The Department of Biostatistics at the University of Alabama at Birmingham is one of five departments in the School of Public Health. The Department offers programs leading to the Doctor of Philosophy (PhD), Master of Science (MS), Master of Public Health (MPH), Master of Science in Public Health (MSPH), and a Certificate in Statistical Genetics (CSG). The MS and PhD degrees are offered through the Graduate School. The MPH and MSPH degrees are offered through the School of Public Health.

Prospective students should click here (http://www.soph.uab.edu/apply) to obtain specific admissions requirements on how to apply to Graduate School.

<table>
<thead>
<tr>
<th>Degree Offered</th>
<th>M.P.H., M.S., M.S.P.H., Ph.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department Chair</td>
<td>David T. Redden, Ph.D.</td>
</tr>
<tr>
<td>Phone</td>
<td>(205) 934-4905</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:bstgrad@uab.edu">bstgrad@uab.edu</a></td>
</tr>
<tr>
<td>Website</td>
<td><a href="http://www.soph.uab.edu/bst">www.soph.uab.edu/bst</a></td>
</tr>
<tr>
<td>Department Contact</td>
<td>Della Daniels</td>
</tr>
<tr>
<td>Department Contact Email</td>
<td><a href="mailto:daniel@uab.edu">daniel@uab.edu</a></td>
</tr>
</tbody>
</table>

The Department of Biostatistics offers an MS degree in Biostatistics. This program provides a balance between theory and application, the perspective being the role of statistics and modeling in scientific research. The objective is to produce research-oriented scientists who can advance statistical and modeling theory and can interact effectively with scientists in other disciplines to advance knowledge in those fields.

**Degree Programs**

The Department offers programs leading to the Doctor of Philosophy (PhD), Master of Science (MS), Master of Public Health (MPH), Master of Science in Public Health (MSPH), and a Certificate in Statistical Genetics (CSG). The MS and PhD degrees are offered through the Graduate School. The MPH and MSPH degrees are offered through the School of Public Health.

**Biostatistics Degree Competencies - click here** (http://www.soph.uab.edu/BST_competencies)

**Admissions**

<table>
<thead>
<tr>
<th>Entry Term</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master Program Deadline:</td>
<td><a href="http://www.soph.uab.edu/apply">www.soph.uab.edu/apply</a></td>
</tr>
<tr>
<td>PhD Program Deadline:</td>
<td>May 1</td>
</tr>
<tr>
<td>GPA</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**Master of Science in Biostatistics**

The objective is to produce research-oriented scientists who can advance statistical and modeling theory and can interact effectively with scientists in other disciplines to advance knowledge in those fields. For admission to the MS program, a student's undergraduate curriculum must include a 3-semester sequence of calculus or equivalent, linear matrix algebra, and proficiency in computing. It is preferred that students have additional advanced mathematics courses, e.g., differential equations, advanced calculus including special functions, and complex analysis. Some background in the natural sciences would be helpful. Interested students should contact the Department of Biostatistics.

**MS Comprehensive Exam**

Upon completion of the first year-and-a-half of course work, the candidate is given a written examination consisting of two parts - Applied Statistics and Theory of Statistics. The exam will test the students on their understanding and comprehension of the foundation of the theory and applications of statistics, and will generally cover materials from BST 621, BST 622, BST 623 BST 626, BST 631, BST 632 and BST 655. This will be a standard departmental exam, administered by the GPC. The criteria for evaluation are the candidate's understanding and competency in basic principles and foundations of statistics, understanding of the appropriate use and interpretation of statistical methods, and ability to succinctly express in writing the results of the problems. This examination is offered during the first half of January. At first attempt, a student must take both parts at the same time. For those years during which at least one student needs to take the exam a second time, the exam may be offered in July at the discretion of the Graduate Program Committee (GPC). Students must be registered for at least 3 semester hours of graduate work during the semester in which the comprehensive examination is given.

The student must pass each part of the exam at the Masters level. If a student fails either part of the exam, one additional chance will be given to retake the part of the exam that was failed. A student who fails the qualifying exam more than once will be dismissed from the MS program. The student has the opportunity to appeal the decision of his/her dismissal. The Graduate School policies on dismissal from the program and appeal of dismissal are described in detail in the UAB Student Handbook.

Please note that receipt of an “A” in all individual courses may not constitute adequate preparation for this exam. The purpose of the qualifying exam is to test your ability to connect the information across
courses, to choose appropriate analysis methods, and to display a working knowledge of the tools used in probability and inference.

**Masters Project**

Immediately after passing the MS Comprehensive examination, the student must form a research project committee consisting of at least 3 members, chaired by the research advisor. Upon successful completion of the project, the student must submit a final write-up of the research and present their work orally in a departmental seminar. It is strongly suggested that the write-up is such that it may lead to an article submitted for publication in the subject matter area. The date and time of the oral presentation will be advertised in the Ryals Building.

All students must be registered for a minimum of 3 credit hours of Non-Thesis Research BST 698 during the semester in which you intend to graduate. When you are nearing completion of your research, you must file an Application for Degree with the Graduate School by the appropriate date during the semester in which you expect to graduate.

### Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BST 621: Statistical Methods I</td>
<td>3</td>
</tr>
<tr>
<td>BST 622: Statistical Methods II</td>
<td>3</td>
</tr>
<tr>
<td>BST 623: General Linear Models</td>
<td>3</td>
</tr>
<tr>
<td>BST 626: Data Management and Reporting with SAS</td>
<td>3</td>
</tr>
<tr>
<td>BST 626L: Data Management and Reporting with SAS Laboratory</td>
<td>0</td>
</tr>
<tr>
<td>BST 631: Statistical Theory I</td>
<td>4</td>
</tr>
<tr>
<td>BST 632: Statistical Theory II</td>
<td>4</td>
</tr>
<tr>
<td>BST 655: Categorical Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>BST 691: Pre-Doctoral Seminar Series (4 hours required for BST 691: Biostatistics Pre#doctoral Seminar Series)</td>
<td>1</td>
</tr>
<tr>
<td>SOPH Requirement:</td>
<td>3</td>
</tr>
<tr>
<td>GRD ESL Assessment</td>
<td>3</td>
</tr>
<tr>
<td>Biostatistics Electives: (Minimum 6 credit hours)</td>
<td>6</td>
</tr>
<tr>
<td>BST 665: Survival Analysis</td>
<td>3</td>
</tr>
<tr>
<td>BST Course</td>
<td>3</td>
</tr>
<tr>
<td>Required Outside Electives: (Minimum 7 graduate credit hours of electives)</td>
<td>7</td>
</tr>
<tr>
<td>EPI 610: Principles of Epidemiologic Research</td>
<td>4</td>
</tr>
<tr>
<td>Other Elective</td>
<td>3</td>
</tr>
<tr>
<td>Other Related Courses including BST 698: (Minimum of 6 credit hours)</td>
<td>6</td>
</tr>
<tr>
<td>BST 698: Non Thesis Research</td>
<td>1-12</td>
</tr>
<tr>
<td><strong>Total Hours:</strong></td>
<td>46-49</td>
</tr>
</tbody>
</table>

All international students must demonstrate proficiency in spoken and written English before graduation, through the Graduate School’s ESL Assessment. Depending on the results of that assessment, the Graduate Program Committee may require additional course work in both written and/or oral English for students not showing proficiency upon arrival, or during any period of their graduate studies.

### Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BST 621: Statistical Methods I</td>
<td>3</td>
</tr>
<tr>
<td>BST 622: Statistical Methods II</td>
<td>3</td>
</tr>
<tr>
<td>ENH 600: Fundamentals of Environmental Health Science</td>
<td>3</td>
</tr>
<tr>
<td>EPI 600: Intro to Epidemiology</td>
<td>3-4</td>
</tr>
<tr>
<td>or EPI 610: Principles of Epidemiologic Research</td>
<td></td>
</tr>
<tr>
<td>HB 600: Social and Behavioral Science Core</td>
<td>3</td>
</tr>
<tr>
<td>HCO 600: Management and Policy in Public Health Systems and Services</td>
<td>3</td>
</tr>
<tr>
<td>PUH 695: The Public Health Integrative Experience</td>
<td>1</td>
</tr>
<tr>
<td><strong>SOPH Requirements:</strong></td>
<td></td>
</tr>
<tr>
<td>PUH 627: Writing &amp; Reviewing Research for MPH Candidates</td>
<td>3</td>
</tr>
<tr>
<td>or GRD 727: Writing &amp; Reviewing Research</td>
<td></td>
</tr>
</tbody>
</table>

### Biostatistics Track Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BST 619: Data Collection and Management</td>
<td>3</td>
</tr>
<tr>
<td>BST 626: Data Management and Reporting with SAS</td>
<td>3</td>
</tr>
<tr>
<td>BST 626L: Data Management and Reporting with SAS Laboratory</td>
<td>0</td>
</tr>
<tr>
<td>Biostatistics Electives (Minimum 9 credit hours of regular courses of 623 or higher level)</td>
<td>9</td>
</tr>
<tr>
<td><strong>Public Health Electives at the 500+ level</strong></td>
<td>3</td>
</tr>
<tr>
<td><strong>Internship</strong></td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Hours</strong></td>
<td>43-44</td>
</tr>
</tbody>
</table>

1 Please choose three (3) hours at the 500+ level from ENH, EPI, GHS, HB, or HCO

School of Public Health’s Catalog (http://www.soph.uab.edu/catalog)

**Master of Science in Public Health (MSPH) in Clinical and Translational Science (CTSB)**

There is a growing interest in medical and other health science schools in developing the clinical research skills of faculty members and fellows. This interest has been fueled by increased support from the National Institutes of Health (NIH) to prepare such individuals to meet the demand for clinical investigators in the field. Locally, the Schools of Medicine and Public Health have combined efforts to create a training program for young faculty members and fellows from a variety of disciplines.

This program is a post-medical or other health science degree training program, aimed primarily at fellows and faculty members interested in developing skills required for clinical research. It is anticipated that this academic training will supplement extensive training in the content area in which the student is trained, and senior mentoring in the politics and policies of development and management. A graduate of this program will have the academic training to develop and lead independent research programs and projects. The program consists of a set of courses common to all students, plus research electives and focus elective courses that reflect the academic interest of the student. At this time, the program can accommodate students with specific interest in biostatistics (CTSB), epidemiology (CTE), and health behavior (CTSH). As a result,
there will be some variation in the specific knowledge and skills acquired by each graduate. However, the primary learning objectives will apply to all students, irrespective of departmental affiliation. As such, graduates will be able to do the following upon completion of the program:

- design, conduct, and evaluate clinical research studies;
- understand issues of data collection and study management;
- follow appropriate policies and procedures relating to the utilization of human subjects in clinical research;
- demonstrate an understanding of the ethics of research on human subjects;
- prepare competitive applications for extramural research funding;
- prepare manuscripts for publication in the scientific literature; and
- critically evaluate published research.

Required Courses: MSPH in Biostatistics

The MSPH in Clinical and Translational Science consists of a minimum of 41 credit hours. Of these, 14 hours are required, including 9 hours of specific biostatistics courses and 5 hours of specific epidemiology courses. Students then select at least 9 hours from a list of approved Masters Research Electives, complete 9 hours of focus specific electives in biostatistics, and take at least 9 hours of directed (698 level) masters research to fulfill the MSPH requirement for conducting a research project.

Students receiving a MSPH are required to complete a 3 hour Online course entitled "Overview of Public Health" by the end of their second semester. Students with prior public health education (coursework in each of the public health core disciplines) may be waived from this requirement by permission of the Associate Dean.

All international students must demonstrate proficiency in spoken and written English before graduation, through the Graduate School's ESL Assessment. Dependent on the results of that assessment, the GPC may require additional course work in both written and/or oral English for students not showing proficiency upon arrival, or during any period of their graduate studies.

The MSPH Research Project

The student, with the advice of his/her chosen MSPH project co-directors forms a small committee (minimum 3 members) to guide the research project. The committee co-chairs should consist of a faculty member from Biostatistics and an MD with experience in the area of clinical research. Upon successful completion of the project, the student must submit a final write-up of the research.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSPH Core Requirement:</td>
<td>14</td>
</tr>
<tr>
<td>BST 621 Statistical Methods I</td>
<td>3</td>
</tr>
<tr>
<td>BST 622 Statistical Methods II</td>
<td>3</td>
</tr>
<tr>
<td>BST 625 Design/Conduct Clinical Trials</td>
<td>3</td>
</tr>
<tr>
<td>EPI 607 Fundamentals of Clinical Research</td>
<td>3</td>
</tr>
<tr>
<td>EPI 680 Topics in Clinical Research</td>
<td>2</td>
</tr>
<tr>
<td>SOPIH Requirement:</td>
<td></td>
</tr>
<tr>
<td>GRD ESL Assessment:</td>
<td>3</td>
</tr>
<tr>
<td>Masters Research Selectives:</td>
<td>9</td>
</tr>
<tr>
<td>BST 619 Data Collection and Management</td>
<td>3</td>
</tr>
<tr>
<td>BST 626 Data Management and Reporting with SAS</td>
<td>3</td>
</tr>
</tbody>
</table>

Biostatistics Selectives: (Minimum 9 hours of regular courses of 623 or higher level)

| Masters Project Research:              | 9       |
| BST 698 Non Thesis Research            | 1-12    |

Total Credit Hours: 41-44 hours

School of Public Health's Student Catalog (http://www.soph.uab.edu/catalog)

Doctor of Philosophy in Biostatistics

The Department of Biostatistics offers a PhD degree in biostatistics. This program provides a balance between theory and application, the perspective being the role of statistics and modeling in scientific research. The objective is to produce research-oriented scientists who can advance statistical and modeling theory and can interact effectively with scientists in other disciplines to advance knowledge in those fields. For admission to the program, a student's undergraduate curriculum must include a 3-semester sequence of calculus or equivalent, linear algebra, and proficiency in computing. It is preferred that students have additional advanced mathematics courses, e.g., differential equations, advanced calculus including special functions, and complex analysis. Advanced calculus and a prior MS in statistics or biostatistics are required for admission to the PhD program. Some background in the natural sciences would be helpful. Interested students should contact the department of Biostatistics.

All students entering the PhD program are required to complete the coursework required for the MS degree. As described above, it is possible for a student entering the graduate program with an MS degree in statistics or biostatistics from another institution to waive up to 12 credit hours of coursework at the discretion of the GPC. It will be the student's option whether to actually obtain the MS degree, but the department strongly encourages that they do so, since the completion of the master's project is very good research experience and may lead to a publication.

PhD Qualifying/Comprehensive Exam

Upon completion of the first year-and-a-half of course work, the candidate is given a written examination consisting of two parts - Applied Statistics and Theory of Statistics. The exam will test the student on their understanding and comprehension of the foundation of the theory and applications of statistics, and will generally cover materials from BST 621, BST 622BST 623, BST 626, BST 631, BST 632 and BST 665. This will be a standard departmental exam, administered by the GPC. The criteria for evaluation are the candidate’s understanding and competency in basic principles and foundations of biostatistics, potential for conducting independent research in statistical methods, and ability to express in writing the results of the problems. This examination is offered during the first half of January. At first attempt, a student must take both parts at the same time. For those years during which at least three students need to take the exam a second time, the exam may be offered in July at the discretion of the GPC. Students must be registered for at least
3 semester hours of graduate work during the semester in which the comprehensive examination is given.

The student may pass each part of the exam at the PhD level, fail at the PhD level but pass at the Master's level, or fail at the Masters level. If a student fails to pass either part of the exam at the PhD level, one additional chance will be given to retake the part of the exam that was failed. A student who fails the qualifying examination more than once will be dismissed from the PhD program. The student has the opportunity to appeal the decision of his/her dismissal. Graduate School policies on dismissal from the program and appeal of dismissal are described in detail in the UAB Student Handbook.

Please note that receipt of an "A" in all individual courses may not constitute adequate preparation for this exam. The purpose of the qualifying exam is to test the students' ability to connect the information across courses, to choose appropriate analysis methods, and to display a working knowledge of the tools used in probability and inference. It is highly recommended that students find a mentor within six months after successfully completing the qualifying examination.

PhD Dissertation Research

The student should start his/her dissertation research during the second or third year of study. The initial step of the research consists of identifying a topic that is of mutual interest to the student and the research advisor. Courses, seminars, and presentations by the faculty assist the student in this process. The dissertation must be an original contribution to scientific knowledge. It can involve, but is not limited to, the development of new statistical methodologies, evaluation of existing methodologies and study of their properties, innovative application of existing methodologies, or any combination of the above. It must show a clear ability to carry out independent biostatistical research and provide results that are publishable in peer-reviewed journals.

Courses

BST 601. Biostatistics. 4 Hours.
Logic and language of scientific methods in life science research; use of basic statistics in testing hypotheses and setting confidence limits. Simple and multiple regression and elementary experimental designs. No prerequisites but familiarity with basic algebra is important.

BST 601Q. Biostatistics. 4 Hours.
Logic and language of scientific methods in life science research; use of basic statistics in testing hypotheses and setting confidence limits. Simple and multiple regression and elementary experimental designs. No prerequisites but familiarity with basic algebra is important.

BST 603. Introductory Biostatistics for Graduate Biomedical Sciences. 3 Hours.
This course will utilize current statistical techniques to assess and analyze health science related data.

BST 607. Environmental Sampling and Exposure Assessment. 3 Hours.
Application of statistical techniques including use of lognormal distribution for environmental and occupational health exposure assessment problems. Spatial and temporal correlations are discussed and appropriate analysis techniques are described for these situations using statistical software packages.

BST 608. Statistical Modeling in Clinical and Epi Studies. 3 Hours.
Provide an understanding of modeling approaches to address the challenges of "real life" data sets in the framework of linear models as they relate to clinical and epidemiological studies.

Prerequisites: BST 602 [Min Grade: C] and BST 612 [Min Grade: C]

BST 611. Intermediate Statistical Analysis I. 3 Hours.
Students will gain a thorough understanding of basic analysis methods, elementary concepts, statistical models and applications of probability, commonly used sampling distributions, parametric and non-parametric one and two sample tests, confidence intervals, applications of analysis of two-way contingency table data, simple linear regression, and simple analysis of variance. Students are taught to conduct the relevant analysis using current software such as the Statistical Analysis System (SAS).

BST 611Q. Intermediate Statistical Analysis I Online. 3 Hours.
This course will utilize current statistical techniques to assess and analyze public health related data. In addition, students will learn to read and critique the use of such techniques in published research. Students will also determine what analytical approaches are appropriate under different research scenarios.

BST 612. Intermediate Statistical Analysis II. 3 Hours.
This course will introduce students to the basic principles of tools of simple and multiple regression. A major goal is to establish a firm foundation in the discipline upon which the applications of statistical and epidemiologic inference will be built. If prerequisite is not met, permission of instructor is required.

Prerequisites: BST 611 [Min Grade: C]
BST 612Q. Intermediate Statistical Analysis II Online. 3 Hours.
This course will utilize current statistical techniques to assess and
analyze public health related data. In addition, students will learn to read
and critique the use of such techniques in published research. Students
will also determine what analytical approaches are appropriate under
different research scenarios.
Prerequisites: BST 611 [Min Grade: C]

BST 613. Intermediate Stats Analy III. 3 Hours.
This course will introduce students to additional general concepts in
biostatistics beyond an introductory level to include study design, power
and sample size estimation, mixed-models, survival analysis, survey
design and interpretation of research results.
Prerequisites: BST 612 [Min Grade: C]

BST 619. Data Collection and Management. 3 Hours.
Basic concepts of study design, forms design, quality control, data entry,
data management and data analysis. Hands-on experience with data
entry systems, e.g., DBASE, and data analysis software, e.g., PC-SAS.
Exposure to other software packages as time permits. Previous computer
experience or workshop on microcomputers highly recommended.
NOTE: If space permits, non-degree graduate students will be permitted
to enroll. All students registered for the course must attend 1st class
to remain enrolled. Previous computer experience or workshop on
microcomputers highly recommended.
Prerequisites: BST 601 [Min Grade: C] or BST 611 [Min Grade: C] or
BST 621 [Min Grade: C]

BST 620. Applied Matrix Analysis. 3 Hours.
Vector and matrix definitions and fundamental concepts; matrix
factorization and application. Eigen-values and eigen-vectors, functions
of matrices, singular and ill-conditioned problems.
Prerequisites: BST 622 [Min Grade: C]

BST 621. Statistical Methods I. 3 Hours.
Mathematically rigorous coverage of applications of statistical techniques
designed for Biostatistics majors and others with sufficient mathematical
background. Statistical models and applications of probability; commonly
used sampling distributions; parametric and nonparametric one and two
sample tests and confidence intervals; analysis of two-way contingency
table data; simple linear regression; simple analysis of variance designs
with equal or proportional subclass members; use of contrasts and
multiple comparisons procedures; introduction to survival analysis;
multivariate methods. Interested students must have a year of calculus
sequence before enrolling in BST 621.

BST 622. Statistical Methods II. 3 Hours.
Mathematically rigorous coverage of applications of statistical techniques
designed for Biostatistics majors and others with sufficient mathematical
background. Statistical models and applications of probability; commonly
used sampling distributions; parametric and nonparametric one and two
sample tests and confidence intervals; analysis of contingency
tables; simple linear regression; simple analysis of variance designs with
equal or proportional subclass members; use of contrasts and multiple
comparisons procedures; introduction to survival analysis; multivariate
methods.
Prerequisites: BST 621 [Min Grade: C]

BST 623. General Linear Models. 3 Hours.
Simple and multiple regression using matrix approach; weighted and
non-linear regression; variable selection methods; modeling techniques;
regression diagnostics and model validation; systems of linear equations;
factorial designs; blocking; an introduction to repeated measures designs;
Coding schemes.
Prerequisites: BST 622 [Min Grade: C]

BST 624. Experimental Design. 3 Hours.
Intermediate experimental design and analysis of variance models using
matrix approach. Factorial and nested (hierarchical) designs; blocking;
repeated measures designs; Latin squares; incomplete block designs;
fractional factorials; confounding. Students should have had matrix
algebra as a prerequisite.
Prerequisites: BST 623 [Min Grade: C]

BST 625. Design/Conduct Clinical Trials. 3 Hours.
Concepts of clinical trials; purpose, design, implementation and
evaluation. Examples and controversies presented.
Prerequisites: BST 611 [Min Grade: C] and BST 612 [Min Grade: C] or
BST 621 [Min Grade: C] and BST 622 [Min Grade: C]

BST 626. Data Management and Reporting with SAS. 3 Hours.
A hands-on exposure to data management and report generation with
one of the most popular statistical software packages. Concurrent
registration in BST 626L is required. Note: Non-degree graduate
students will be allowed to register if space permits.
BST 626L. Data Management and Reporting with SAS Laboratory. 0
Hours.
A hands-on exposure to data management and report generation with
one of the most popular statistical software packages.

BST 626Q. Data Management and Reporting with SAS. 3 Hours.
This course is designed to provide an introduction to data management
and reporting using the SAS system. Students who have some PC
computer experience or who have been introduced to SAS are eligible
to take this course. Any student taking this course should be familiar
with simple summary statistics such as the mean, standard deviation,
standard error, median and percentiles as well as proportions. Outside
of familiarity with these basic statistics, no other statistical background
is required. Though not required, some programming background will be
useful as this assures the instructor that the student is familiar with the
logic critical in understanding conditional execution commonly used in
SAS.

BST 631. Statistical Theory I. 4 Hours.
Fundamentals of probability: independence; distribution and density
functions; random variables; moments and moment generating
functions; discrete and continuous distributions; exponential families,
marginal and conditional distributions; transformation and change of
variables; convergence concepts, sampling distributions, Point and
interval estimation; hypothesis and significance testing; sufficiency and
completeness; ancillary statistics; maximum likelihood and moment
estimators; asymptotic properties of estimators and tests; introduction to
Bayesian inference. Prerequisite: Advanced Calculus.

BST 632. Statistical Theory II. 4 Hours.
Fundamentals of probability; independence; distribution and density
functions; random variables; moments and moment generating functions;
discrete and continuous distributions; exponential families, marginal
and conditional distributions; transformation and change of variables;
convergence concepts, sampling distributions, Point interval estimation;
hypothesis and significance testing; sufficiency and completeness;
ancillary statistics; maximum likelihood and moment estimators;
asymptotic properties of estimators and tests; introduction to Bayesian
inference.

Prerequisites: BST 631 [Min Grade: C]
BST 640. Nonparametric Methods. 3 Hours.
Properties of statistical tests; order statistics and theory of extremes; median tests; goodness of fit; tests based on ranks; location and scale parameter estimation; confidence intervals; association analysis; power and efficiency.
Prerequisites: BST 621 [Min Grade: C] and BST 631 [Min Grade: C]

BST 655. Categorical Data Analysis. 3 Hours.
Logistic regression models; regression diagnostics; proportional odds; ordinal and polytomous logistic regression; analyses for multi-way tables; Mantel-Haenszel test; measures of association and of agreement; loglinear and logit models; ordinal discrete data; matched pairs; repeated categorical data. BST 612 or equivalent recommended as a prerequisite.
Prerequisites: BST 622 [Min Grade: C]

BST 660. Applied Multivariate Analysis. 3 Hours.
Analysis and interpretation of multivariate general linear models including multivariate regression, multivariate analysis of variance/covariance, discriminant analysis, multivariate analysis of repeated measures, canonical correlation, and longitudinal data analysis for general and generalized linear models. Extensive use of SAS, SPSS, and other statistical software.
Prerequisites: BST 623 [Min Grade: C]

BST 661. Structural Equation Modelling. 3 Hours.
Basic principles of measurements; factor analysis and latent variable models; multivariate predictive models including mediation mechanisms and moderators effects; path analysis; integrative multivariate covariance models, methods of longitudinal analysis.
Prerequisites: BST 623 [Min Grade: C]

BST 665. Survival Analysis. 3 Hours.
Design and analysis of clinical trials; sample size computation; properties of survival distributions; estimation and hypothesis testing for survival parameters; Kaplan-Meier estimation; exponential tests; Cox proportional hazards regression models, parametric survival models.
Prerequisites: BST 622 [Min Grade: C]

BST 670. Sampling Methods. 3 Hours.
Simple random, stratified, cluster, ratio regression and systematic sampling; sampling with equal or unequal probabilities of selection; optimization; properties of estimators; non-sampling errors; sampling schemes used in population research; methods of implementation and analyses associated with various schemes.
Prerequisites: BST 631 [Min Grade: C]

BST 671. Meta-Analysis. 3 Hours.
Statistical methods and inference through meta analysis.
Prerequisites: BST 623 [Min Grade: C] and BST 632 [Min Grade: C]

BST 675. Introduction to Statistical Genetics. 3 Hours.
This class will introduce students to population genetics, genetic epidemiology, microarray and proteomics analysis, Mendelian laws,inheritance, heritability, test cross linkage analysis, QTL analysis, human linkage and human association methods for discrete and qualitative traits.
Prerequisites: BST 611 [Min Grade: C] or BST 621 [Min Grade: C]

BST 676. Genomic Data Analysis. 3 Hours.
Algorithms and methods that underlie the analysis of high dimensional biological data, as well as issues in the design and implementation of such studies. High dimensional biology includes microarrays, proteomics, genomic, protein structure, biochemical system theory and phylogenetic methods. NOTE: Some knowledge of statistics (MTH 180 or BST 621) also some bio-informatics/high dimensional biology training (CS 640, MIC 753, or BST 675 is required. Interested students are urged to contact the instructors with concerns regarding assumed knowledge.
Prerequisites: BST 611 [Min Grade: C] or BST 621 [Min Grade: C]

This course is mainly focused on R and how to use R to conduct basic statistical computing. The course contains three themes: R programming, introduction to high performance computing, and basics of statistical computing.
Prerequisites: BST 621 [Min Grade: C] and BST 622 [Min Grade: C] and BST 626 [Min Grade: C] and BST 631 [Min Grade: C] and BST 632 [Min Grade: C]

BST 690. Biostatistical Consulting and Applied Problems. 3 Hours.
Students will work individually to address, analyze and present the results of an applied problem or grant design each week. The presentation of approaches, solutions and designs will be conducted in a round table format. Students will be evaluated on the quality of solution and by their presentation and class participation.
Prerequisites: BST 621 [Min Grade: C] and BST 622 [Min Grade: C]

BST 691. Pre-Doctoral Seminar Series. 1 Hour.
Biostatistics Seminar Series. This course is restricted to Biostatistics in Public Health majors only.

BST 695. Special Topics. 1-3 Hour.
Special topics in Biostatistics not covered in regular 600 level courses, but suited for Masters students in Biostatistics and doctoral students in other related disciplines.
Prerequisites: BST 671 [Min Grade: C] (Can be taken Concurrently)

BST 697. Internship in Biostatistics. 3 Hours.
Field experience under joint direction of appropriate public health faculty member and qualified specialists working in selected aspects of public health.
Prerequisites: BST 601 [Min Grade: C] or (BST 611 [Min Grade: C] and BST 612 [Min Grade: C]) and ENH 600 [Min Grade: C] and EPI 600 [Min Grade: C] and HB 600 [Min Grade: C] and HCO 600 [Min Grade: C]

BST 698. Non Thesis Research. 1-12 Hour.
Independent non-thesis research with guidance of appropriate faculty. Restricted to Biostatistics Majors only or permission of instructor / department.

BST 699. Thesis Research. 1-12 Hour.
Thesis Research under the direction of research committee. At least 6 graduate credits needed for graduation. Must be admitted to candidacy.
Prerequisites: GAC M

BST 723. Theory of Linear Models. 3 Hours.
Multivariate normal distributions and quadratic forms; least square estimation; nested models; weighted least squares, testing contrasts; multiple comparison; polynomial regression; maximum likelihood theory of log linear models will be studied.
Prerequisites: BST 632 [Min Grade: C]
**BST 725. Advances Clinical Trials. 3 Hours.**
This course will provide students with the tools to develop a basic understanding of the fundamental statistical principles involved in the design and conduct of clinical trials.

**Prerequisites:** BST 611 [Min Grade: C] and BST 612 [Min Grade: C] or BST 621 [Min Grade: C] and BST 622 [Min Grade: C] and BST 625 [Min Grade: C]

**BST 726. Adv Clin Trials II. 3 Hours.**
Students will develop a more thorough understanding of the basic methodology behind important statistical concepts used in the design and analysis of large randomized clinical trials.

**Prerequisites:** BST 621 [Min Grade: C] and BST 622 [Min Grade: C] and BST 625 [Min Grade: C] and BST 631 [Min Grade: C] and BST 632 [Min Grade: C] and BST 725 [Min Grade: C]

**BST 735. Advanced Inference. 4 Hours.**
Families of models; likelihood; sufficiency; significance tests; similar regions; point and interval estimation; invariant tests; asymptotic theory and large sample inference; LR, score and Wald tests; robust procedures will be studied.

**Prerequisites:** BST 632 [Min Grade: C] and BST 631 [Min Grade: C]

**BST 740. Bayesian Analysis. 3 Hours.**
To introduce the student to the basic principles and tools of Bayesian Statistics and most importantly to Bayesian data analysis techniques. A major goal is to establish a firm foundation in the discipline upon which the applications of statistical and epidemiologic inference will be built.

**Prerequisites:** BST 632 [Min Grade: C]

**BST 741. Advanced Bayesian Analysis II. 3 Hours.**
This course is intended to illustrate advanced Bayesian modeling and computation for variety of models and problems.

**Prerequisites:** BST 622 [Min Grade: C] and BST 632 [Min Grade: C]

**BST 750. Stochastic Modeling. 3 Hours.**
Poisson processes; random walks; simple diffusion and branching processes; recurrent events; Markov chains in discrete and continuous time; birth and death process; queuing systems; applications to survival and other biomedical models will be studied.

**Prerequisites:** BST 632 [Min Grade: C]

**BST 760. Generalized Linear and Mixed Models. 3 Hours.**
Generalized linear models; mixed models; and generalized estimating equations.

**Prerequisites:** BST 723 [Min Grade: C]

**BST 765. Advanced Computational Methods. 3 Hours.**
Numerical algorithms useful in biostatistics including likelihood maximization using the Newton-Raphson method, EM algorithm, numerical integration using quadrature and Monte-Carlo methods, interpolation using splines, random variate generation methods, data augmentation algorithm, and MCMC and Metropolis-Hastings algorithm; randomization tests; resampling plans including bootstrap and jackknife will be studied.

**Prerequisites:** BST 632 [Min Grade: C]

**BST 775. Statistical Methods for Genetic Analysis I. 3 Hours.**
This course will provide a statistical basis for describing variation in qualitative (disease) and quantitative traits. This will include decomposition of trait variation into components representing genes, environment and gene-environment interaction. Resemblance between relative and heritability will be described. Important topics of discussion will include oligogenic and polygenic traits, complex segregations analysis, methods of mapping and characterizing simple and complex trait loci. NOTE: It is assumed that students are comfortable with regression theory, covariance, correlation, and likelihood theory. Interested students are urged to contact the instructors with concerns regarding assumed knowledge.

**Prerequisites:** BST 623 [Min Grade: C] and BST 632 [Min Grade: C] and BST 675 [Min Grade: C]

**BST 776. Statistical Methods for Genetic Analysis II. 3 Hours.**
This course builds on the knowledge gained in BST 775 with rigorous mathematical & statistical treatment of methods for localizing genes and environmental effects involved in the etiology of complex traits using case-control and pedigree data. NOTE: Knowledge of SAS and programming languages such as C++, and basic knowledge of multivariate methods and Markov chain theory is highly recommended.

**Prerequisites:** BST 775 [Min Grade: C]

**BST 793. Post-doc Seminar Series. 3 Hours.**
BST seminar series. Permission of instructor / department required.

**BST 795. Advanced Special Topics. 1-3 Hour.**
This course is designed to cover advanced special topics in Biostatistics that are not covered in regular 700 level courses, but suited for doctoral students in Biostatistics.

**Prerequisites:** BST 622 [Min Grade: C] and BST 632 [Min Grade: C]

**BST 798. Non-Dissertation Research. 1-12 Hour.**
Non-dissertation research with the guidance of appropriate faculty. Research conducted before admission to candidacy for the doctoral degree. Biostatistics majors only or permission of instructor / department required.

**BST 799. Dissertation Research. 1-12 Hour.**
Doctoral Level Dissertation Research under the direction of the dissertation research committee. Reserved for Biostatistics only or permission of instructor /department. Admission to Candidacy required.

**Prerequisites:** GAC Z