Biostatistics

Biostatistics

Biostatistics is the science of applying statistical theory and principles to research in public health, medicine, biology, pharmaceuticals, environmental science, and other related fields.

DEGREES OFFERED:

• MPH in Biostatistics
• Ph.D. in Biostatistics

CERTIFICATES

• Applied Biostatistics

MPH IN BIOSTATISTICS

The MPH degree in Biostatistics is meant for students with moderate to strong quantitative backgrounds. The purpose of this degree is to provide additional training in statistical data analysis and study design generally not available with other MPH degrees. The target competencies of this concentration include:

• Explain and assess basic concepts of probability and statistical inference.
• Summarize public health data using descriptive biostatistical methods.
• Distinguish appropriate basic inferential statistical analyses and summarize their results.
• Produce tabular and graphical displays of data that effectively convey analytic findings.
• Manage standard statistical software to efficiently manage data structures.
• Summarize central concepts of statistical theory and inference.
• Apply standard statistical methods for the analysis of continuous data in a valid manner.
• Use analytic tools to describe and make inferences on categorical data in a valid manner.
• Communicate effectively, in writing and verbally, with substantive investigators and members of the community when assisting in the design of research studies as well as the results of statistical analyses.
• Discriminate situations where standard analytic tools can be applied from those problems where more complex methods are needed.
• Integrate and synthesize biostatistics knowledge, skills and abilities as demonstrated in the context of a culminating experience.

A typical student who graduates with an MPH in Biostatistics from WVU will be qualified to work as a biostatistical or research coordinator in research organizations such as a health department, pharmaceutical company, contract research organization (CRO), or a university.

PH.D. IN BIOSTATISTICS

The Biostatistics major of the Ph.D. in Public Health Sciences will provide students with a general background in not only public health and its related disciplines, but it will also allow students the opportunity to obtain in-depth knowledge and extensive experience in advanced and modern methods for data analysis. In addition, the Ph.D. in Biostatistics will provide students training and experience in collaborating in a health research environment as well as teaching biostatistics to students of varying backgrounds.

As part of the existing Ph.D. in Public Health Sciences, Biostatistics students will gain the following general competencies common to all students in the program, with additional competencies specific to the Biostatistics major:

GENERAL PH.D. IN PUBLIC HEALTH SCIENCES COMPETENCIES

• Develop effective strategies for teaching in higher education
• Review and synthesize pertinent literature and formulate focused research questions that address identified knowledge gaps
• Design and conduct original research that uniquely contributes to the public health scientific knowledge
• Disseminate research findings through appropriate peer-reviewed publications and presentations, and to other public health community audiences

BIOSTATISTICS MAJOR COMPETENCIES

• Assimilate the foundations of public health, including the physical, biological, and social behavioral/factors which affect the health of the community.
• Synthesize and illustrate principles of study design, estimation, statistical inference, and standard data analysis methods to students and researchers across various health disciplines
• Integrate the foundations of statistical theory and inference for estimation and testing of hypotheses in public health
• Discern gaps in current statistical methods that limit further public health research and propose solutions based on rigorous theoretical justification
• Synthesize new developments in the biostatistical literature to address relevant and challenging public health questions
• Evaluate research reports and proposals for research funding on the basis of their scientific integrity, validity, and the strength of the quantitative analysis
• Prepare reports of quantitative analyses for journal publication, presentations at scientific meetings, and grant applications

We expect graduates to obtain not only a deep knowledge of biostatistical theory and principles, but also a broad understanding of public health. Graduates will be trained and receive extensive experience in both consulting/collaboration as well as teaching, making them suitable candidates for careers in industry (for example, pharmaceutical companies, contract research organizations) or academia.

The required amount of credits for this degree is 117, of which 60 are didactic. The courses and the typical schedule may be different to allow for additional biostatistics specialization. This degree typically would take four years to complete.

**BIOSTATISTICS CERTIFICATE**

The Applied Biostatistics Certificate is designed for those individuals who lack formal training in biostatistics and would like to gain skills needed to understand and apply standard statistical techniques. It is an [online program](http://publichealth.hsc.wvu.edu) that is available to practitioners and/or students at WVU and elsewhere.

The primary objectives of the program are thus to:

• Describe basic concepts of probability and statistical inference
• Demonstrate standard techniques of database management and analysis
• Compare and contrast study designs common to health research
• Recognize the primary sources of bias observed in health research
• Interpret appropriate inferences from data based on strengths and limitations of major epidemiologic study designs as well as the results of descriptive and inferential statistical analyses

Individuals who would be interested in such a Certificate include clinical and translational researchers at varying levels of their career (faculty, fellows, residents, basic scientists) as well as public health practitioners, in the state of West Virginia or beyond. Interested individuals in the program should have a desire to be more self-sufficient with their research, specifically being able to know basic study design principles, analyze their data, and interpret their results.

The entire curriculum will be available both [online and in-person (live)](http://publichealth.hsc.wvu.edu), thus being accessible to individuals from a variety of backgrounds, locations, and experiences. The program will take advantage of existing course technology where courses are taught in a synchronous fashion in which the instructor lectures in-class, and the lecture (along with associated PowerPoint slides or other files, such as SAS programs) is broadcast online. While the lecture is available live during the lecture itself, the video or audio of the lecture is archived and available on the course for access at any time. All course notes, homeworks, programs, etc. are available online, and the instructor is available in a number of formats (online chat, email, phone) to accommodate distance-learning students.

Applied Biostatistics Certificate Program students will typically take one class per semester. Completion of the program will typically take two years.

Certificate Program students will pay tuition at the standard School of Public Health per-credit rate. Please visit the School of Public Health financial information link (http://publichealth.hsc.wvu.edu) for more information on current rates.

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**FACULTY**

**INTERIM CHAIR**

• Matthew J. Gurka - Ph.D. (University of North Carolina at Chapel Hill)

**PROFESSOR**

• George A. Kelley - DA (Middle Tennessee State University)

**ASSISTANT PROFESSORS**

• Christa L. Lilly - Ph.D. (Vanderbilt University)
• D. Leann Long - Ph.D. (University of North Carolina at Chapel Hill)
• Dustin M. Long - Ph.D. (University of North Carolina at Chapel Hill)
• Michael D. Regier - Ph.D. (University of British Columbia)
• Sijin Wen - Ph.D. (The University of Texas Health Sciences Center at Houston)
MPH in Biostatistics

ADMISSIONS GUIDELINES

• A baccalaureate degree from an accredited college or university with a preferred overall GPA of 3.0 and a GPA of 3.4 for quantitative courses
• Successful completion of multivariable calculus
• GRE scores of 150 (verbal), 155 (quantitative), 4.0 (analytical writing)
• TOEFL scores (minimum 550 paper-based) (minimum 213 computer-based)
• Computer skills are a program requirement. It is the responsibility of the students to become skilled in computer applications and to acquire the minimum software specifications required to be successful

TO APPLY FOR THE MPH IN BIOSTATISTICS

If you are ready to apply to West Virginia University School of Public Health, the admissions team is here to assist you. Our MPH Program is CEPH accredited, and our new School of Public Health is transitioning to be a CEPH-accredited school of public health as well.

We are also one of the schools participating in SOPHAS (Schools of Public Health Application Service). Our MPH Admissions process is a two-step process. All MPH applications must be submitted through the national SOPHAS service and applicants must also submit a WVU Graduate application.

In addition to the general application, applicants must submit to SOPHAS a statement of purpose and objectives, official GRE test scores, three letters of reference, a current resume/curriculum vitae, and all university transcripts. SOPHAS requires original transcripts from ALL U.S. institutions attended! (Even Study Abroad) Please see each Major’s website for additional application requirements.

There is a $120 SOPHAS application fee. Applicants must indicate their first choice of MPH major, and may also indicate a second choice. A maximum of two choices is allowed.

• E-submit your application as soon as the applicant entered information is complete. Do NOT wait for SOPHAS to receive transcripts, recommendations or test scores
• Plan Ahead! Allow up to 4 weeks for SOPHAS to verify grades, process and mail your application to your designated institutions after your documents have been received.

Applications that are complete will then be reviewed by the department. Students will receive a communication from the WVU School of Public Health regarding their recommendation for acceptance and instructions to complete the WVU Graduate application and pay the $60.00 WVU application fee.

Important: when sending GRE scores for consideration for admission at WVU use the GRE WVU School of Public Health College code: 0157. This is the code that MUST be used, otherwise your GRE score will not be reported to SOPHAS and your application will be incomplete and therefore will not be reviewed for an admissions decision. [There are different codes for other programs at West Virginia University]

All other degrees and certificate programs will use the WVU application system .

Ph.D. in Biostatistics

ADMISSIONS GUIDELINES

• Baccalaureate degree from an accredited college or university (preferred GPA: 3.00 overall; 3.4 for quantitative courses) or a Master’s degree from an accredited program or school in biostatistics, statistics, mathematics, or another quantitative field (preferred)
• GRE scores: 160 Quantitative, 150 verbal, and 4.0 for analytical writing.
• A completed Ph.D. application, including a Statement of Purpose
• Three letters of recommendation

TO APPLY FOR THE PH.D. IN BIOSTATISTICS

• Complete the WVU graduate application and submit with the processing fee (https://app.applyyourself.com/AYApplicantLogin/ApplicantConnectLogin.asp?id=wvugrad )
• Submit official school transcripts and official GRE scores to:

WVU Admissions and Records
PO Box 6009
Morgantown, WV 26506-6009
(304) 293-2121.
• Complete the Ph.D. application online and indicate BIOS as your preference (http://www.hsc.wvu.edu/resoff/hscresoff/publichealth/phapp.asp)
• Three academic letters of recommendation and CV/Resume, mailed to:

WVU School of Public Health
Ph.D. Admissions
PO Box 9190
One Medical Center Drive
Morgantown, WV 26506

Fall Admissions Only: Fully completed applications received by February 15 are considered.

Applied Biostatistics Certificate

ADMISSIONS GUIDELINES
• Baccalaureate degree from an accredited college or university with a preferred overall GPA of 3.0 (official transcripts required)
• GRE scores or a terminal degree (MD, Ph.D., etc.)
• Essay describing previous education and experience and career objectives
• Resume or curriculum vitae
• At least two letters of recommendation
• Computer skills are a program requirement. It is the responsibility of the students to become skilled in computer applications and to participate in the Health Sciences Center Mandatory Laptop Program (http://publichealth.hsc.wvu.edu/students/student-policies/student-computer-policy).
• The admissions process will include a 15-20 minute phone interview between the Biostatistics Certificate Admissions Committee and the applicant.

Students currently enrolled at WVU should fill out the admissions form for current students (http://publichealth.hsc.wvu.edu/academics/online-programs/applied-biostatistics-certificate/application-process) to apply for the Applied Biostatistics Certificate. Please contact Dr. Christa Lilly with questions or the completed form.

STUDENTS INTERESTED IN APPLYING FOR THE APPLIED BIOSTATISTICS CERTIFICATE MUST:
• Complete the WVU graduate application and indicate Applied Biostatistics Certificate and submit with the processing fee.
• https://app.applyyourself.com/AYApplicantLogin/ApplicantConnectLogin.asp?id=wvugrad
• Submit official school transcripts and official GRE scores to:

WVU HSC Admissions
1 Medical Center Drive
1170 HSC North
Morgantown, WV 26506

• International students must submit to:

WVU Admissions and Records
PO Box 6009
Morgantown, WV 26506-6009

Overview of MPH in Biostatistics Curriculum

Students in the MPH program in Biostatistics will complete a total of forty-three credit hours (sixteen credit hours of School of Public Health core courses, two credit hours of Seminar, nineteen credit hours of departmental required courses, and six credit hours of elective courses). The culminating experience, taken during the final semester, requires completing a consulting practicum (three credit hours) and submitting a paper and poster. This degree will typically take four semesters to complete.

MPH Core Courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS 610</td>
<td>Intermediate Biostatistics</td>
<td>4</td>
</tr>
<tr>
<td>EPID 601</td>
<td>Public Health Epidemiology</td>
<td>3</td>
</tr>
<tr>
<td>or EPID 610</td>
<td>Principles of Epidemiology</td>
<td></td>
</tr>
<tr>
<td>HPML 601</td>
<td>Foundations of Health Policy</td>
<td>3</td>
</tr>
<tr>
<td>OEH 601</td>
<td>Environmental Health</td>
<td>3</td>
</tr>
<tr>
<td>PUBH 696</td>
<td>Graduate Seminar</td>
<td>1</td>
</tr>
<tr>
<td>SBHS 601</td>
<td>Social and Behavioral Theory</td>
<td>3</td>
</tr>
</tbody>
</table>

Curriculum Concentration:
The Biostatistics curriculum of the Ph.D. in Public Health Science Program provides students with training and practical experience in advanced and modern quantitative methods. Statistical theory focusing on tools used in practice is presented in the first two years, along with a comprehensive foundation in public health. Students will be provided a balanced education that not only allows them to succeed in biostatistical research, but to excel in environments that emphasize collaboration and education.
# Curriculum Requirements

## Common Core Courses for the SPH Doctoral Program

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPID 710</td>
<td>Adv Principles-Epidemiology</td>
<td>3</td>
</tr>
<tr>
<td>EPID 711</td>
<td>Adv Epidemiologic Theory</td>
<td>3</td>
</tr>
<tr>
<td>PUBH course - Foundations of Public Health</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>BIOS 797</td>
<td>Research</td>
<td>15</td>
</tr>
<tr>
<td>BIOS 797</td>
<td>Research</td>
<td>15</td>
</tr>
<tr>
<td>BIOS 797</td>
<td>Research</td>
<td>15</td>
</tr>
<tr>
<td>BIOS 797</td>
<td>Research</td>
<td>15</td>
</tr>
<tr>
<td>C&amp;I 789</td>
<td>Teaching In Higher Education</td>
<td>3</td>
</tr>
<tr>
<td>PUBH 790</td>
<td>Teaching Practicum</td>
<td>3</td>
</tr>
<tr>
<td>BMS 700</td>
<td>Scientific Integrity</td>
<td>1</td>
</tr>
<tr>
<td>BMS 720</td>
<td>Scientific Writing</td>
<td>2</td>
</tr>
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</table>

## BIOS Required Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS 623</td>
<td>Biostatistical Consulting</td>
<td>1</td>
</tr>
<tr>
<td>BIOS 624</td>
<td>Consulting Experience</td>
<td>2</td>
</tr>
<tr>
<td>BIOS 700</td>
<td>Foundtns-Modrn Statstcl Infrnc</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 701</td>
<td>Modern Statistical Inference</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 720</td>
<td>Theory/Applicatn-Linear Models</td>
<td>4</td>
</tr>
<tr>
<td>OR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STAT 645</td>
<td>Linear Models</td>
<td>4</td>
</tr>
<tr>
<td>&amp; BIOS 745</td>
<td>and Adv Application-Linear Models</td>
<td></td>
</tr>
<tr>
<td>BIOS 721</td>
<td>Advanced Caregorical Data</td>
<td>4</td>
</tr>
<tr>
<td>BIOS 740</td>
<td>Adv Longitudinal Data Analysis</td>
<td>4</td>
</tr>
<tr>
<td>BIOS 788</td>
<td>Grant Writing-Biostatisticians</td>
<td>2</td>
</tr>
<tr>
<td>BIOS 796</td>
<td>Graduate Seminar</td>
<td>1</td>
</tr>
<tr>
<td>BIOS 796</td>
<td>Graduate Seminar</td>
<td>1</td>
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Select one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS 720</td>
<td>Theory/Applicatn-Linear Models</td>
<td>4</td>
</tr>
<tr>
<td>STAT 645</td>
<td>Linear Models</td>
<td>4</td>
</tr>
<tr>
<td>&amp; BIOS 745</td>
<td>and Adv Application-Linear Models</td>
<td></td>
</tr>
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</table>

## Elective Courses

<table>
<thead>
<tr>
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<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS 622</td>
<td>Analysis of Time-to-Event Data</td>
<td>1</td>
</tr>
<tr>
<td>BIOS 764</td>
<td>Bayesian Biostatistics</td>
<td>1</td>
</tr>
<tr>
<td>BIOS 765</td>
<td>Adv Structural Equation Models</td>
<td>1</td>
</tr>
<tr>
<td>STAT 547</td>
<td>Survival Analysis</td>
<td>1</td>
</tr>
<tr>
<td>STAT 745</td>
<td>Data Mining</td>
<td>1</td>
</tr>
<tr>
<td>STAT 761</td>
<td>Theoretical Statistics 1 **</td>
<td>1</td>
</tr>
<tr>
<td>STAT 762</td>
<td>Theoretical Statistics 2 **</td>
<td>1</td>
</tr>
<tr>
<td>STAT 763</td>
<td>Stochastic Processes</td>
<td>1</td>
</tr>
<tr>
<td>STAT 765</td>
<td>Stat Methods-Bioinformatics</td>
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<td>1</td>
</tr>
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Total Hours: 118

* Students with MS in Statistics or Biostatistics may be exempt from these courses
** Strongly recommended for students interested in an academic career.

## Suggested Plan of Study

### First Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Hours Spring</th>
<th>Hours Summer</th>
<th>Hours</th>
</tr>
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<tbody>
<tr>
<td>Fall</td>
<td>BIOS 700</td>
<td>3 BIOS 701</td>
<td>3 C&amp;I 789</td>
</tr>
<tr>
<td></td>
<td>EPID 710</td>
<td>3 BIOS 721</td>
<td>4 BMS 720</td>
</tr>
<tr>
<td></td>
<td>STAT 645</td>
<td>3 BIOS 623</td>
<td>1 BIOS 797</td>
</tr>
<tr>
<td></td>
<td>BIOS 745</td>
<td>1 BIOS 788</td>
<td>2</td>
</tr>
<tr>
<td>Course</td>
<td>Fall Hours</td>
<td>Spring Hours</td>
<td>Summer Hours</td>
</tr>
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</tr>
<tr>
<td>BIOS 601</td>
<td>3</td>
<td></td>
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<tr>
<td>BIOS 602</td>
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<td></td>
<td></td>
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</tr>
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<td>BIOS 610</td>
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<tr>
<td>BIOS 611</td>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td>BIOS 612</td>
<td>3</td>
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</tbody>
</table>

Total credit hours: 118

**COURSES**

**BIOS 601. Applied Biostatistics 1. 3 Hours.**
CoReq: BIOS 602. Introduces parametric and nonparametric statistical methodology, including descriptive measures, elementary probability, estimation, hypothesis testing, confidence intervals, common nonparametric methods, and base contingency table analysis. Empirically demonstrates underlying theory.

**BIOS 602. Applied Biostatistics Lab. 1 Hour.**
PR or CONC: BIOS 601. This course, taken concurrently with BIOS 601, introduces students to the use of statistical software (SAS, R) to perform basic analyses.

**BIOS 603. Applied Biostatistics 2. 3 Hours.**
PR: BIOS 601 and BIOS 602. Addresses estimation and hypothesis testing within the context of the generalized linear model. Examines multiple linear regression, logistic regression, survival analysis, and select advanced techniques. Emphasis on applied data analysis of health care studies.

**BIOS 604. Applied Biostatistics 3. 3 Hours.**
PR: BIOS 602 and BIOS 603. Focus on advanced methodological tools important in public health contexts. Topics include structural equation models and hierarchical linear models (mixed models, random-effect models), using relevant software packages.

**BIOS 605. Applied Biostatistics Capstone. 2 Hours.**
PR: BIOS 601 and BIOS 602 and BIOS 603 and BIOS 604 and consent. Students will work on a dedicated data analysis stemming from their own research or the work of others, culminating in a final research paper.

**BIOS 610. Intermediate Biostatistics. 4 Hours.**
Designed for students advanced mathematical background, focus is on mathematically sophisticated principles and methods of hypothesis testing, associations, one- and two-sample parametric and non-parametric tests. Includes real data set analyses on public health datasets.

**BIOS 611. Data Management and Reporting. 3 Hours.**
Introduction to statistical software for data management and analysis. Focus is on SAS for data management and analysis.

**BIOS 612. Pb Hlth Statisticl Inference 1. 3 Hours.**
Fundamental applications used in the field of public health including, probability, discrete and continuous distributions, functions, of random variables, descriptive statistics, fundamentals of statistical inference, including estimation and hypothesis testing.

**BIOS 620. Applied Linear Models HS. 3 Hours.**
PR: BIOS 611 and BIOS 612. Mathematically sophisticated introduction to the analysis of continuous data using applications related to public health, including multiple linear regression (selection of predictor variables, diagnostics), analysis of variance, and mixed models.
BIOS 621. Categorical Data Analysis HS. 3 Hours.
PR: BIOS 610 and BIOS 611. Introduction to the analysis of categorized data with a Health Sciences-Epidemiologic focus: rates, ratios, and proportions; relative risk and odds ratio; Mantel-Haenszel methods; logistic regression, Poisson regression, and other models for categorical data.

BIOS 622. Analysis of Time-to-Event Data. 3 Hours.
PR: BIOS 610 and BIOS 611. Introduction to modern methods for the analysis of time-to-event data (e.g., survival, cessation, and recidivism). Theory and application are emphasized; covering survival functions, hazard rates, inference, regression, model construction, stratification, time-dependent covariates, and clinical trials.

BIOS 623. Biostatistical Consulting. 1 Hour.
PR: BIOS 610 and BIOS 611. Focuses on the responsibilities of the biostatistician as a consultant. Discussion topics include consulting models, interpersonal communication, ethics, common client types, time management, and other issues.

BIOS 624. Consulting Experience. 2 Hours.
PR: BIOS 623. Students will gain practical experience in the Biostatistics Consulting Group, under the guidance of the faculty director of the group, to assist with general consulting for the HSC.

BIOS 628. Biostatistics Practicum. 3 Hours.
PR: Consent. Students will work in a collaborative setting for a minimum of 180 hours, applying sophisticated biostatistical principles and skills learned in classes to address research questions that arise in that setting.

BIOS 629. Apply BIOS-Pub Hlth Data: CAPS. 3 Hours.
PR: PUBH 622 and BIOS 628. Students will develop research question(s) pertaining to an available public health related data set, determine the public health relevance of that question, plan analyses and implement that plan, and determine public health impact of analysis results. Students will gain practical experience integrating biostatistics concepts within a public health issue.

BIOS 660. Applied Bioinformatics 1. 3 Hours.
PR: BIOS 610 and BIOS 611. Foundational methodological tools for analyzing molecular and population genetics are discussed in detail including methods for modeling genetic inheritance, linkage analysis, genetic association studies, family designs, SNPs analysis, gene interactions, and genome wide association studies.

BIOS 661. Applied Bioinformatics 2. 3 Hours.
PR: BIOS 612 and BIOS 660. The course will cover the fundamental methods that have been successfully applied in bioinformatics, such as supervised learning, unsupervised learning and multiple testing. Students will learn relevant programming languages and software.

BIOS 662. Statistics in Clinical Trials. 3 Hours.
PR: BIOS 610 and BIOS 611. Introduces concepts relevant to the design and analysis of clinical trials. Topics covered include protocol development, quality control, ethical considerations, determination of sample size, and interim analysis.

BIOS 663. Introduction to Meta-Analysis. 3 Hours.
PR: BIOS 603. An introduction to the quantitative analysis (meta-analysis) of data from systematic reviews, including (1) effect size and precision, (2) fixed versus random-effects models, (3) heterogeneity, (4) complex data structures, and (5) bias.

BIOS 691A-Z. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

BIOS 693A-Z. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.

BIOS 695. Independent Study. 1-6 Hours.
Faculty-supervised study of topics not available through regular course offerings.

BIOS 696. Graduate Seminar. 1 Hour.
PR: Consent. Each graduate student will present at least one seminar to the assembled faculty and graduate student body of his or her program.

BIOS 700. Foundtns-Modrn Statstcl Infrnc. 3 Hours.
PR: Consent. The foundations and application of advanced statistical theory used in the field of biostatistics will be presented, including likelihood theory with related estimation, asymptotic and inferential theory, and theoretical and computational procedures for missing data.

BIOS 701. Modern Statistical Inference. 3 Hours.
PR: BIOS 700 or Consent. Advanced statistical theory for biostatistics will be presented, including estimation theory, semi-parametric theory, asymptotic and inferential theory, and algorithmically based estimators and inference.

BIOS 720. Theory/Applicatn-Linear Models. 4 Hours.
PR: BIOS 700 or Consent. This is a theoretical course in linear models for continuous responses and their applications. Topics include matrix theory, the multivariate normal distribution, multivariate quadratic forms, estimability, linear restrictions, estimation theory, eighter least squares, multivariate tests of linear hypotheses, multiple comparisons, confidence regions, and missing data.

BIOS 721. Advanced Caregorical Data. 4 Hours.
PR: BIOS 700 or Consent. This course offers an advanced examination of statistical theory and application of methods for models with categorical response data; concepts include likelihood theory and application, general linear models theory and application, estimating equations and contingency table methods.
BIOS 740. Adv Longitudinal Data Analysis. 4 Hours.
PR: BIOS 720 or Consent. This course gives an advanced understanding and approach to the analysis of longitudinal data; concepts include linear mixed effects models, generalized linear models for correlated data (including generalized estimating equations), computational issues and methods for fitting models, and dropout or other missing data. Knowledge of an appropriate software package and basic matrix algebra is assumed.

BIOS 745. Adv Application-Linear Models. 1 Hour.
PR or CONC: STAT 645 or Consent. This course offers an understanding of advanced linear models as utilized in practice. Application of linear models across a range of research areas will be emphasized, covering computational techniques, practical issues that arise in utilizing linear models, and interpretation of results.

BIOS 746. Bayesian Biostatistics. 3 Hours.
PR: BIOS 700 or Consent. This course examines fundamental aspects of the Bayesian paradigm and will focus on Bayesian inferential methods with emphasis on biostatistics applications. Topics covered include: principles of Bayesian statistics; single-parameter and multi-parameter models; Bayesian linear and generalized linear models; Monte Carlo approaches to model fitting; Prior elicitation, with illustrations of a variety of computational methods.

BIOS 748. Grant Writing-Biostatisticians. 2 Hours.
This course gives an advanced conceptual and applied understanding of writing external grants in biostatistics. Topics include writing grants as a principal investigator and assisting others in grant-writing as a co-investigator, with a focus on NIH grants.

BIOS 790. Teaching Practicum. 1-3 Hours.
PR: Consent. Supervised practice in college teaching of BIOS. Note: This course is intended to ensure that graduate assistants are adequately prepared and supervised when they are given college teaching responsibility. It also provides a mechanism for students not on assistantships to gain teaching experience.

BIOS 796. Graduate Seminar. 1 Hour.
PR: Consent. Each graduate student will present at least one seminar to the assembled faculty and graduate student body of his or her program.

BIOS 797. Research. 1-15 Hours.
PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading will be S/U.)

BIOS 798. Thesis or Dissertation. 2-4 Hours.
PR: Consent. This is an optional course for programs that believe that this level of control and supervision is needed during the writing of students’ reports, theses, or dissertations.