

**Department of Biostatistics**  
**Graduate Student Handbook**  
**University of Alabama at Birmingham**  
**School of Public Health**  
**2017 - 2018**



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# DEPARTMENT OF BIOSTATISTICS UNIVERSITY OF ALABAMA AT BIRMINGHAM GRADUATE STUDENT HANDBOOK 2017-2018

## ADMINISTRATIVE ORGANIZATION

The Department of Biostatistics at the University of Alabama at Birmingham (UAB) is one of five departments in the School of Public Health: Biostatistics, Environmental Health Science, Epidemiology, Health Behavior, and Health Care Organization and Policy.

Dr. Lloyd Edwards is the Chair of the department, Dr. Jeff Szychowski is the Graduate Program Director, and Ms. Della Daniel is the department liaison to the graduate program. The department currently has 20 faculty members and 48 full-time staff. Members of the department conduct research in statistical methodology and applications, as well as in fundamental problems of modeling in biological systems. Much of the department's research is collaborative in nature involving projects from basic science, genetics, clinical medicine, public health, and other health-related areas, both within and outside of UAB. Grant support for faculty in the department fall into four broad areas: 1) applied grants involving the application of statistical methods to health-related issues, 2) statistical coordinating centers for large multi-center randomized clinical trials, 3) methodological grants advancing statistical techniques, and 4) training grants for preparing the next generation of statisticians.

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

## GENERAL INFORMATION

### **Admission to MPH, MS, MSPH, and PhD Programs**

Students in the graduate program are typically admitted in the fall semester of each academic year. Applicants for the MS and PhD programs are expected to have a strong foundation in mathematics. At the very minimum, they should have excelled in a 3-semester sequence of calculus or equivalent and a semester of linear algebra. Generally, applicants to the PhD must have a relevant Master's degree. The MSPH and MPH applicants should also be quantitatively oriented with background in calculus and linear algebra.

Application requirements include completion of the online application form, a non-refundable application fee, official transcripts from all undergraduate coursework and all prior graduate coursework, (International transcripts must be submitted to World Education Services (WES) or Educational Credential Evaluators (ECE) for an official course-by-course credential evaluation; document-by-document evaluations will not suffice), three letters of recommendation (submitted online), a statement of purpose, and Graduate Record Examination (GRE) scores. International applicants for whom English is not their first language are also required to submit TOEFL scores. Please note that the department has a competitive and ongoing admissions process that begins in January. Thus, it is recommended that prospective students submit completed applications as early as possible (especially if financial support is desired).

Minimum admission requirements include: a bachelor's degree from an accredited college or university with grade point average of 3.0 or better (on a 4.0 scale); a GRE score of 147 on verbal and 150 on quantitative for MS; for PhD, a GRE score in 70<sup>th</sup> percentile for both verbal and quantitative sections. For GRE exams taken prior to August 1, 2011, the PhD program requires a

minimum score of 1100 on the combined verbal and quantitative sections, with a verbal score of at least 550, a quantitative score of at least 550, and a score of 550 (or 3.5) on the analytic section; the MS program requires a minimum score of 1080 on the combined verbal and quantitative sections, with a verbal score of at least 400 and a quantitative score of at least 550, and a score of 3.5 on the analytic section. Applications that fail to meet no more than one of these criteria (prior GPA, verbal GRE score or quantitative GRE score) may be considered on a case by case basis. The department also requires an IELTS score of at least 6.5, or a TOEFL score of at least 80 for internet based test, (550 for paper based test) for all international students whose native language is not English. *Note that meeting minimum eligibility criteria does not guarantee admission to the program.*

### **Admission to MSPH Program**

Applicants should possess a relevant undergraduate, masters, medical or health science professional degree with sufficient background in mathematics as described above. They may be in their final years of training as residents or fellows or hold positions as faculty members. The GRE is required for applications to all MSPH programs in the School of Public Health. A minimum score of 147 on verbal and 150 on quantitative are recommended. GRE exams taken prior to August 1, 2011, a minimum score of 1080 on the combined verbal and quantitative sections, with a verbal score of at least 400 and a quantitative score of at least 550, and a score of 550 (or 3.5) on the analytic section are preferred. The GRE may be waived for applicants who have been pre-screened by the clinical investigator training grant committee of the School of Medicine. The applicant must produce three letters of reference and, if in training, practice, or employed full- or part-time, a letter stating that s/he will be guaranteed sufficient release time to be able to attend classes regularly and fulfill course requirements in a timely manner. A medical/health sciences mentor should be identified along with a setting where the student can gain experience in conducting clinical research. A faculty member within the School of Public Health will be assigned as an advisor based on the stated interests of the applicant.

### **Academic Advisors and Plan of Study**

The Graduate Program Director assigns each student a faculty member to serve as an academic advisor upon entering the program. The purpose of the academic advisor is to help students stay on track for their degree and to take the required courses in the proper order. This is important since many courses are offered in sequences and later courses cannot be taken without having had the proper prerequisites.

The student must complete a "Plan of Study" form during their first year, with the help of his/her academic advisor. The plan of study should include a list of all courses to be taken at UAB, including the required courses, electives, readings & research courses, transferred courses, and any other courses relevant to the student's research. The plan of study, and any subsequent changes in it, must be approved by the Graduate Program Director. The advisor will evaluate the progress in the plan of study each semester until all courses listed in the plan are completed.

As the area in which a PhD student wishes to complete their research becomes known, the student may approach a faculty member with special expertise or interest in the chosen area to be a dissertation advisor. It is highly recommended that the selection is made within six months after the successful completion of the qualifying examination (see below for additional information regarding the qualifying exam). The selection is done by mutual agreement between the student, the proposed research advisor, and the Graduate Program Director. Once the research advisor is selected, the research advisor will take over the responsibility for academic advising, with certain exceptions.

### **Transfer/Substitution/Waiver of Courses**

Previously earned graduate credit that has **not** been applied toward another degree (either at UAB or elsewhere) is eligible for transfer into the student's current degree program. No more than 12 semester hours of transfer credit can be applied to a degree program. If a student has previously taken required courses elsewhere that counted towards their degree requirements, up to 12

semester hours of course requirement may be waived. All transfers and waivers must be initiated by the student and require the approval of the Graduate Program Director and the Dean of the Graduate School. A "Transfer/Substitution/Waiver of Course Form" must be completed and submitted along with transcripts and a syllabus from the previous course to the Graduate Program Director and instructor of the course to be waived for approval. If approved by the Graduate Program Director and course instructor, the request will be forwarded to the Graduate School. All students should note the distinction between waiving credit hours and transferring credit hours. Only graduate credits that have **not** been applied toward another degree are eligible for transfer. If credit hours are waived, the student must still obtain the minimum number of credit hours required by the Graduate School [a minimum of 30 graduate credit hours of coursework for the MS degree and 51-72 graduate credit hours of coursework for the PhD]. No 700 level doctoral core requirements can be transferred, substituted, or waived.

A student must successfully complete with a grade of B or higher, transfer or substitution credits, or get official waiver for all required courses. **In no instances will a student be allowed to substitute another course from the Department of Biostatistics (such as Readings and Research, Special Topics, etc.) for a required course.** Students must initiate all requests and the requests must be completed within 5 years of completing the course used for transfer.

**Transfer/Waiving BST Core Courses:** Applicants with prior statistical education or an MS in statistics or biostatistics (not from UAB) are advised to enroll in the courses covered in the qualifying / comprehensive exam at UAB. Students can discuss with their academic advisor which courses are appropriate or eligible for transfer / waiver.

## **Seminars**

The department sponsors a seminar series. The goals of these seminars are: 1) to promote biostatistics, applied research, and biostatistical methodology; 2) serve as a learning opportunity for both students and faculty; 3) foster communication, collaboration, professionalism, and career development among all participants. Presentations are made by faculty, visiting professors, staff, students, and collaborating investigators. These seminars consist of one hour presentations and discussions of current research on both methodological developments and collaborative work with other researchers. Both local and visiting speakers (often of international renown) present. Departmental seminars are often videotaped and posted on the department website, along with a synchronous PowerPoint slide show of the presentation. This resource allows students to view and learn from past seminars. The department always welcomes suggestions related to the seminar series (e.g., speakers, topics, etc.). Students are also encouraged to attend other seminars in related areas within the School of Public Health, the School of Medicine, and the University at large.

**All students are expected to attend all departmental seminars, unless there is a conflict with course times.** Students enrolled in the MS and PhD programs are required to attend seminars, through the BST 691 course. MS students must enroll in BST 691 at least 4 semesters, and PhD students must enroll in BST 691 at least 6 semesters. These seminars are considered an essential part of the education of all students in biostatistics. The department recognizes that a student may not fully understand the content of every seminar. However, the cumulative effect of all such seminars is substantial, and is an integral part of the preparation toward the future role as a professional statistician. Students are also required to attend other seminars within the School of Public Health, the School of Medicine, and the university at large.

## **Statistical Consulting**

Regardless of the degree sought, an integral part of the training in biostatistics is to prepare students to be effective statistical consultants. MSPH, MS and PhD students are expected to collaborate with other biomedical researchers at UAB and provide statistical consulting under the supervision of the faculty. Each student has the opportunity to gain experience in applying statistics to real problems.

This experience is considered to be a vital part of the graduate program since it helps develop skills as a statistician, serves to increase understanding of the theory learned in the classroom, and prepares the student for summarizing statistical work to non-statistical audiences. All students should note that this is *not* a didactic course. Rather, this is intended to involve the student in an ongoing research project with the intent that no student should leave the program without some basic fundamental experience in actually applying statistics to real-world problems.

### **Leave of Absence**

A student who needs to take an extended leave of absence (more than 2 weeks) must contact the Graduate School and fulfill the requirements for leave of absence, in addition to getting permission from their advisor and the Graduate Program Director. Other than special cases, funding will be suspended during an extended leave of absence.

### **Academic Misconduct**

Both the School of Public Health and the Graduate School expect that students will obey the Honor Code (accessed at <http://www.soph.uab.edu/students/honorcode>). The Department of Biostatistics strictly observes these guidelines. The Graduate School has an extensive and explicit procedure for hearing charges of academic misconduct, which is detailed in the UAB Graduate Student Handbook (accessed at <http://catalog.uab.edu/student-handbook/>).

### **Grading Policy and Policy on Dismissal**

Academic excellence in the classroom and in research, and continuing professional behavior are required of all students. All students must maintain a minimum GPA of 3.0 in regular course work (courses that do not get a Pass/Fail grade). If the GPA falls below 3.0, the student will be placed under probation for a maximum of two semesters (excluding summer). The student must maintain a 3.0 average in each of those two semesters, and the cumulative GPA at the end of the second semester must be brought up to at least 3.0. Failure to meet these criteria will result in the student being recommended for dismissal.

Any student who receives a grade of “F” in any biostatistics core course will be removed from the program immediately. Any student who receives a grade of “C” in any biostatistics core course will be placed on academic probation for a maximum of two (excluding summer) semesters. Within that time he/she must retake the course and obtain a grade of B or higher. Failure to improve the grade within two semesters will result in the student not being permitted to continue in the program.

Any student who obtains an incomplete grade (“I”) will have one semester to complete the requirements to obtain a grade in the course. If work is not completed in that time, the grade will automatically be changed to “F”.

### **Financial Support**

The department is not able to guarantee funding for all students. However, there are many on-campus part-time employment opportunities with on-going research projects across campus that are available to qualified students with experience in statistical analysis. Within reason, the department will work with all students in order to assist them with finding a funding source for their studies.

Fellowships, Traineeships, and/or Assistantships are awarded to well-qualified students. The financial support of a fellowship or traineeship typically consists of (i) an annual stipend of \$22,032 paid over 12 months, and (ii) tuition, fees, and health insurance paid by the department directly to your student account. The financial support of an assistantship typically consists of (i) an annual stipend of \$21,000 paid over 12 months, and (ii) \$7,000 additional funds to assist with tuition and etc. (paid as additional salary to the student in two installments in August and January, \$3,500 each month). The financial support is intended to help full-time students in the graduate program. Accordingly, (i) students must register as a full-time student in approved graduate courses each

semester (9 hours in the Fall, 9 hours in the Spring, and 9 hours in the Summer, or a total of 27 credit hours per academic year and successfully complete the studies) and (ii) students may not engage in any other remunerated activities either on or off campus (exceptions to this rule are rare and require prior approval in writing). In order to continue receiving financial support students must remain in good standing, continue making satisfactory progress towards their degree, and perform their work in a satisfactory manner. Should the faculty responsible for the funding source determine that a student fails to meet any of these criteria, he/she forfeits the award.

***A research assistantship requires the student to devote approximately 20 hours per week average effort on research/teaching projects under the supervision of a faculty mentor.*** Students must be enrolled full-time in order to maintain a research assistantship. This requires the student to take at least 9 credit hours in the Fall, 9 hours in the Spring, and 9 hours in the Summer, or a total of 27 credit hours per academic year and successfully complete the studies. Assistantship appointments are typically for one year at a time.

***A student fellowship does not require any work effort.*** A student on Fellowship is required to take 9 hours in the Fall, 9 hours in the Spring, and 9 hours in the Summer, or a total of 27 credit hours per academic year and successfully complete the studies.

### **Reclassification of Residency**

The School of Public Health allows the reclassification of residency for tuition purposes for students receiving institutional support as a graduate, teaching, or research assistant employed within the School of Public Health. Students who wish to take advantage of this should complete a *Reclassification of Residency Form*. The reclassification will be good for one semester. The Dean's office will need to verify the student's employment status for future semesters. If the student is no longer employed as a graduate assistant in the capacity in which he/she was approved, the Dean's office will inform the Graduate School and the student will be responsible for out-of-state tuition.

### **Computer Access**

All incoming students will be required to have a laptop. Please review the enclosed ***School of Public Health Guidelines for Student Laptops*** memo for laptop specification details. If you have questions regarding the laptop guidelines, please contact Robbie Nix at [sophsupport@uab.edu](mailto:sophsupport@uab.edu). In addition, there is a computer lab located on the first floor of the Ryals building.

### **Desk Space**

Limited space is available for graduate students. Priority is given to students who are supported by a traineeship or assistantship. Space allocations are reviewed each semester and are renewed in August. However, designated space can be reassigned at any time as needed.

### **Forms**

The department administrator maintains copies of most forms necessary for the graduate programs. A complete listing of most forms that will be required is provided at the end of this document. These forms can also be obtained at the graduate school website: <http://www.uab.edu/graduate/online-forms>.

### **Visiting Professors Program**

The Department has a well established visiting professors (VP) program. This program involves individuals coming for both short-term visits (e.g. several days) as well as long-term visits (e.g., several months). These VPs are generally well-established senior individuals. Such VPs not only serve as an outstanding source of education, but they also serve as an outstanding source of inspiration for trainees.



## Journal Clubs

The Department sponsors a monthly journal club. For each journal club, a student, post-doctoral fellow, or faculty member chooses an article and leads the discussion. This discussion generally involves a brief review of the article and related topic issues. The goals of the journal clubs are: 1) Enable students to become comfortable reviewing the statistical literature regarding theoretical and applied biostatistics, 2) Allow students to select review material, coordinate the review with a faculty member, and lead the session (which involves learning how to critically evaluate the statistical literature), 3) Improve knowledge of tools and resources available to students, 4) Keep up to date on the current literature, and 5) to foster a relaxed faculty-student learning environment. **All students are expected to attend departmental journal clubs, unless there is a conflict with course times. All PhD students are expected to lead at least one journal club during their studies.**

## Awards

Since 2002, the department has awarded the Janet L. Norwood Award, an annual award for outstanding achievement by a woman in the statistical sciences. Dr. Norwood was the first female commissioner of the U.S. Bureau of Labor Statistics and is Past-President of the American Statistical Association.

In 2008, the department implemented the Charles R. Katholi Distinguished Dissertation Award. The Katholi Award is presented to a student graduating with a doctoral degree during the previous academic year who demonstrates superior performance in academics, knowledge in biostatistics, and overall contributions to student life in the department. Each fall, the Norwood Award winner delivers a lecture at UAB. Both awards are presented in conjunction with this lecture. **All students are invited and encouraged to attend and the ceremony counts towards seminar credit as outline above.**

## **Department of Biostatistics Qualifying/Comprehensive Exam**

Upon completion of the first year-and-a-half of course work, MSPH, MS, and PhD students are given a written exam in Applied Statistics (MSPH, MS, PhD) and Theory of Statistics (MS, PhD). 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, 622, 623, 626, and 655 (Applied) and 631, 632 (Theory). This will be a standard departmental exam, administered by the GPC. This examination is offered during the first half of January. At first attempt, a student must take both parts at the same time. (See below for more information regarding specifics for each degree program.)

The objectives for the exam are to ensure that a successful student should be able to demonstrate the following towards their degree competencies:

- An ability to write clearly and concisely
- An ability to demonstrate in the theory exam and seek out in the applied exam both primary and secondary sources of information to support an argument
- An ability to defend, logically and clearly, their reasoning
- An understanding of the principles of statistical problem solving
- In addition, if a student is asked to revise a question: the ability to express themselves clearly and concisely in both written and oral argument

The criteria for evaluation are the student 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

## THE MPH PROGRAM

The MPH degree in biostatistics is intended primarily for those who wish to acquire an MPH degree with an emphasis on statistical methodology. This can include individuals from decision-making positions in health care settings as well as those interested in data management, statistical analyses and interpretation, and presentation of analytical results. This degree can be completed in approximately 2 years. Note that the MPH does not require some of the theoretical courses required for the MS, and as such, it is not a direct route to prepare a student for a PhD. **Students anticipating that they will wish to continue for a PhD in biostatistics are advised to pursue the MS rather than the MPH.**

### **Required Courses: MPH in Biostatistics**

### **Credit Hours**

			<b><u>43-44</u></b>
MPH Core:	BST 621	Statistical Methods I	3
	BST 622	Statistical Methods II	3
	ENH 600	Fundamentals of Environmental Health Science	3
	EPI 600	Introduction to Epidemiology	3
	or		
	EPI 610	Principles of Epidemiology Research	4
	HB 600	Social and Behavioral Sciences Core	3
	HCO 600	Introduction to Public Health Systems and Population-Based Health Programs	3
	PUH 695	Public Health Integrative Experience	1
	PUH 627	Writing and Reviewing Research for MPH	3
	PUH 697	Internship in Biostatistics	3
Biostatistics Core:	BST 619	Data Collection and Management	3
	BST 626/Lab	Data Management/Reporting with SAS	3
Biostatistics Electives:	Minimum 9 credit hours of regular courses of 623 or higher-level.		
Outside Electives:	A minimum of 3 graduate credit hours of electives must be taken from some field of Biology, Public Health or Medicine. The academic advisor must approve these courses.		

### **MPH Competencies**

Core CEPH Competencies in Biostatistics for all MPH Students (All are covered in BST 601, or BST 621-622):

1. Apply design and analytical methods to describe, implement, evaluate, and interpret research addressing public health concerns.
2. Identify how environmental and occupational hazards impact health.
3. Apply legal and ethical principles in public health research and practice.
4. Communicate public health issues, research, practice, and intervention strategies effectively.
5. Design public health programs, policies, and interventions, including planning, implementation, and evaluation.

6. Discuss the history and structure of public health systems.
7. Assess public health concerns in diverse cultures and communities.

#### Core CEPH Competencies for MPH Students with a focus in Biostatistics:

1. Apply descriptive and inferential methodologies according to the type of study design for answering a particular research question
2. Understand issues of data collection, analysis and study management
3. Effectively communicate research results orally and in writing across the spectrum of scientific venues
4. Critically evaluate published research
5. Utilize common computer programs to aid in analysis, description, and presentation of statistical data and results
6. Understand the courses and means of control of infectious and chronic diseases
7. Gain experience in public health service and research

### **The MPH Non Coursework Requirements: The Internship**

As a student in the MPH program, you are required to complete three credit hours of an internship experience. The internship is a field experience which bridges professional academic preparation and public health practice. Knowledge and skills learned in coursework are applied in an agency setting under the supervision and guidance of an experienced public health specialist. You may check with the school's internship coordinator or the school's website at <http://www.soph.uab.edu/fieldplacementsfor> for internship opportunities. Faculty research projects are not appropriate venues for an internship, nor are positions which are primarily administrative or focused on data management.

#### **Registering for Internship Experience**

Before the hold on the internship course can be lifted, we require that the internship description and agreement form is completed and on file. This form is to be completed in the online internship database Intern Track. You can log in to this program with your BlazerID and password at [www.soph.uab.edu/intertrack](http://www.soph.uab.edu/intertrack). Your faculty advisor and site supervisor will also be required to sign off on this document, so it is important that you communicate with them as you complete the form, and do not wait until the deadline to register. A hyperlink allowing you to formally request the hold to be lifted will become active once all the signatures are on file.

You should register under your academic advisor for BST 697 – Internship in Biostatistics. For three credit hours, you are expected to spend a minimum of 240 hours during the 12 weeks working for the agency. The internship must be completed in one semester, and all hours must be completed by the last day of exams. You are required to complete your core course work before registering for internship hours. Credit cannot be applied retroactively to work you have done prior to registering for the internship. Students should feel free to contact the Graduate Program Director or Internship Coordinator if they have any questions or problems during the summer.

## **Grading and Requirements**

The internship is a pass/no pass course. Your grade will be assigned by your faculty advisor based on the completion of all the components below. All forms related to the MPH internship will be completed in the Intern Track program.

- Internship Description and Agreement Form
- Midpoint Meeting Form, and confirmed meetings with the faculty advisor and site supervisor
- Final student evaluation
- Final student paper
- Completion of poster and attendance at the internship poster session
- Evaluations (Midpoint and Final) from the site supervisor
- Any additional product required by your internship site

*Midpoint meeting:* You will be required to complete a midpoint form halfway through your internship. This is to prompt your reflection on the internship to that point, and steps to make the remainder of the internship a success. You will set up times to individually meet with your faculty advisor and site supervisor; use the midpoint form as a guide for your conversation. If you are not able to meet in person, discussions via telephone, email, or Skype will be accepted. Your faculty advisor and site supervisor will need to confirm the meeting took place in the Intern Track system.

*Internship Poster Session:* At the end of the internship, prior to the end of exams for that semester, a poster session will be held to showcase the internships completed during that semester. You will receive additional instructions on creating your poster prior to the event. Attendance is mandatory, as it is a required component to the internship experience. Limited exceptions will be made for students completed internships out of the state or country or that are completing the MPH program online.

For complete internship requirements please check out the syllabus on the UAB School of Public Health website:

<https://www.soph.uab.edu/fieldplacements/sites/edu.fieldplacements/files/Internship%20Syllabus%2003.16.17.pdf>.

## **MS, MSPH, and PHD PROGRAMS**

**All students enrolled in the MS, MSPH, and PhD programs** must participate in the 37 hour self-paced online course entitled "Overview of Public Health". This course must be completed by the students second semester of program enrollment. Registration will be flagged until this requirement is completed. Students with prior public health education (course work in each public health core discipline) or experience (5 years experience in public health) may be waived from this requirement (this is rare). Please contact Cheryl Johnson, Director of Student Services for the School of Public Health, for waiver information.

**All students receiving financial support (for any degree),** must complete the INDIVIDUAL DEVELOPMENT PLAN (IDP) RESOURCES program. Information on the program will be provided annually at student orientation and during an annual student meeting.

## **THE MSPH PROGRAM**

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. The MSPH in Biostatistics is an applied statistics degree with a focus on Public Health.

This program is open to all qualified applicants with relevant undergraduate, masters, medical or health science professional degree. For fellows and faculty members interested in developing skills required for clinical research, this program is an ideal post-medical or other health science degree training program. 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.

## **MSPH Competencies**

### **Core CEPH Competencies in Biostatistics for all MSPH Students**

1. Design, conduct, and evaluate research studies
2. Understand issues of data collection, analysis and study management
3. Demonstrate an understanding of the ethics of scientific research
4. Formulate a proposal for a research study, present it, and revise it appropriately for implementation
5. Effectively communicate research results orally and in writing across the spectrum of scientific venues
6. Critically evaluate published research
7. Demonstrate expertise in a area of specialization

### **Core CEPH Competencies for MSPH Students with a focus in Biostatistics**

1. Identify and apply appropriate descriptive and inferential statistical methodologies according to the type of study design for answer a particular research question
2. Effectively communicate statistical methods and research results orally and in writing across the spectrum of scientific venues to biostatisticians and non-biostatistician public health professionals
3. Critically evaluate the design of research studies, data collection methods, analysis methods, and results of published research

4. Utilize common computer and statistical programs to analyze, describe, and present statistical data and results
5. Demonstrate an understanding of the ethics of statistical aspects of scientific research
6. Demonstrate application of biostatistics in an area of specialization by designing a proposal for a research study, performing the analysis and providing a written presentation of the results
7. Identify and apply appropriate descriptive and inferential statistical methodologies according to the type of study design for answer a particular research question
8. Effectively communicate statistical methods and research results orally and in writing across the spectrum of scientific venues to biostatisticians and non-biostatistician public health professionals
9. Critically evaluate the design of research studies, data collection methods, analysis methods, and results of published research
10. Utilize common computer and statistical programs to analyze, describe, and present statistical data and results
11. Demonstrate an understanding of the ethics of statistical aspects of scientific research
12. Demonstrate application of biostatistics in an area of specialization by designing a proposal for a research study, performing the analysis and providing a written presentation of the results

### **Required Courses: MSPH in Biostatistics**

The MSPH in Clinical and Translational Science consists of a minimum of 41 credit hours. Of these, 20 hours are required, including 15 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 3 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.

<b>Coursework</b>			<b>Credit Hours</b>
<b><u>Required Core Courses</u></b>			<b><u>41</u></b>
Biostatistics Core:	BST 621	Statistical Methods I	3
	BST 622	Statistical Methods II	3
	BST 623	General Linear Models	3
	BST 625	Design and Conduct of Clinical Trials	3
	BST 655	Categorical Data Analysis	3
	EPI 607	Epidemiology of Clinical Research	3
	EPI 680	Topics in Clinical Research (P/NP) <sup>1</sup>	2

### **Masters Research Electives<sup>2</sup>**

A minimum of **9** credit hours taken from the following courses (selected by faculty advisor and student):

BST 619	Data Collection and Management	3
BST 626/Lab	Data Management/Reporting with SAS	3
ENH 650	Essentials of Environmental and Occupational Toxicology and Diseases	3
EPI 625	Quantitative Methods in Epidemiology	3

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<sup>2</sup> Care must be exercise when selecting these courses since some have prerequisites that must be taken earlier in the sequence of classes or taken concurrently.

EPI 703	Grant Proposal Writing	3
HB 624	Advanced Theory and Practice in Behavioral Science	3
HCO 677	Patient-Based Outcomes Measurement	3

Biostatistics Electives: Minimum 3 credit hours of regular BST courses of 623 or higher-level. With approval of the advisor, courses included in the research electives that are not taken to meet that requirement may be taken as part of the focus specific electives.

Masters Project Research: Minimum 9 credit hours of supervised research in clinical setting (BST 698).

### **MSPH Comprehensive Exam**

Upon completion of the first year-and-a-half of course work, the candidate is given a written examination consisting of one part - Applied 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, 622, 623, 626 and 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. For those years during which at least three students needs to take the exam, 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 must pass the Applied Exam at the Masters level. If a student fails the exam, one additional chance will be given to retake the exam. A student who fails the qualifying exam more than once will be dismissed from the MSPH program. The student has the opportunity to appeal the decision of his/her dismissal to the Graduate School. The Graduate School policies on dismissal from the program and appeal of dismissal are described in detail in the UAB Student Handbook.

### **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.

## **THE MS PROGRAM**

The MS degree in Biostatistics is intended primarily for those who wish to acquire a master's degree with an emphasis in statistical methodology. Generally, students who anticipate a career performing data management and statistical analysis would enroll in the MS program. Further, the MS program is the appropriate program to prepare students to enter the PhD. Successful completion of this degree requires a GPA of 3.0 or better, passing the comprehensive examination at the MS level, completion of a master's project under the direction of an advisor with committee approval, and oral and written defense of this project.

### **Required Courses: MS in Biostatistics**

**Credit Hours**  
**46**

Biostatistics Core:	BST 621	Statistical Methods I	3
	BST 622	Statistical Methods II	3
	BST 623	General Linear Models	3
	BST 626	Data Management / SAS	3
	BST 631	Statistical Theory I	4
	BST 632	Statistical Theory II	4
	BST 655	Categorical Data Analysis	3
	BST 691	Biostatistics Predoctoral Seminar Series	4
Biostatistics Electives:	Minimum 6 credit hours of regular courses of 624 or higher-level. For those students planning to go on for the PhD, it is a good idea to take more advanced biostatistics courses as electives. <b>BST 665 - Survival Analysis is highly recommended.</b>		6
Outside Requirement:	EPI 610 - Principles of Epidemiological Research		4
Outside Electives:	A minimum of 3 additional graduate credit hours of electives must be taken from a non-quantitative field (i.e. Biology, Public Health or Medicine). The academic advisor must approve these courses.		3
Readings & Research:	Minimum 6 credit hours of Non-Thesis Research.		

### **MS Competencies**

1. Apply descriptive and inferential methodologies according to the type of study design for answering a particular research question
2. Understand issues of data collection, analysis and study management
3. Propose and complete research project appropriate for addressing a specific research question in statistics or in an applied field
4. Effectively communicate research results orally and in writing across the spectrum of scientific venues
5. Critically evaluate published research

### **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, 622, 623, 626, 631, 632 and 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 three students needs 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 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 to the Graduate School. 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 School of Public Health.

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.

### **Summary of Steps to the MS Degree**

- Step 1. The student must successfully complete all of the core courses.
- Step 2. The student must pass the qualifying exam at the master’s level.
- Step 3. Working with their chosen research advisor, the student should select a research committee and conduct a research project.
- Step 4. The student prepares and submits a final written summary of the project to the department and presents the work orally in a departmental seminar.

MS students are generally expected to complete all degree requirements within **5 years of matriculation**. One extension of this time limit can be requested when mitigating circumstances preclude completion of the requirements within 5 years. The recommendation for an extension should include a plan and timeline for completion. Such requests require the approval of the Graduate Program Director and must be presented in writing to the Dean of the Graduate School for consideration and approval. Courses taken more than 5 years before graduation may not be applied towards the degree without the approval of the Graduate Program Director and Dean of the Graduate School.

### **Pathway from UAB MS to PhD**

Students who excel in the UAB Biostatistics MS program may apply for admission to the UAB Biostatistics PhD program. This request should occur after demonstrating excellence in the core courses in the MS program and successful completion of both parts of the comprehensive exam at the PhD level. While not required, students are strongly advised to graduate with the MS degree before transferring to the PhD program (details below). Formal application to the PhD program allows for the student to be eligible for new PhD student status including fellowships not available to those simply transferring degree programs. Formal procedures for advancing to the PhD program include the following steps:

1. Successful completion of the comprehensive exam at the PhD level

2. Maintain a 3.0 GPA in all MS coursework
3. Formal application to the PhD program through UAB, including letters of recommendation
4. Request transfer or waiving of specific course credits
  - a. The student must complete a minimum of 51 credit hours in residence for successful completion of the PhD credit hours. The core courses for the MS program (BST 621, 622, 623, 626, 631, 632, 655 and EPI 610) are also core courses for the PhD program. Students are not required to retake these courses. The Department will request a formal waiver for these core courses.
  - b. Up to 12 credit hours earned in the MS program may be transferred and counted towards the PhD as long as they were not counted towards the MS degree. These courses cannot include the waived BST core courses and cannot be 700 level courses.
  - c. The UAB Graduate School outlines the minimum required 51 credit hours to be divided into 27 coursework hours and 24 research hours. We recommend:
    - i. BST 665 Survival Analysis (3 hours)
    - ii. BST 691 Biostatistics Predoctoral Seminar Series (6 hours)
    - iii. BST 723 Theory of Linear Models (3 hours)
    - iv. BST 735 Advanced Inference (4 hours)
    - v. BST 760 Generalized Linear and Mixed Models (3 hours)
    - vi. BST 765 Advanced Computational Methods (3 hours)
    - vii. Minimum 9 credit hours of 700 level courses (9 hours)
    - viii. A minimum of 3 additional graduate credit hours of electives must be taken from a non-quantitative field (i.e. Biology, Public Health or Medicine). The academic advisor must approve these courses.
    - ix. Minimum 24 hours of BST 799 (after PhD candidacy is approved) (24 total hours)

Exceptional students may also transfer to the PhD program without completing the MS degree. Students must excel in the MS program, with a 3.0 GPA, pass the comprehensive exam at the PhD level for both exams, and submit an application to the Biostatistics Admissions Committee for review prior to transfer of degree program. The application should contain a statement of interest from the student detailing why they would like to change programs and 3 letters of reference from faculty at UAB.

## **THE PHD PROGRAM**

The PhD degree in biostatistics provides a balance between theory and application. In addition to providing students with an in-depth understanding of statistical theory and methodology, the main objectives of the program are to train students to become independent researchers, effective statistical consultants and collaborators in scientific research, and effective teachers.

### **Required Courses: PhD in 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 an MS degree in Biostatistics from UAB during their PhD program, 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 students are required to take the following courses.			<b>Credit Hours</b>
			<b><u>88</u></b>
Biostatistics Core:	BST 621	Statistical Methods I	3
	BST 622	Statistical Methods II	3
	BST 623	General Linear Models	3
	BST 626/Lab	Data Management/Reporting with SAS	3
	BST 631	Statistical Theory I	4
	BST 632	Statistical Theory II	4
	BST 655	Categorical Data Analysis	3
	BST 665	Survival Analysis	3
	BST 691	Biostatistics Predoctoral Seminar Series	6
	BST 723	Theory of Linear Models	3
	BST 735	Advanced Inference	4
	BST 760	Generalized Linear and Mixed Models	3
	BST 765	Advanced Computational Methods	3
Graduate School Requirement:	GRD 717: Principles of Scientific Integrity -or- HCO 670: Social and Ethical Issues in Public Health		3
Biostatistics Electives:	Minimum 9 credit hours of 700 level courses		9
Outside Requirement:	EPI 610 - Principles of Epidemiological Research		4
Outside Electives:	A minimum of 3 additional graduate credit hours of electives must be taken from a non-quantitative field (i.e. Biology, Public Health or Medicine). The academic advisor must approve these courses.		3
Readings & Research:	Students are strongly recommended to take Research in Statistics (BST 698) under various faculty members every semester after completion of the first-year equivalent of course work, until a research advisor is chosen.		
Biostatistics PhD Research:	Minimum 24 hours of BST 799 (after PhD candidacy is approved)		24

### **PhD Competencies**

In addition to the MS competencies, PhD graduates should acquire these additional competencies:

1. Explain the theoretical justifications for statistical methodologies.
2. Apply statistical techniques with rigorous evaluation of any required distributional assumptions.
3. Design scientific investigations with collaborators.
4. Critically evaluate the statistical literature relevant to a specific statistical method or design.
5. Write publishable articles that advance public health and/or statistical theory/methodology.

### **Residence Requirement**

Although there is great variation, the usual minimal period in which the doctoral degree can be earned is three academic years of full-time study. The nature of doctoral study requires the closest contact between the student and the faculty of the graduate program, and the individual investigation or other special work leading to the dissertation must be done directly under the guidance and

supervision of a regular member of the UAB graduate faculty. Therefore, doctoral students must be involved in full-time doctoral study for at least one academic year (two semesters).

### **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, 622, 623, 626, 631, 632 and 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 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 to the Graduate School. 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.

### **PhD Dissertation Committee**

Upon successful completion of the qualifying exam at the doctoral level and identifying a dissertation topic, the student and his/her research advisor should form a dissertation committee consisting of at least five members (including the advisor). This committee should consist of at least five graduate faculty members, one of whom should be from outside the department of biostatistics. Each member of the committee should be able to bring some relevant insight and expertise to guide the student. The research advisor serves as the chairperson of this committee. All members of the committee must have a graduate faculty appointment (adjunct, ad-hoc, or full graduate faculty status). If a faculty member from another department is asked to serve on a committee, they will need to obtain graduate faculty status (unless they already have it in their department). If a faculty member outside of UAB will serve on the committee, the department will need to request an ad-hoc

appointment through the Graduate School. In either situation, the process for this includes submitting a memo requesting adjunct or ad-hoc status from the Graduate Program Director along with a current CV. Recommendations for graduate study committee members are submitted by the advisor and the student to the Graduate Program Director, who must approve the committee and submit the list to the Dean of the Graduate School for approval and formal appointment. Graduate study committee appointments are made by the Dean of the Graduate School, who is an *ex officio* member of all graduate study committees. The dissertation committee should meet periodically to monitor the student's progress during the conduct of the research.

### **Dissertation Proposal and PhD Oral Examination**

After forming a graduate committee, the student should present and prepare a written proposal to their committee for suggestions/approval. The whole committee must approve the proposal, not just the advisor. This is to ensure that the work is novel, feasible, and significant. The word "novel" here is important. A dissertation must add to the body of knowledge in biostatistics, meaning that a careful review of the existing literature on the chosen subject is necessary. It would be very unfortunate to get to the last stages of your work and to have someone suddenly point out to you that it had already been done! During the early stages of the research, it may be useful for the student to register for readings courses (BST 798) under the direction of the research advisor. The purpose of such courses is to review the literature for the research area of interest in order to help the student formulate a research problem.

After a literature survey and a clearer definition of the scope of the proposed research under the direction of the advisor, the student must submit a written proposal and **present it orally to the dissertation committee**. The dissertation proposal is closed to the general public and should be attended only by the dissertation committee. The committee may approve unconditionally, approve conditionally, or disapprove the proposal. The oral presentation also represents the oral doctoral exam. As such, a student is expected to demonstrate a good understanding of materials relevant to the general field in which the dissertation is written. The format of the questions for the proposal is left to the discretion of the committee. The outline and the organization of the proposal must follow the graduate school requirements described in the UAB Graduate Student Handbook. The Dissertation Committee and the Graduate Program Director will recommend the student to the Graduate School Dean for admission to candidacy. The committee meeting at which candidacy is discussed must be scheduled through the Graduate School to allow the Dean to attend. If the proposal is not approved, the student may be given only one other opportunity to re-present the proposal and it must be done within six months of the first attempt. You must be registered for at least 3 hours in the semester in which you present your project proposal to your committee. Doctoral students who have not attained candidacy by December 31, 2012, and are using the 3-paper format for their dissertation are required to submit at least one paper from the student's dissertation to a peer-reviewed journal on or before the date of the dissertation defense.

### **Annual Presentation**

All PhD students are required to give an oral presentation annually to the Department. This can be fulfilled through the Dissertation Proposal or Defense, or through other Departmental seminars.

### **Admission to Candidacy for the PhD Degree**

Admission to candidacy is an important step forward in the student's pursuit of the doctorate. By this step, the dissertation committee indicates its confidence that the student is capable of completing the proposed research project and the doctoral program.

Once the student has (1) passed the qualifying exam at the doctoral level, (2) written a formal dissertation proposal, and (3) had the dissertation proposal approved by the dissertation committee as an acceptable proposal for research, the committee will recommend to the Dean of the Graduate School that the student be admitted to candidacy. This requires that the student file an "Admission

to Candidacy” form with the Graduate School (this deadline is at the beginning of each semester, no exceptions). A student must be in good academic standing to be admitted to candidacy. **Admission to candidacy must take place at least two semesters before the expected completion of the doctoral program.** Students must be admitted to candidacy before they can register for dissertation research hours (BST 799).

### **Application for Degree**

Each candidate for a doctoral degree must signify the intention to complete the requirements by a particular graduation date by submitting a completed ‘Application for Degree’ form. Because this form is used to check requirements, order the diploma, and enter the student on the commencement program, it must be received in the Graduate School Records Office no later than 3 weeks into the expected semester of graduation (no exceptions). Students must be registered for a minimum of 3 credit hours during the semester in which they intend to graduate (no exceptions).

### **Directives for the Dissertation**

The results of the candidate’s individual inquiry must be presented in a written dissertation comprising a genuine contribution to knowledge in the field of biostatistics. The document should also demonstrate the candidate’s acquaintance with the literature. The physical form of the dissertation must comply with the regulations stated in the booklet *UAB Format Manual for Theses and Dissertations*, which is published by the Graduate School and is available online as a PDF or HTML file. The description below is intended to provide helpful information. However, students should note that any description in the Graduate Student Handbook supersedes the descriptions in this document. All PhD students should obtain a copy of the Graduate School Handbook and familiarize themselves with the content.

The dissertation research must include an original contribution to the body of knowledge in biostatistics and should be of sufficient quality to be published in the statistical literature. The dissertation may be arranged in either the standard format or the three paper model. Under the standard format, the body of the dissertation should include the following components:

- 1) Introduction, Statement of Research Problem
- 2) Literature Review
- 3) Presentation of research results
- 4) Example of application of results to biomedical data
- 5) Conclusions and outline of future research on the topic

If a student chooses to use the alternative three paper model, sections (1) and (2) above should be combined and sections (3) and (4) above should be replaced with three papers of sufficient quality to be submitted to appropriate journals.

Computer programs and the listing of large data sets used in the dissertation should be put in appendices. Care must be taken to fully document all computer programs used in the dissertation.

Students should attend the free seminar titled “Staying Afloat While Preparing a Thesis or Dissertation”, which is offered each semester by the Graduate School Professional Development Program. Additional assistance is available for students registered in GRD 704 (offered every semester by the Graduate School Professional Development Program).

### **PhD Final Exam**

After the student has completed all formal requirements for the PhD degree, the dissertation committee administers the final oral examination. The final examination should take the form of a presentation and defense of the dissertation, followed by an examination of the candidate’s comprehensive knowledge of the field. This examination must be scheduled through the Graduate School to allow attendance of the Dean. The defense must be announced at least 2 weeks in advance. It is the responsibility of the student to schedule the defense at a time convenient to all

parties involved. **A preliminary copy of the dissertation must be submitted to the dissertation committee for approval at least two weeks prior to the defense, unless otherwise approved in advance by the dissertation committee. The meeting must be open to all interested parties, publicized on the UAB campus, published in the UAB Reporter, and must take place at least 30 days before the expected date of graduation. Candidates must be registered for at least 3 semester hours of Dissertation Research (BST 799) during the semester in which the final examination is taken.** Doctoral students who have not attained candidacy by December 31, 2012, and are using the 3-paper format for their dissertation are required to submit at least one paper from the student's dissertation to a peer-reviewed journal on or before the date of the dissertation defense.

The dissertation committee will evaluate the student's performance in the final exam. In order for the student to pass, all of the committee or all but one member of the committee must pass the student in the final exam. Upon approval by the committee and the Graduate Program Director, the result of the final exam should be forwarded to the Graduate School Dean for approval. Final copies of the dissertation after final approval of the committee, including any changes required by the committee, must be submitted to the Dean within two weeks following successful completion of the defense. Please see the Graduate Student Handbook for various deadlines and further details. Upon satisfying all requirements, the dissertation committee and the Graduate Program Director will recommend the student to the Graduate School Dean for the doctoral degree.

**No later than 10 business days following your public defense,** submit one corrected copy of your finished manuscript as a PDF file, your signed approval forms and all additional applicable forms to Thomas Harris in the graduate school (LHL G03) for review. If you are reprinting a published article, you must also submit permission to reprint from the copyright holder. You do not need to make an appointment. You will be notified when the document review is completed (usually within 2-3 days of submission). Your manuscript will be reviewed for adherence to format requirements and consistency in style throughout the document.

### **Summary of Steps to the PhD**

- Step 1. The student must successfully complete all of the masters' level core courses.
- Step 2. The student must pass the qualifying exam at the doctoral level.
- Step 3. The student must successfully complete all of the doctoral level core courses.
- Step 4. When the required coursework is near completion, the student should identify a research advisor and begin to prepare a formal, written proposal for his/her dissertation research.
- Step 5. The advisor and student should nominate a Graduate Committee, with an eye towards choosing the appropriate people to help guide the dissertation research.
- Step 6. IRB approvals obtained (if necessary)
- Step 7. The student should prepare and present a written proposal.
- Step 8. Admission to candidacy – no later than two semesters before expected graduation. This admission to candidacy gives the student permission to pursue the research. Note that steps 1-7 must be completed before the student can be admitted to candidacy – no exceptions.
- Step 9. The student should work with appropriate committee members, taking advantage of their varied expertise as needed. There should be intermediate meetings and progress reports. **By the time of the dissertation defense, neither the student nor the committee should find any surprises.**
- Step 10. Application for degree – no later than 3 weeks into the expected semester of graduation.
- Step 11. Final examination – no later than 30 days before expected graduation
- Step 12. Submit one PDF copy of defended committee-approved version of thesis to Graduate School Office – no later than 10 days following the public defense

PhD students are generally expected to complete all degree requirements within **7 years of matriculation**. One extension of this time limit can be requested when mitigating circumstances preclude completion of the requirements within 7 years. The recommendation for an extension should include a plan and timeline for completion. Such requests require the approval of the dissertation committee and Graduate Program Director and must be presented in writing to the Dean of the Graduate School for consideration and approval. Courses taken more than 7 years before graduation may not be applied towards the degree without the approval of the Graduate Program Director and Dean of the Graduate School.

### **Frequently Asked Questions**

*If there are more than five members on the committee, do they all have to sign off on the final defense?*

Officially, the student only needs five committee members. The student could have additional committee members present but the official committee would only consist of those faculty members that were submitted on the official *Graduate Committee Letter* to the Graduate School Dean. As a result, only those five would appear on the approval forms to be signed by the committee.

*Do faculty members have to be physically present at the proposal or defense (i.e., can they participate via phone)?*

It is highly preferred that all faculty members be present at the defense.

*Can a student include a faculty member at another institution on their committee?*

Yes. The department will need to request an ad-hoc appointment through the Graduate School. The process for this includes submitting a memo requesting ad-hoc status from the Graduate Program Director and a current CV.

## **FACULTY AND RESEARCH INTERESTS**

Faculty and students in the Department of Biostatistics are involved in activities relating to the development of statistical theory and in the application of statistical methods to the analysis of data collected in many different experimental situations. Much of the department's research is collaborative in nature, involving participants from basic science, clinical medicine, public health, and other areas both within and outside UAB. Faculty in the department are actively involved in the development of grant proposals in fields of general statistics, statistical genetics, and other collaborative research areas.

### **Faculty**

**Professors (8):** Aban, Beasley, Cutter, Edwards, Howard, Redden, Tiwari, Yi

**Associate Professors (4):** Cofield, Judd, Morgan, Szychowski

**Assistant Professors (6):** Austin, Perumean-Chaney, Jaeger, D. Long, L. Long, Rahman

**Emeritus Professors (2):** Bartolucci, Katholi

**Inmaculada (Chichi) Aban, PhD** (Bowling Green State University), Professor. *Clinical Trials, Modeling of Count Data, Analyses of Imaging Data, Model Diagnostics, Survival and Reliability Analysis, Inference for Heavy Tailed Distributions.*

**Erika (Ela) Austin, PhD** (University of Virginia), Assistant Professor. *Survey methodology, design, and analysis. Mixed methods (qualitative-quantitative) and triangulation. Sampling hard-to-reach/hidden populations.*



**Alfred A. Bartolucci, PhD** (State University of New York, Buffalo), Professor Emeritus. *Clinical Trials, Survival Analysis, Bayesian Statistics, Longitudinal Data Analysis.*

**T. Mark Beasley, PhD** (Southern Illinois University - Carbondale), Professor. *Linear Models, Linkage and Association with Quantitative Traits, Nonparametric Methods, Microarray Analysis.*

**Stacey S. Cofield, PhD** (Virginia Commonwealth University), Associate Professor. *Mixed-Effects Models, Clinical Trial Design, Management, and Analysis, Multiple Sclerosis.*

**Gary Cutter, PhD** (University of Texas Health Science Center - Houston), Professor. *Clinical Trials and Community Studies Trial Analyses, Chronic Disease Epidemiology, Large Scale Data Bases, Multiple Sclerosis, Myasthenia Gravis and Neonatal Trials, Behavioral Studies, Neurofibromatosis, HIV, Pregnancy Outcomes and Design of Trials.*

**Lloyd J. Edwards, PHD** (University of North Carolina, Chapel Hill), Professor and Chair. *Mixed Effects Models, Linear Models, Model Selection, Longitudinal Data Analysis, Clinical Trials.*

**George Howard, DrPH** (University of North Carolina, Chapel Hill), Professor. *Design and Analysis of Multi-center Clinical Trials, Application of Statistical Methods in Epidemiological Studies, Linear Models.*

**Byron C. Jaeger, PhD** (University of North Carolina, Chapel Hill), Assistant Professor. *Longitudinal Data Analysis, Machine Learning, Statistical Programming in R, Blood Pressure Monitoring Data, Exercise/Health Behavior Studies.*

**Suzanne E. Judd, PhD** (Emory University), Research Associate Professor. *Racial Differences in Vitamin D Metabolism and Outcomes, Data Collection and Management, Cystic Fibrosis, Nutritional Assessment and Quantification in Longitudinal Observational Studies.*

**Charles R. Katholi, PhD** (Adelphi University), Professor Emeritus. *Computationally Intensive Statistical Methods, Large Sample Theory, Use of Asymptotic Tests in the Presence of Small Samples, Estimation and Testing Infection Potential by Pool Screening.*

**Dustin Long, PhD** (University of North Carolina, Chapel Hill), Assistant Professor. *Causal Inference, Group Randomized Trials, Survival Analysis.*

**Leann Long, PhD** (University of North Carolina, Chapel Hill), Assistant Professor. *Categorical Data Analysis, Zero-inflated Models, Injury Prevention.*

**Charity Morgan, PhD** (Harvard University), Associate Professor. *Finite Mixture Models, Zero-Inflated Count Data, Clinical Trials, Multiple Sclerosis, Psychopathology.*

**Suzanne Perumean-Chaney, PhD** (State University of New York, Albany), Assistant Professor. *Count Data, Missing Data, Adolescent At-Risk Behavior, School-Based Interventions, Pedagogy.*

**Akm Fazlur Rahman, PhD** (University of South Carolina). Assistant Professor. *Survival Analysis, Agreement Study, Statistical Methods for Biomedical Applications, Non- and Semi-parametric Bayesian Inference, Recurrent Events Analysis, Mental Health Study.*

**David T. Redden, PhD** (University of Alabama), Professor. *Regression Diagnostics, Admixture, Association Studies.*

**Jeff Szychowski, PhD** (University of Alabama), Associate Professor and Director of Graduate Studies. *Clinical Trials, Maternal and Fetal Medicine, Interim Monitoring of Clinical Trials, Categorical Data Analysis, Regression Analysis.*

**Hemant K. Tiwari, PhD** (University of Notre Dame), Professor. *Genetic Linkage and Association Analysis, Haplotype Analysis, Disequilibrium Mapping, Population Genetics, Molecular Evolution, Bioinformatics.*

**Nengjun Yi, PhD** (Zhejiang University), Professor. *Statistical Genetics/Genomics, Bayesian Statistics, Hierarchical Models.*

## BIOSTATISTICS COURSES

**BST 601 – Biostatistics.** This course will introduce students to the Logic and language of scientific methods in life science research. Students will learn to use basic statistics in testing hypotheses and setting confidence limits. Simple and multiple regression and elementary experimental designs will be introduced as well. 4 hours. Fall/Spring.

**BST 603 – Introductory Biostatistics for Graduate Biomedical Sciences.** This course will provide non-biostatistics students seeking a Graduate Biomedical Sciences (GBS) degree with the ability to understand introductory biostatistics concepts. 3 hours. As needed.

**BST 611 – Intermediate Statistical Analysis I.** 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). 3 hours. Fall/Spring.

**BST 612 – Intermediate Statistical Analysis II.** This course will introduce students to the basic principle 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. Prerequisite: BST 611 or Permission of Instructor. 3 hours. Spring/Summer.

**BST 613 – Intermediate Statistical Analysis III.** Continuation of concepts in BST 611/612, intended to introduce students to additional general concepts in biostatistics beyond an introductory level. The course will include a broad overview of three areas: 1) categorical, ordinal, and count methods with proportional odds model and Poisson regression; 2) survival analysis and event outcome data with Kaplan-Meier, proportional hazards, and repeated events; 3) repeated measures, mixed models, hierarchical modeling for longitudinal and missing data. Study design, analysis interpretation of results, power and sample size estimation, and non-parametric alternatives will be presented for all topic areas. Prerequisite: BST 601 or 611 and 612. 3 hours. Fall (odd years).

**BST 619 – Data Collection and Management.** 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 (SAS). Exposure to other software packages as time permits. Prerequisites: BST 601 or BST 611; Previous computer experience or workshop on microcomputers highly recommended. 3 hours. Spring (even years).

**BST 620 – Applied Matrix Analysis.** Vector and matrix definitions and fundamental concepts; matrix factorization and application. Eigenvalues and eigenvectors, functions of matrices, singular and ill-conditioned problems. Prerequisites: BST 622. 3 hours. As needed.

**BST 621 – Statistical Methods I.** 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 and analysis of variance. Prerequisites: A year of calculus and linear algebra. 3 hours. Fall.

**BST 622 – Statistical Methods II.** Continuation of concepts in BST 621, extended to multiple linear regression; analysis of variance, analysis of covariance, multiple analysis of variance; use of contrasts and multiple comparisons procedures; simple and multiple logistic regression, and an introduction to survival analysis. Prerequisites: BST 621 with a grade of B or higher. 3 hours. Spring.

**BST 623 – General Linear Models.** Simple and multiple regression using matrix approach; weighted and nonlinear 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. Prerequisite: BST 622 with a grade of B or higher. 3 hours. Fall.

**BST 624 – Experimental Designs.** 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. Prerequisites: Matrix algebra and BST 623. 3 hours. As needed.

**BST 625 – Design and Conduct of Clinical Trials.** Concepts of clinical trials; purpose, design, implementation, and evaluation. Examples and controversies presented. Prerequisite: BST 611 and 612 or permission of the instructor. Pass/No Pass. 3 hours. Summer.

**BST 626/626L – Data Management/Reporting with SAS.** A hands-on exposure to data management and report generation with one of the most popular statistical software packages. Concurrent registration in BST 626 and BST 626L is required. 3 hours. Fall.

**BST 631 – Statistical Theory I.** Fundamentals of probability; conditional probability and independence; distribution, density, and mass functions; random variables; moments and moment generating functions; discrete and continuous distributions; exponential families, joint, marginal, and conditional distributions; transformation and change of variables; convergence concepts; sampling distributions; order statistics; random number generation. Prerequisite: Advanced calculus. 4 hours. Fall.

**BST 632 – Statistical Theory II.** Point interval estimation; sufficiency and completeness; ancillary statistics; maximum likelihood and moment estimators; best unbiased estimator; hypothesis and significance testing; likelihood ratio tests and uniformly most powerful tests; confidence interval estimation; asymptotic properties of estimators and tests; introduction to Bayesian inference. Prerequisite: BST 631 with a grade of B or higher. 4 hours. Spring.

**BST 640 – Nonparametric Methods.** 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. Prerequisite: BST 622, BST 632. 3 hours. As needed.

**BST 655 – Categorical Data Analysis.** Intermediate level course with emphasis on understanding the discrete probability distributions and the correct application of methods to analyze data generated by discrete probability distributions. The course covers contingency tables, Mantel-Haenszel test, measures of association and of agreement, logistic regression models, regression diagnostics, proportional odds, ordinal and polytomous logistic regression, Poisson regression, log linear models, analysis of matched pairs, and repeated categorical data. Prerequisite: BST 622 or equivalent recommended. 3 hours. Fall.

**BST 660 – Applied Multivariate Analysis.** 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. Prerequisite: BST 623. 3 hours. As needed.

**BST 661 – Structural Equation Modeling.** Basic principles of measurements; factor analysis and latent variable models; multivariate predictive models including mediation mechanisms and

moderator effects; path analysis; integrative multivariate covariance models, methods of longitudinal analysis. Prerequisite: BST 623. 3 hours. As needed.

**BST 665 – Survival Analysis.** Kaplan-Meier estimation; Parametric survival models; Cox proportional hazards regression models; sample size calculation for survival models; competing risks models; multiple events models. Prerequisite: BST 622. 3 hours.

**BST 670 – Sampling Methods.** 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. Prerequisite: BST 631. 3 hours. As needed.

**BST 671 – Meta Analysis.** Statistical methods and inference through meta analysis. Prerequisites: BST 623, BST 632. 3 hours. As needed.

**BST 675 – Introduction to Statistical Genetics.** 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 quantitative traits. Prerequisite: BST 611 or BST 621. 3 hours. Spring (odd years).

**BST 676 – Genomic Data Analysis.** The purpose of this class will be to teach graduate students statistics methods that underlie the analysis of data generated by high throughput genomic technologies, as well as issues in the experimental design and implementation of these technologies. High throughput technologies that will be covered include microarrays, proteomics, and second generation sequencing. Prerequisites: BST 611 or 621. BST 675 recommended. 3 hours. Spring (even years).

**BST 680 – Statistical Computing with R.** 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, BST 622, and BST 626 (Introductory Probability and Inference) or equivalent. 2 hours. (Every other year.)

**BST 691 – Biostatistics Pre-doctoral Seminar Series.** This course provides an opportunity for students to learn about ongoing research in the field of biostatistics, clinical trials, and statistical genetics. Reserved for BST students. Pass/No Pass. 1 hour. Fall/Spring.

**BST 695 – Special Topics.** This course is designed to cover special topics in Biostatistics that are not covered in regular 600 level courses, but suited for Masters students in Biostatistics and doctoral students in other related disciplines. 1 - 3 hours

**BST 697 – Internship.** Field experience under joint direction of appropriate public health faculty member and qualified specialists working in selected aspects of public health. **Prerequisites:** BST 601 or BST 611 and BST 612, ENH 600, EPI 600, HB 600, and HCO 600. Pass/No Pass. 3 hours.

**BST 698 – Non-Thesis Research.** Independent non-thesis research with guidance of appropriate faculty. Pass/No Pass. 1-6 hours

**BST 699 – Master's Thesis Research.** Prerequisite: Admission to candidacy for MS degree. Pass/No Pass. 1 - 12 hours.

**BST 723 – Theory of Linear Models.** Multivariate normal distributions and quadratic forms; least square estimation; nested models; weighted least squares, testing contrasts; multiple comparisons; polynomial regression; maximum likelihood theory of log-linear models. Prerequisite: BST 632. 3 hours. Fall (odd years).

**BST 725 – Advanced Clinical Trials I.** This course will provide students with a basic understanding of the fundamental statistical principles involved in the design and conduct of clinical trials. Important topics of discussion will include data management, quality assurance, endpoints, power analysis, interim analysis, adaptive designs, and genetic issues in clinical trials. Prerequisites: BST 611, 612 or 621, 622 and 625. 3 hours. Spring (odd years).

**BST 726 – Advanced Clinical Trials II.** This course builds on the knowledge gained in BST 725 in order to develop a more thorough understanding of the basic methodology behind power analysis, interim data monitoring, and analysis of missing data. The class will involve discussions of recent publications dealing with current topics of interest in clinical trials. Each student will also be asked to conduct, summarize, and present a course project based on a more in-depth exploration of one of the topics introduced in the BST 725 course. Prerequisites: BST 621, 622, 625, 631, 632 and 725. 3 hours. Summer (odd years).

**BST 735 – Advanced Inference.** Stochastic convergence and fundamental inequalities; weak convergence and the central limit theorems; large sample behavior of the empirical distribution and order statistics; asymptotic behavior of estimators and tests with particular attention to LR, score, and Wald tests. Prerequisites: BST 631 and 632. 4 hours. Spring (odd years).

**BST 740 – Bayesian Analysis.** 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. The practical part of the course will be based on Bugs (either WinBugs or OpenBugs), possibly accessed through R with the existing tools for the interface (R packages: R2WinBugs or BRugs, coda). This will enable participants to take the practical examples all the way to the reporting stage in terms of tabulations and graphics. Prerequisites: BST 632. 3 hours. Fall (even years).

**BST 741 – Advanced Bayesian Analysis II.** To illustrate advanced approaches to Bayesian modeling and computation in statistics. We begin with a brief description of the basic principle and concepts of Bayesian statistics. We then study advanced tools in Bayesian modeling and computation. A variety of models are covered, including multilevel/hierarchical linear and generalized linear models, models for robust inference, mixture models, multivariate models, nonlinear models, missing data, and Bayesian model selection. We also introduce some applied areas of modern Bayesian methods, such as genetics/genomics and clinical trials. The practical part of the course will be based on Bugs (either WinBugs or OpenBugs), possibly accessed through R with the existing tools for the interface (R packages: R2WinBUGS or BRugs, coda). This will enable participants to take the practical examples all the way to the reporting stage in terms of tabulations, graphics etc. Prerequisites: BST 631 and 632. BST740 would be helpful but not absolutely required. 3 hours. Fall (odd years).

**BST 750 – Stochastic Modeling.** 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. Prerequisite: BST 632. 3 hours. As needed.

**BST 760 – Generalized Linear and Mixed Models.** Generalized linear models; mixed models; and generalized estimating equations. Prerequisite: BST 723. 3 hours. Spring (even years).

**BST 765 – Advanced Computational Methods.** Numerical algorithms useful in biostatistics including likelihood maximization using the Newton-Raphson method, EM algorithm, numerical integration using quadratic 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. Prerequisites: BST 632. 3 hours. Fall (even years).

**BST 775 – Statistical Methods for Genetic Analysis I.** 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 relatives 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. Prerequisites: BST 623, BST 632, and BST 675. 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. 3 hours. Fall (odd years).

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

**BST 793 – Biostatistics Post-doctoral Seminar Series.** This course provides an opportunity for post-doctoral students to learn about ongoing research in the field of biostatistics, clinical trials, and statistical genetics. Reserved for BST Postdoctoral students. Pass/No Pass. 3 hours. Fall/Spring.

**BST 795 – Advanced Special Topics.** 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 and 632. Pass/No Pass. 1-3 hours

**BST 798 – Non-Dissertation Research.** Non-dissertation research with the guidance of appropriate faculty. Research conducted before admission to candidacy for the doctoral degree. Pass/No Pass. 1-6 hours

**BST 799 – Doctoral Dissertation Research.** Doctoral level dissertation research under the direction of the dissertation research committee. Prerequisite: Admission to candidacy for PhD Pass/No Pass. 1-12 hours.

## ONLINE FORMS

All forms can be found at the following web links from the graduate school or SOPH websites:

<http://www.uab.edu/graduate/online-forms>

<https://www.soph.uab.edu/students/studentforms>