# Biostatistics

## Courses

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<td>General Biostatistics</td>
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<td>BIOS:5510, STAT:5810</td>
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<td>BIOS:4120</td>
<td>Introduction to Biostatistics</td>
<td>3 s.h.</td>
<td>BIOS:5120</td>
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<td>BIOS:5120</td>
<td>Regression Modeling and ANOVA in the Health Sciences</td>
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<td>BIOS:5120, BIOS:5720</td>
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<td>BIOS:5130</td>
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<td>BIOS:5310</td>
<td>Research Data Management</td>
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<td>BIOS:5510</td>
<td>Biostatistical Computing</td>
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<td>BIOS:5710</td>
<td>Biostatistical Methods I</td>
<td>4 s.h.</td>
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<td>BIOS:6420</td>
<td>Survey Design and Analysis</td>
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BIOS:6610 Statistical Methods in Clinical Trials 3 s.h.
Survey of statistical methods commonly used in clinical trials; primary focus on methodologic perspective for the design, conduct, analysis, and interpretation of phases of clinical trials; logistical and operational aspects of conducting multisite clinical trials; designed for biostatistics majors. Offered spring semesters. Prerequisites: BIOS:5720. Requirements: familiarity with SAS and R programming. Same as IGPI:6610.

BIOS:6650 Causal Inference 3 s.h.
Concepts of causal inference, counterfactuals, confounding, causal graphs, internal/external validity, and heterogeneity of treatment effect; methods include propensity score matching (i.e., optimal pair, multiple control and full matching; nearest, fine-balance, risk set matching) and stratification; covariate balance checks; sensitivity analysis; inverse probability of treatment weighted estimation; doubly robust estimators; mediation analysis; marginal structural models. Prerequisites: BIOS:5720 and BIOS:5730 and ((STAT:4100 and STAT:4101) or (STAT:5100 and STAT:5101)). Same as IGPI:6650.

BIOS:6720 Statistical Machine Learning for Biomedical and Public Health Data 3 s.h.
Statistical machine learning techniques for analysis of biomedical and public health data; methodology and application of unsupervised learning, supervised learning for regression and classification, ensemble learning, model assessment, feature selection, and high-dimensional inference. Prerequisites: BIOS:5510 and BIOS:5720 and (STAT:4100 and STAT:4101) or (STAT:5100 and STAT:5101). Requirements: BIOS:5510 with topic of programming with R.

BIOS:6810 Bayesian Methods and Design 3 s.h.
Theory and application of Bayesian methods in biomedical research; foundations of Bayesian statistics including decision theory, study design, model development, inference and implementation of computational algorithms; designed for biostatistics majors. Offered fall semesters of even years. Prerequisites: BIOS:5510 and BIOS:5720 and BIOS:5730 and STAT:4100 and STAT:4101.

BIOS:7110 Likelihood Theory and Extensions 4 s.h.
Theoretical foundations of inferential methods based on likelihood and its extensions (e.g., profile, conditional, partial, marginal, pseudo likelihood). Prerequisites: BIOS:5720 and STAT:5100 and STAT:5101) or (STAT:4100 and STAT:4101). Prerequisites: BIOS:5510 and BIOS:6720 and BIOS:5730 and STAT:4100 and STAT:4101.

BIOS:7120 Advanced Topics in Biostatistics 4 s.h.
Classical likelihood-based inference, numerical optimization, model and data deficiencies, expectation-maximization (EM) algorithm, M-estimation, nonparametrics and marginal likelihood, and the bootstrap. Prerequisites: BIOS:7110.

BIOS:7210 Survival Data Analysis 3 s.h.
Types of censoring and truncation; survival function estimation; parametric inference using exponential, Weibull, and accelerated failure time models; nonparametric tests; sample size calculation; Cox regression with stratification and time-dependent covariates; regression diagnostics; competing risks; topics may include analysis of correlated survival data and/or recurrent events; designed for biostatistics and statistics majors. Offered fall semesters of odd years. Prerequisites: BIOS:5720 and ((STAT:4100 and STAT:4101) or (STAT:5100 and STAT:5101)). Same as IGPI:7210, STAT:7570.

BIOS:7230 Advanced Clinical Trials 3 s.h.
Modules that address advanced topics and issues encountered when conducting a clinical trial; discussions of recent publications and FDA guidance documents dealing with current topics in clinical trials. Prerequisites: (STAT:4101 or STAT:5101) and BIOS:6610. Requirements: familiarity with SAS and R programming.

BIOS:7240 High-Dimensional Data Analysis 3 s.h.
Analysis of high-dimensional data with emphasis on use of penalized regression models such as lasso, elastic net, minimax concave penalty (MCP), smoothly clipped absolute deviation (SCAD), and group lasso; large-scale hypothesis testing and false discovery rate estimation; inference for penalized likelihoods. Prerequisites: (STAT:4100 and STAT:4101) or (STAT:5100 and STAT:5101) and BIOS:5510 and BIOS:5720. Requirements: BIOS:5510 with section subtitle of programming with R.

BIOS:7250 Theory of Linear and Generalized Linear Models 4 s.h.
Theoretical foundations of traditional linear models and generalized linear models; emphasis on modeling structures, estimability and identifiability, estimation and testing. Prerequisites: STAT:5100 and STAT:5101 and BIOS:5720.

BIOS:7270 Scholarly Integrity in Biostatistics 1 s.h.
Responsible conduct of research training; emphasis on issues of particular relevance to biostatisticians including authorship, communication, student/mentor relationships, plagiarism, fabrication and falsification of data, bias, Type I/II errors, reproducible research, data confidentiality and security, conflicts of interest, and human/animal subjects. Requirements: graduate standing in biostatistics.

BIOS:7310 Longitudinal Data Analysis 3 s.h.
Statistical models and estimation methods for outcome variables (normal and non-normal) clustered or measured repeatedly in time or space; includes ANOVA based methods, hierarchical linear models, linear mixed models, error structures, generalized estimating equations, and generalized linear mixed models; may include Bayesian approaches; designed for biostatistics and statistics majors. Offered spring semesters of odd years. Prerequisites: (BIOS:5720 and STAT:4100 and STAT:4101) or (STAT:5100 and STAT:5101). Same as IGPI:7310.

BIOS:7330 Advanced Biostatistical Computing 3 s.h.
Advanced topics in biostatistical computing and large or complicated data/models; matrix decomposition, optimization, Bayesian computing, parallel programming, working with campus high performance computing (HPC) resources; topics are explored in R, including package development and efficient R code. Prerequisites: MATH:2700 and BIOS:5510 and STAT:4101. Requirements: BIOS:5510 with section subtitle of programming with R.

BIOS:7410 Analysis of Categorical Data 3 s.h.
Models for discrete data, distribution theory, maximum likelihood and weighted least squares estimation for categorical data, tests of fit, models selection. Offered spring semesters. Prerequisites: (BIOS:5720 or STAT:5200) and (STAT:5101 or STAT:4101). Same as STAT:7510.

BIOS:7500 Preceptorship in Biostatistics 3 s.h.
Work experience using knowledge and skill acquired in classroom; arranged in conjunction with ongoing departmental or collegiate activities or with governmental agencies or private industry; preparation of prospectus and presentation of research results in a department seminar.
**BIOS:7600 Advanced Biostatistics Seminar** 0-3 s.h.
Current topics; supervised experience in reading and interpreting biostatistical literature. Same as IGPI:7600.

**BIOS:7604 Scholarly Integrity in Biostatistics for Postdocs** 0 s.h.
Responsible conduct of research training; emphasis on issues of particular relevance to biostatisticians and statisticians including authorship, communication, student/mentor relationships, plagiarism, fabrication and falsification of data, bias, Type I/II errors, reproducible research, data confidentiality and security, conflicts of interest, human/animal subjects. Requirements: postdoctoral research scholar/fellow standing in biostatistics or statistics.

**BIOS:7700 Problems/Special Topics in Biostatistics** arr.
Didactic material in biostatistics; may include tutorials, seminars, faculty-directed independent work (e.g. literature search, project, short research project).

**BIOS:7800 Independent Study in Biostatistics** arr.
In-depth pursuit of an area of special interest in biostatistics requiring substantial creativity and independence.

**BIOS:7850 Research in Biostatistics** arr.
Research that may lead to a dissertation.