examples of medical and biologic data will be used throughout the course, and use of computer software demonstrated.
- Course usually offered in fall term
- Prerequisites: Multivariable calculus and linear algebra, BSTA 620 (may be taken concurrently) and permission of instructor.
- Activity: Lecture
- 1.0 Course Unit

**BSTA 632 Statistical Methods for Categorical and Survival Data**
- This is the second half of the methods sequence, where the focus shifts to methods for categorical and survival data. Topics in categorical include defining rates; incidence and prevalence; the chi-squared test; Fisher’s exact test and its extension; relative risk and odds-ratio; sensitivity; specificity; predictive values; logistic regression with goodness of fit tests; ROC curves; the Mantel-Haenszel test; McNemar’s test; the Poisson model; and the Kappa statistic. Survival analysis will include defining the survival curve, censoring, and the hazard function; the Kaplan-Meier estimate, Greenwood’s formula and confidence bands; the log rank test; and Cox’s proportional hazards regression model.
- Course usually offered in spring term
- Prerequisites: BSTA 630, 620, 621 (may be taken concurrently), linear algebra, calculus and permission of instructor.
- Activity: Lecture
- 1.0 Course Unit

**BSTA 651 Introduction to Linear Models and Generalized Linear Models**
- This course extends the content on linear models in BSTA 630 and BSTA 632 to more advanced concepts and applications of linear models. Topics include the matrix approach to linear models including regression and analysis of variance, general linear hypothesis, estimability, polynomial, piecewise, ridge, and weighted regression, regression and collinearity diagnostics, multiple comparisons, fitting strategies, simple experimental designs (block designs, split plot), random effects models, Best Linear Unbiased Prediction. In addition, generalized linear models will be introduced with emphasis on the binomial, logit and Poisson log-linear models. Applications of methods to example data sets will be emphasized.
- Course usually offered in spring term
- Prerequisites: Linear algebra, calculus, BSTA 620, 630. BSTA 621 and 632 (may be taken concurrently), permission of instructor.
- Activity: Lecture
- 1.0 Course Unit
**BSTA 656 Longitudinal Data Analysis**
This course covers both the applied aspects and methods developments in longitudinal data analysis. In the first part, we review the properties of the multivariate normal distribution and cover basic methods in longitudinal data analysis, such as exploratory data analysis, two-stage analysis and mixed-effects models. Focus is on the linear mixed-effects models, where we cover restricted maximum likelihood estimation, estimation and inference for fixed and random effects and models for serial correlations. We will also cover Bayesian inference for linear mixed-effects models. The second part covers advanced topics, including nonlinear mixed-effects models, GEE, generalized linear mixed-effects models, nonparametric longitudinal models, functional mixed-effects models, and joint modeling of longitudinal data and the dropout mechanism.
Prerequisites: BSTA 621, 631 or 632, 651, 653 or 754, permission of instructor.
Activity: Lecture
0.5 Course Units

**BSTA 660 Design of Observational Studies**
This course will cover statistical methods for the design and analysis of observational studies. Topics for the course will include epidemiologic study designs, issues of confounding and hidden bias, matching methods, propensity score methods, sensitivity analysis, and instrumental variables. Case studies in biomedical research will be presented as illustrations.
Prerequisites: BSTA 621, 631 or 632, 651, permission of instructor.
Activity: Lecture
0.5 Course Units

**BSTA 661 Design of Interventional Studies**
This course is designed for graduate students in statistics or biostatistics interested in the statistical methodology underlying the design, conduct, and analysis of clinical trials and related interventional studies. General topics include designs for various types of clinical trials (Phase I, II, III), endpoints and control groups, sample size determination, and sequential methods and adaptive design. Regulatory and ethical issues will also be covered.
Prerequisites: BSTA 621, 631 or 632, permission of instructor.
Activity: Lecture
0.5 Course Units

**BSTA 670 Statistical Computing**
This course concentrates on computational tools, which are useful for statistical research and for computationally intensive statistics. Through this course you will develop a knowledge base and skill set of a wide range of computational tools needed for statistical research. Topics include computer storage, architecture and arithmetic; random number generation; numerical optimization methods; spline smoothing and penalized likelihood; numerical integration; simulation design; Gibbs sampling; bootstrap methods; and the EM algorithm.
Prerequisites: BSTA 651, 620, 621 or equivalents or permission of instructor.
Activity: Lecture
1.0 Course Unit

**BSTA 699 Lab Rotation**
Activity: Laboratory
0.33 Course Units

**BSTA 754 Advanced Survival Analysis**
This advanced survival analysis course will cover statistical theory in counting processes, large sample theory using martingales, and other state of the art theoretical concepts useful in modern survival analysis research. Examples in deriving rank-based tests and Cox regression models as well as their asymptotic properties will be demonstrated using these theoretical concepts. Additional potential topics may include competing risk, recurrent event analysis, multivariate failure time analysis, joint modeling of survival and longitudinal data, sample size calculations, multistate models, and complex sampling schemes involving failure time data.
Course usually offered in fall term
Prerequisites: BTA 622 (may be taken concurrently) and permission of instructor.
Activity: Lecture
0.5 Course Units

**BSTA 899 Pre-Dissertation Research**
Activity: Lecture
0.5 Course Units

**BSTA 920 Guided Dissertation Research**
Activity: Masters Thesis
1.0 Course Unit

**BSTA 990 Guided Dissertation Research**
Activity: Masters Thesis
1.0 Course Unit

**BSTA 995 Dissertation**
One-term course offered either term
Activity: Dissertation
1.0 Course Unit