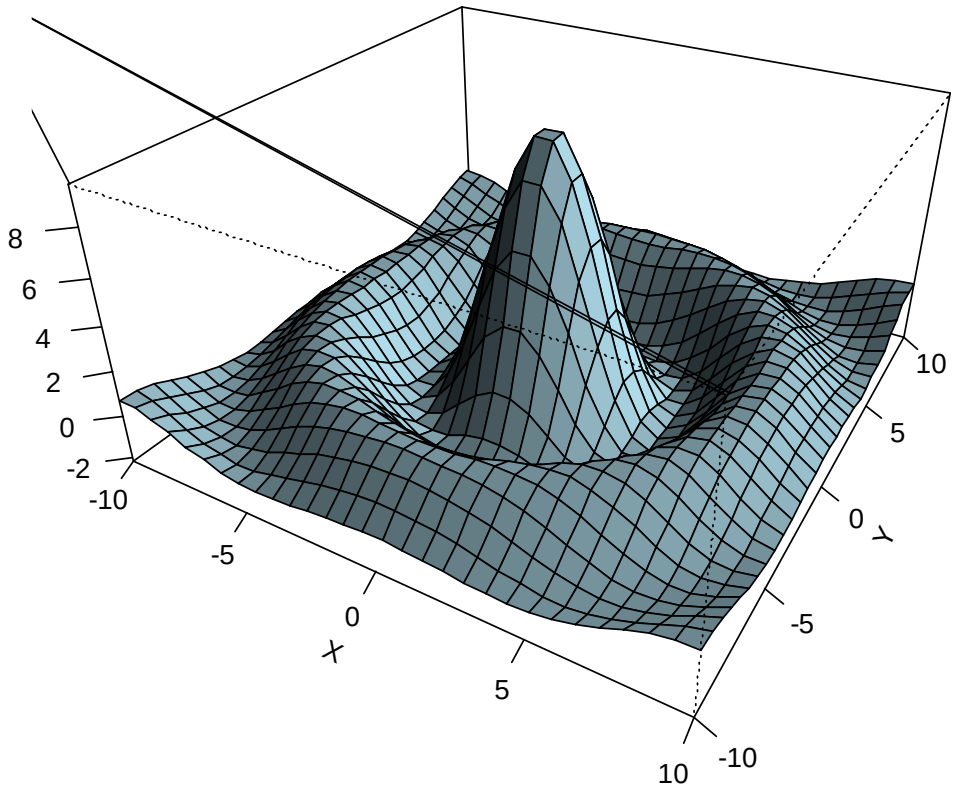
BIOSTATISTICS



ACADEMIC INFORMATION MANUAL

2020 – 2021 Edition

DEPARTMENT OF BIOSTATISTICS
GILLINGS SCHOOL OF GLOBAL PUBLIC HEALTH
3101 McGavran-Greenberg Hall, CB# 7420
The University of North Carolina at Chapel Hill
Chapel Hill, NC 27599-7420
www.sph.unc.edu/bios

DEPARTMENT OF BIOSTATISTICS
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2020-2021 EDITION

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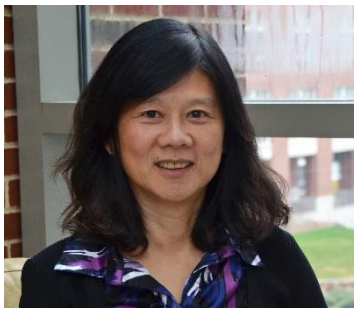
Welcome from the Interim Co-Chairs



Scientists in nearly all disciplines collect quantifiable data to address important research questions. We biostatisticians collaborate with our colleagues in a wide variety of disciplines across the health sciences to define research questions and delineate clear research objectives, optimize the design of studies or data analyses intended to address those objectives, develop innovative data science and statistical methods for data acquisition and analysis, and apply methods to ensure replication, appropriate interpretation, and dissemination of results. The field of biostatistics is at the cutting edge of the newest developments in the health sciences. The Department of Biostatistics at the University of North Carolina is proud to be one of the leading academic research departments of biostatistics in the world. For seventy years, our department has been at the forefront of biostatistics and public health training and research.

The graduate and undergraduate training in our department is rigorous, challenging, and state-of-the art. Our students take interesting but difficult courses in statistical theory, data science and applications. At the same time, most of our students participate actively in the methodological and collaborative research that our faculty conducts. Graduates of our program are prepared to be leaders in biostatistics, and a roster of over 1000 successful alumni illustrates this. Our graduates are faculty members at leading universities around the world and hold leadership positions in all employment sectors. UNC Biostatistics alumni are chairs and deans in academia; direct divisions and offices in government agencies, such as the Food and Drug Administration (FDA), the National Institutes of Health (NIH), and the Centers for Disease Control (CDC); and hold strategic leadership positions in the pharmaceutical industry, the software development industry, and many other institutions in the health sciences and data science industries.

Many of our graduate students receive at least partial financial support. This comes from our training grants in research in environmental biostatistics, research in statistical genomics and cancer, and genomics and big data to knowledge, as well as from many research projects of our faculty. Biostatistics faculty direct or co-direct two Gillings Innovative Laboratories, the Laboratory for Innovative Clinical Trials and the Causal Inference Research Laboratory, both of which provide student research opportunities. Other research projects currently providing graduate student funding include methodological research grants as well as large-scale epidemiologic studies and clinical trial networks. The latter include studies of cardiovascular health in the US population as a whole and in the growing US Hispanic/Latino population, studies of chronic obstructive pulmonary disease (COPD) and severe asthma, studies of chronic low back pain that are part of the NIH Help End Addiction Long-Term (HEAL) initiative conducted in response to the critical opioid epidemic, and studies investigating behavioral interventions in adolescents at risk for or living with HIV/AIDS. Methodological research studies focus on new methods for producing and reading mammograms, complex adaptive trial designs in cancer and other disease areas, statistical genomics, environmental health, precision medicine, Big Data, translational medicine, and many others, too numerous to list here.

As you can see from this partial list of research projects, our faculty is very actively involved in important and timely research in biostatistics methods and health science applications. At the same time, they are excellent teachers and bring the excitement of their research interests into the classroom. Our faculty members regularly receive teaching awards given by the Gillings School of Global Public Health and the University.

Our faculty also value and enjoy working with students one-on-one in research projects and on their doctoral dissertations. Many of our students co-author several peer-reviewed publications before they graduate.

Students are offered a broad range of required and elective courses for their Biostatistics degree programs – BSPH, MS, and PhD – each of which is described here. They can also take advantage of the exceptionally strong and diverse course offerings from other departments within the Gillings School, the Statistics and Operations Research Department (STOR) in the School of Arts and Sciences, and from other departments and schools across the UNC campus. Through our non-traditional courses such as statistical consulting, statistical leadership, and varied special topics, biostatistics students graduate from our program ready to launch their own successful careers.

We personally look forward to getting to know you better in the coming years and wish you the best of success here at UNC.

Jianwen Cai, PhD and Lisa LaVange, PhD
Interim Co-Chairs of Biostatistics

DEPARTMENT OVERVIEW

The Department of Biostatistics in the University of North Carolina Gillings School of Global Public Health stands as one of the best departments of its kind in the world. The Department was established in 1949 with the goals to advance statistical science and, ultimately by its application, to improve human health. To achieve these goals, the Department of Biostatistics offers training and research programs to develop and apply innovative statistical methods to problems of human health and disease, including basic biomedical sciences.

Mission Statement

Our mission is to forge dramatic advances in health science research that benefit human health in North Carolina, the US, and globally through the development of profound and paradigm-shifting innovations in biostatistical methodology and the thoughtful implementation of biostatistical practice to solve public health problems.

We bring about positive, sustainable changes in health by:

A. Supporting excellence in biostatistical practice by conducting theory and methods research of clear relevance to practice

B. Promoting sound application of new and existing statistical methods

C. Improving biostatistical education at the undergraduate and graduate levels

D. Working with undergraduate colleges to promote biostatistics as a discipline for graduate studies and a professional career

E. Anticipating and meeting the learning needs of our students

F. Using the tools of our discipline to enhance human welfare through collaboration in research with colleagues in the biological and health sciences

G. Seeking opportunities to advance the biostatistics profession.

Goal

Our goal is to be a world leader in statistical research and statistical practice for the purposes of improving the public's health, improving biostatistical education, and advancing the biostatistics profession.

ADMINISTRATIVE PERSONNEL

Department of Biostatistics

Department Interim Co-Chair– Jianwen Cai, *cai@bios.unc.edu*
Department Interim Co-Chair – Lisa M. LaVange, *lisa.lavange@unc.edu*

Director of Undergraduate Admissions – Jane Monaco, *jmonaco@bios.unc.edu*

Director of Graduate Admissions – Fei Zou, *feizou@email.edu*

Director of Undergraduate Studies - Jane Monaco, *jmonaco@bios.unc.edu*

Director of Graduate Studies - Joseph G. Ibrahim, *ibrahim@bios.unc.edu*

Director, Biometric Consulting Laboratory - Gary G. Koch, *bcl@bios.unc.edu*

Director, Collaborative Studies Coordinating Center – Lisa M. LaVange, *lisa.lavange@unc.edu*

Co-Directors, Carolina Survey Research Laboratory – Robert Agans, *agans@unc.edu*
and Donglin Zeng, *dzeng@email.unc.edu*

Director, Causal Inference Research Lab – Michael Hudgens, *mhudgens@bios.unc.edu*

Director, Laboratory for Innovative Clinical Trials - Joseph G. Ibrahim, *ibrahim@bios.unc.edu*

Director of Finance and Administration – Wesley Winkelman, *wwinkelm@email.unc.edu*

Finance – Finance Manager - Debbie Quach, *dquach@bios.unc.edu*

Finance – Accounting Technician - Terry Link, *tlink12@email.unc.edu*

Finance - Accounting Technician – Xiaoqing (Michelle) Huang

Human Resources Consultant – Annette Raines, annette_raines@unc.edu

Executive Assistant - Betsy S. Seagroves, *bseagrov@bios.unc.edu*

Business Services Coordinator – Anneli Leander, *anneli@email.unc.edu*

IT - Network Administrator – Scott Zentz, *support@bios.unc.edu*

IT – Network Support – David Hill, support@bios.unc.edu

Academic Coordinator – Melissa C. Hobgood, *mhobgood@bios.unc.edu*

Academic Program Support Coordinator – TBD

Contracts and Grants Manager – Monika Caruso, *mcaruso@bios.unc.edu*

Training Grant Directors
Michael R. Kosorok –Biostatistics & Mental Health Neuroimaging and Genomics
Joseph Ibrahim – Biostatistics for Research in Genomics and Cancer
Haibo Zhou – Biostatistics for Research in Environmental Health

DEPARTMENT/FACULTY MEETINGS

At the beginning of each academic year, the Department Interim Co-Chairs decide the time and days of regular Departmental Meetings. Additional meetings may be called as needed.

All faculty members (Instructors and above) are eligible to vote at the regular Departmental Meetings.

The Agenda for each meeting are initiated by the Interim Co-Chairs and given to the Chair's Administrative Assistant for completion. Items to be put on the Agenda should be given to the Administrative Assistant one week before the meeting.

The Interim Co-Chairs (or an appointed representative) presides over all meetings. In general, Robert's Rules of Order are followed in the conduct of the meetings.

A Faculty Meeting may be held when necessary to consider business of such a nature that students should not be present (for example, decisions with respect to Department-wide written examinations). Attendance is restricted to faculty.

Minutes are prepared by the Administrative Assistant and given to the Interim Co-Chairs for approval. Copies are distributed via-email along with the agenda in advance of the next meeting.

2020-2021 – Department Meetings are scheduled on the following Thursdays, 4:15-5:15 PM
August 27
September 17
October 15
November 19
January 21
February 18
March 18
April 15
May 20

ORIENTATION AND ADVISING

ORIENTATION

At the beginning of the year, the Department Academic Coordinator (AC), with the help of the Directors of Undergraduate and Graduate Admissions, organize orientation meetings for all new students. At these meetings, students are introduced to members of the faculty and staff, as well as the Department Chair, Vice Chair, Associate Chair, and the Directors of Undergraduate and Graduate Admissions and Studies. Current information about the department, degree requirements, and departmental research activities are also provided.

APPOINTMENT OF ACADEMIC ADVISORS

Academic advising and mentoring are essential components of your Gillings School education. Biostatistics is committed to providing the advice, assistance, and support that you need at every step throughout your degree program. A successful system of academic advising and mentoring is highly dependent upon a shared commitment of students, staff, and faculty to the process and availability of timely, accurate information.

The Director of Undergraduate Studies usually advises all undergraduates.

The Academic Coordinator (AC) office and the Director of Graduate Admissions (DGA) appoint faculty advisors for newly admitted graduate students. The selections are made with consideration of such factors as interests of the students and faculty, any specialized fellowship support, and faculty commitments. Any request for change in advisor assignment should be directed to the DGA and/or your AC. The academic advisor advises students on departmental matters until replaced by the dissertation advisor for doctoral students or master's paper advisor for master's student.

DUTIES OF ACADEMIC PROGRAM SUPPORT COORDINATOR (APSC)

The Academic Program Support Specialist is a Biostatistics Professional that serves in the role as liaison to the students and Academic Coordinator. Prior to the entry of new students, the APSC sends the advisors information about the backgrounds of their advisees and the degree program to which each advisee has been admitted. Before each registration, the APSC also sends the advisee a copy of the course schedule and other relevant registration material. At the start of the fall semester, the advisee is provided with a copy of the latest version of the Academic Information Manual (AIM). Subsequent meetings between the advisor and advisee should be arranged by them directly. Please see the APSC for all your departmental student needs. If your AC is not available and your request is not urgent, please send an email. If there is urgent need, by all means, see either.

What can your Academic Program Support Coordinator help with?

- Works with the Academic Coordinator at the department level as an expert in navigating academic policies, procedures, and program requirements.
- Assistance with preparing and submitting forms to appropriate offices for academic needs.
- Serves as liaison between the department and other Gillings offices. Works closely with the Directors of Graduate Admissions and Graduate Studies to maintain departmental information and procedures in accordance with university policy and procedure and keep you informed of such.

DUTIES OF THE ACADEMIC COORDINATOR (AC)

Your Academic Coordinator:

- Is a Gillings School Student Affairs professional that serves in the role as your primary academic advisor but does not take the place of your Faculty Mentor for course information and selection.
- Serves as an expert in navigating academic policies, procedures, program requirements, and campus resources
- Helps with necessary paperwork including, but not limited to registration transactions, policy exceptions, transfer requests, continuous enrollment or leave of absence, etc.
- Assists in tracking your progress toward degree completion
- Is available via email, appointment, drop-in, or cohort academic advising sessions

What can your Academic Coordinator help with?

- Academic Strategies: Academic Coordinators can help you learn strategies for success at Gillings, including effective study habits, test-taking strategies, time management, test anxiety, etc.
- Academic Advisement: Need help navigating your degree requirements? Your Academic Coordinator can talk with you about your degree requirements, your progression towards degree completion, and your plan for graduating.
- Involvement on Campus: Your Academic Coordinator is knowledgeable about opportunities to make the most of your Gillings experience. Work with them to create your plan to get involved on campus and within the community.
- Navigating Campus Resources: Ever feel overwhelmed or stressed out? Your Academic Coordinator can connect you with the right resources that will help you on your path to success.

DUTIES OF FACULTY ADVISORS (MENTORS)

The primary responsibilities of the faculty member appointed as advisor for a newly admitted student are to provide initial guidance regarding the academic program of the advisee and to carry out selected academic functions (such as assistance regarding options for practical training or for a research project**)** related to completion of academic program requirements. **However, after the first semester, primary responsibility should shift to students for updating plans to satisfy their degree programs and for discussing such plans with their advisors. Students are expected to meet with their advisor at the beginning of each semester to discuss course selection and academic progress.**

Advisors are specifically expected to confer with their advisees in all selections of courses, and to sign appropriate forms showing their approval of the course plans (as well as any subsequent course additions or drops) of their advisees.

In carrying out their responsibilities, advisors need to keep "up-to-date" on the academic and related requirements of the degree programs for which they are advising students, and to monitor the progress of their advisees in meeting these requirements.

Every student is responsible for keeping an updated degree checklist. This should be done with their advisor at the beginning and end of each semester. In the final year, the checklist must be verified and signed off by the Director of Graduate Studies. You will also be responsible for completing with your advisor the BIOS Annual Graduate Student Progress & Goals report in your 2nd year or beyond of your graduate study. This must be completed with and signed by your academic advisor or doctoral adviser if you are registered for dissertation.

The academic advisor is not committed to continuing as the advisor of the Master's paper or doctoral dissertation.

Your Faculty Mentor:

- Is a full time Gillings School faculty member
- Serves as an expert in your specific field of study
- Provides feedback regarding courses related to your overall academic goals and career interests

- Suggests professional development opportunities, funding opportunities, recognition awards, etc.
- Is available for you to discuss appropriateness of course selection each semester

Faculty Mentor Relationship:

While each student is assigned an individual Faculty Mentor, they are also encouraged to develop relationships with other faculty members throughout their time at Gillings. These individuals may serve as future references for you, connect you with future employers, or help to expose you to otherwise unknown professional resources in your area of study. The value of building relationships with our phenomenal faculty members cannot be overstated.

Students are responsible for scheduling, preparing for, and keeping appointments; for seeking out contacts and information; and for knowing the basic requirements of their individual programs. Ultimately, students are responsible for making their own decisions based on the best information and advice available and, on their own judgment.

Faculty Mentors are responsible for helping students develop professionally by suggesting opportunities based on their own expertise and experience in the field, connecting students to professional networks relevant to their interests, and providing guidance on career interests. Faculty Mentors stay current with trends in the field, conferences and professional development opportunities, and other valuable discipline-specific resources.

ABSENCE OF ADVISORS

Advisors who have to be away during registration, or for any length of time during the year, should make arrangements, in consultation with the Academic Coordinator, for another faculty member to meet with their advisees when they need faculty assistance. If such arrangements are not made, changes in a student's program may be made at the discretion of the Director of Graduate Studies and the Academic Coordinator.

DEPARTMENT OF BIOSTATISTICS GUIDELINES FOR AWARDING TUITION REMISSIONS

*Students who receive a stipend through UNC as a Graduate Research Assistant and earn the minimum amount as set by the Graduate School become eligible for tuition support (Tuition Remission).

The following criteria will be used by the Department of Biostatistics (and followed by the Chair, Directors of Graduate Admissions and Studies, and by the Academic Coordinator) for making decisions about Tuition Remission awards. All such awards are, of course, subject to the availability of funds, which are allocated by the Graduate School.

Each award to a new student will be for one academic year (fall and spring). Returning student Tuition Remission eligibility is determined on a semester basis and is contingent upon:

(a) full time student status;
(b) high quality performance in course work;
(c) high quality performance in GRA activities;
(d) compliance with guidelines set by the Graduate School;
(e) number of tuition remissions received.

ENROLLMENT REQUIREMENTS

Doctoral Students:

Full enrollment is required (9 hours or more) during the first two years of graduate study. Thereafter, once all other degree requirements have been satisfied, students must enroll for at least 3 hours of BIOS 994. Credit hours of courses that are not required for your degree will not be counted towards tuition remission.

Master's Students:

Full enrollment is required (9 hours or more) during the first three semesters of graduate study. Thereafter, once all other degree requirements have been satisfied, students must enroll for at least 3 hours of 992.

All students must remain appropriately enrolled for the entire semester to be eligible for, and to retain tuition remission or an in-state tuition award for the relevant semester.

Dropping below the minimum enrollment requirement during the semester will result in the loss of tuition remission, and the financial responsibility rests on the student.

DURATION OF SUPPORT

1. Students in terminal masters' programs are eligible for tuition remission and/or in-state tuition awards from the designated tuition fund for up to four semesters;

2. Doctoral students (or students in masters then doctoral sequence programs) are eligible for tuition remission and/or in-state tuition awards from the designated tuition fund for up to ten semesters. However, the maximum semesters of eligibility may depend on the availability of funds from the Graduate School.

3. A student who completes a degree in one UNC academic program, then enrolls in another UNC academic program or changes academic programs without receiving a degree, is only eligible for the maximum semesters of eligibility as noted above during their enrollment at the university, or no more than ten semesters

4. Students taking courses that are required for their degree will be eligible to receive remission to cover those credit hours. Courses of interest or courses recommended outside of Biostatistics that are not required for degree completion will not be covered by tuition remission and are the financial responsibility of the student.

Criteria indicating lack of excellent academic progress include poor academic performance (e.g., as indicated by the grade of F or L in any course) and/or the inability to maintain full time student status (except in certain circumstance such as a major illness or personal hardship).

BACHELOR OF SCIENCE IN PUBLIC HEALTH (BSPH)

DEGREE DESCRIPTION

The Bachelor of Science in Public Health program is designed for students who have strong quantitative abilities and an interest in applications of math, statistics, and computer programming to health-related issues. The program prepares students for entry-level professional statistical and programming careers, and provides a firm academic base for subsequent studies in biostatistics, medicine and other fields.

DEGREE COMPETENCIES

Upon satisfactory completion of this course of study the student will be able to:

1. Perform descriptive and inferential data analyses to answer varied research questions (Bios 500H)
2. Interpret data analysis results for a variety of audiences (Bios 500H)
3. Use software appropriately in data collection, data management, and analysis. (Bios 511)
4. Demonstrate the use of elementary statistical theory including the use of basic concepts of probability, random variation and common statistical probability distributions (Bios 650)
5. Demonstrate strong quantitative skills through the successful completion of calculus, linear algebra, and discrete mathematics (Math 233, Math 547 and Math 381)

In addition to these competencies, all BSPH Biostatistics students meet the Public Health CEPH competencies through the Public Health Core coursework: EPID 600, SPHG 351 and SPHG 352 (This "New PH Core" is for students who matriculate Fall 2019 and later) .

ADMISSION REQUIREMENTS

The first two years of the four-year course of study are usually completed within UNC-CH's General College. Students typically apply to the BSPH Biostatistics Program in February of their sophomore (or second) year for fall admission in their junior (or third) year. Admission requirements include:

1. Completion of MATH 231, 232, and 233 before an admission decision can be made. Thus, Math 233 must be completed by May of the sophomore (or second) year.
2. Completion of BIOL 101 and BIOL 101L and (COMP 110 or COMP 116) before entering the program in the Fall of the junior (or third) year.
3. Completion of at least 60 credits and the vast majority of their General College requirements before entering the program in the Fall.
4. A Minimum GPA of 3.2.

The application consists of a transcript, two letters of recommendation (at least one recommendation from a quantitative/math person), and a personal statement. Applications are submitted completely online. Prospective students should familiarize themselves with program prerequisites early in their General College studies and are encouraged to discuss their plans with the Director of Undergraduate Studies (Dr. Jane Monaco) who holds periodic information sessions for prospective students. More information here: http://sph.unc.edu/bios/faqs-undergraduates-2/

PROGRAM REQUIREMENTS

1. BIOL 201 or 202; (both these courses have a prerequisite of CHEM 101)
2. BIOS 500H, 511, 645, 650, 664, 668 (or 662) and 691;
3. EPI 600, SPHG 351 and SPHG 352;
4. MATH 381 (or STOR 215), MATH 521 or 528, and MATH 547

BSPH students are required to earn a grade of C (or higher) for all above required courses.

Advanced students who wish to double major or have a minor are encouraged to take some of the required courses (such as Math 381, Biol 201 (or 202), Math 547) in their freshman and sophomore years in order to allow flexibility of scheduling in their last two years.

Bios 500H can be taken in the freshman or sophomore years to introduce interested students to the discipline of biostatistics and to allow flexibility of scheduling in the junior and senior years.
Students must also meet UNC-CH graduation requirements including: completion of at least 120 semester hours; a 2.0 (C) average on all work attempted at UNC-CH; at least 45 credit hours must be earned from UNC-CH courses; at least 24 of the last 30 credit hours applied to degree requirements must be earned from UNC-CH courses. See the Undergraduate Bulletin for complete details.

Academic achievement is recognized at graduation with the designations of Distinction (Overall GPA $\geq$ 3.5) and Highest Distinction (Overall GPA $\geq$ 3.8).

SENIOR HONORS PROJECT IN BIOSTATISTICS

A senior honors project is intended for the small number of undergraduates who choose to complete original research. Attempting an honors project requires a substantial time commitment, dedication and the ability to work independently. The senior honors project is not designed to reward academic achievement. However, students must have a grade point average of 3.3 or higher at the end of the semester preceding the semester when they intend to begin honors research work and maintain a GPA of at least 3.3 while completing the project.

Faculty member availability to guide the student in their honors work governs whether a student can begin a research project. Students are responsible for finding a biostatistics faculty member to direct their honors project.

Students attempting an honors project must enroll in at least six credit hours of acceptable research coursework (Usually Bios 693H- 3 hours in the fall and Bios 694H - 3 hours in the spring). As part of this coursework, students carry out a research project, prepare a paper based on the project, and give an oral presentation on their honors research.

Senior honors papers are reviewed by a committee of three individuals which include the primary biostatistics faculty research advisor and usually at least one person from another department. The review committee is selected by the student and his/her research advisor after consultation with the Director of Undergraduate Studies.

To graduate with Honors, a student must complete the honors project including oral presentation and have a GPA of at least 3.3 at the end of the first semester of the senior year on (a) all courses taken at UNC-Chapel Hill and (b) the courses required for the biostatistics major.
To be eligible for *consideration* of Highest Honors designation, students must also have a GPA of at least 3.6 in (a) and (b) above. Evaluation of Honors vs. Highest Honors designation is made by a subcommittee of the faculty based on scholarly merit of senior honors project and student presentation.
More information regarding deadlines and university regulations is available at
http://honorscarolina.unc.edu/research/senior-honors-thesis/

More information is also available from the Director of Undergraduate Studies or on BSPH Sakai Site

DUAL BSPH/MS DEGREE

OVERVIEW: A Dual BSPH/MS Degree is available for students who are interested in completing some of the MS in Biostatistics degree requirements while completing their undergraduate degree. The degree requirements for each degree are unchanged. The program identifies a coherent course of study to efficiently complete both

degrees. The program is best suited for high achieving students who seek a *terminal* MS biostatistics degree. The Dual Degree does not guarantee completion after 5 years; some sample schedules span more than five years. *Details, rules, and sample semester-by-semester curriculums are available from the Director of Undergraduate Studies or on the BSPH Sakai Site.*

ADMISSION: Briefly, interested students must be admitted to the BSPH program first. Students submit a 'letter of interest' approximately 9 months before entering the MS degree (for most students, in their junior (or third) undergraduate year). This letter should include a semester-by-semester plan for completing the BSPH degree in 8 (or less) total regular semesters, as well as their semester–by-semester plan for completing the MS requirements. The letter is submitted to the Director of Graduate Admissions and Director of Undergraduate Studies. If approved, the student will be encouraged to pursue formal admission to the MS program.

BENEFITS: One benefit of the Dual Degree is the additional number of hours that can be transferred in to MS degree (20% vs. 30% Rule). The requirement of 36 hours of MS coursework remains unchanged. In general, any student is allowed to transfer up to 20% of the total hours required for the master's degree (20% of 36 = 7 hours) with approved coursework (for example, applicable graduate courses taken while an undergraduate) provided the course did not count toward the requirements of the undergraduate degree (20% Rule: *http://gradschool.unc.edu/handbook/pdf/handbook.pdf* p. 3) [For example, if BIOS 660 and 661 are taken while an undergraduate, those hours can be transferred into the MS graduate program for any student because those courses are not required for the BSPH.] Students in the Dual BSPH/MS may transfer in a *maximum of 10 hours credit (30% of 36 hours)* of approved coursework taken while an undergraduate, provided those hours do not fulfill BSPH requirements. (30% Rule: *http://gradschool.unc.edu/pdf/DualBachelorsMastersPrograms102010.pdf*).
Another benefit of the Dual Degree (or taking any graduate coursework as an undergraduate) is added *flexibility* to the MS Degree; because some of the required graduate coursework is completed as an undergraduate, students have additional flexibility to complete the 36 MS hours with other approved coursework.

PLANNING: Planning ahead is critical for students interested in the Dual Degree program; students are encouraged to consult with the Director of Undergraduate Studies early in their undergraduate career.

- Students interested in the BSPH/MS Dual Degree program are encouraged to apply to the BSPH program (not the Dual BSPH/MS Degree) in February of their freshman year and begin coursework in Biostatistics by their sophomore year, including BIOS 511 and BIOS 500H.
- Students are also encouraged to take required math courses MATH 381 (Foundations and Decision Sciences), MATH 547 (Linear Algebra),….) early in their undergraduate program.
- Early preparation will allow students to have sufficient prerequisite courses to take BIOS 660, BIOS 661, BIOS 662 and BIOS 663 in their 4th year in preparation for MS qualifying exams at the beginning of their 5th year.

NOTES: Financial considerations may play a role regarding whether the dual BSPH/MS is a good fit for a student. Some students may prefer to retain undergraduate status for eight semesters because of undergraduate scholarships. Other students may prefer to transition to graduate student status earlier because of the potential to obtain graduate funding. Other considerations include a student's readiness to commit to a terminal master's degree early and preference for depth vs. breadth in undergraduate study.

EXAMPLE BSPH BIOSTATISTICS CURRICULUM

FRESHMAN-SOPHOMORE YEARS Approximately 60 credit hours including:

BIOL 101, 101L:	Principles of Biology and its Laboratory
COMP 110 or 116:	Introduction to Programming
MATH 231:	Calculus of Functions of One Variable I
MATH 232:	Calculus of Functions of One Variable II
MATH 233:	Calculus of Functions of Several Variables

Calculus series must be completed before a student can be admitted (by May of sophomore year)
Completing all the General College requirements is recommended in the first two years
See Director of Undergraduate Studies in Biostatistics for complete details

JUNIOR- SENIOR YEARS Approximately 60 credit hours including:

FALL JR

BIOS 500H:	Introduction to Biostatistics
BIOS 511:	Introduction to Statistical Computing and Data Management (SAS)
MATH 381 (or STOR 215):	Foundations of Decision Sciences or Introduction to Decision Sciences
SPHG 351:	Foundations in Public Health
FREE ELECTIVE	

SPRING JR

BIOS 645:	Principles of Experimental Analysis (Multiple Linear Regression)
MATH 521:	Advanced Calculus I **or** MATH 528: Math for the Physical Sciences
EPID 600:	Principles of Epidemiology
SPHG 352:	Public Health Systems and Solutions
FREE ELECTIVE	

FALL SR

BIOS 650:	Basic Elements of Probability/ Statistical Inference I
BIOS 691:	Field Observations in Biostatistics (1 credit hour)
MATH 547:	Linear Algebra for Application
FREE ELECTIVE	
FREE ELECTIVE	

SPRING SR

BIOS 664:	Sample Survey Methodology
BIOS 668:	Design of Public Health Studies
BIOL 201*:	Ecology and Population Biology **or** BIOL 202*: Genetics
FREE ELECTIVE	

* Biol 201 and 202 have prerequisites of Chem 101.
Taking the biostatistics courses in the above order is recommended because they are offered Fall only/Spring only and may have prerequisites.

This 'example' program assumes that a student does not have substantial AP credit and does not plan to double major. Many students are able to take the courses noted in the junior/senior year *earlier*, allowing the flexibility to double major or to pursue other opportunities.

MASTER OF SCIENCE (MS)

DEGREE DESCRIPTION

The Master of Science (MS) program is designed to provide research-oriented training in the theory and methodology of biostatistics and its applications to the solution of problems in the health sciences.

DEGREE COMPETENCIES

Upon satisfactory completion of this program, the student will have:

1. demonstrated an understanding of probability and statistical inference, including the fundamental laws of classical probability, discrete and continuous random variables, expectation theory, bivariate and multivariate distribution theory, maximum likelihood methods, hypothesis testing, power, and likelihood ratio, score, and Wald tests [BIOS 660, 661];

2. demonstrated ability to apply the elementary methods of statistical analysis, including those based on classical linear models and on nonparametric alternatives, involving categorical, discrete, normal, or ranked data, to problems of description, goodness of fit, univariate location and scale, bivariate independence and correlation, regression analysis, and the comparison of independent and matched samples possibly adjusting for covariables [BIOS 662,663];

3. used computers for research data management (applying a defensible standard of documentation, archiving, protection of confidentiality, and audit trail) and for the analysis of data with standard statistical program packages [BIOS 511];

4. learned to develop an efficient design of an observational or experimental study in the health sciences [BIOS 841];

5. gained successful experience in statistical consulting, including interaction with research workers in the health sciences, abstracting statistical aspects of substantive problems, and communicating the results to persons without specialized biostatistical training (as evaluated by the consultees), and observed and evaluated nonacademic biostatistical programs in the Research Triangle area [BIOS 841, BIOS 691];

6. a course requiring a written an adequate report related to the statistical aspects of a problem in the health sciences, a case study, or a contribution to statistical methodology [BIOS 992].

In addition, student(s) meet or exceed CEPH 2016 Public Health competencies through completion of SPHG 600.

ADMISSION REQUIREMENTS

Requirements for admission include an acceptable Bachelor's degree with mathematics training at least including multivariable calculus and linear algebra.

TIME/RESIDENCE REQUIREMENTS

The Graduate School requires a minimum residence period of two semesters, but the MS in Biostatistics usually requires about two years for completion. All requirements for the degree must be completed within five years of matriculation. ***Please refer to the Graduate School Handbook located in the appendix for additional information***.

COURSE REQUIREMENTS

Students must complete at least 36 hours of coursework for the MS degree. Note that for students who do not exempt any required courses, the total credit hours for all required courses below is greater than 36 hours.

1. **Basic Statistics**
   - BIOS 511, 660, 661, 662, 663, 667, 680 and 691 are required.
2. **Intermediate and Advanced Statistics**
   - Six hours of course work numbered 664 or higher not including 667 and 680 in Biostatistics or equivalent in Statistics at UNC, or in Statistics at NCSU.
3. **Practicum**
   - BIOS 691, BIOS 841, BIOS 843 (2 semesters (credits) are required). BIOS 992, BIOS 843 can only be taken 2nd year of study. In addition, each MS student may be required to grade up to two courses: See page 58 for details.

Bios 843:

Students in all graduate degree programs (MS, DrPH and PhD) are not allowed to miss more than two seminars in the semester for which they are registered for BIOS 843. If the student should miss more than two seminars, they will receive an automatic incomplete for the semester for which they are registered. To remove the incomplete, the student must makeup all missed seminars in the subsequent semester for which they are NOT registered for BIOS 843. The student must also write a one paragraph summary about each seminar and submit these summaries to the Director of Graduate Studies.

Electronic devices WILL NOT be allowed during seminar presentations.

4. **Supporting Program**
   - EPID 600 or 710 (or equivalent), plus SPHG 600 is required. See page 41 for details.

TIMING OF COURSEWORK: Typically, BIOS 511, 660, 661, 662 and 663 are first-year MS courses; BIOS 667, 680, 841, 843, 992, and BIOS electives (e.g., 664, 665, 668, 670, etc.) are usually second-year MS courses; supporting program courses can be taken at any time.

TRANSFERRING IN COURSE HOURS (20% Rule): A maximum of seven hours credit (20% of 36 hours) may be transferred from other institutions, or from Continuing Studies, or from courses taken at UNC-CH as an undergraduate in partial satisfaction of this requirement. Credit received for graduate-level courses taken as an undergraduate may be transferred into the MS program with approval *provided the course did not count toward the requirements of the undergraduate degree.* The transfer must be recommended by the Department and approved by the Graduate School. The residence requirement is not affected. The necessary letter to the Graduate School is prepared by the Registrar. The Graduate School notifies the student directly by letter when action has been taken on the request for the transfer of credits. More information can be found at http://handbook.unc.edu/coursecredit.html.

EXEMPTING COURSEWORK: Some students (for example, graduates of UNC's BSPH Biostatistics program or students with a strong math/stat background) may be allowed to exempt a limited number of individual required courses on a case-by-case basis based on their previous coursework. For example, BSPH biostatistics students from UNC-CH have satisfied the requirement of BIOS 511, 691, 6 hours of credit at or above 664, EPID 600 and SPHG 600 (through completion of the five SPH core courses) and can exempt those courses. These students will still need to fulfill the

remaining requirements including 36 hours of approved coursework. Thus these students gain flexibility in selecting coursework and should work with their academic advisor in course selection depending on their interests and goals.

Click for the Masters of Science Checklist

***** The basic written examinations are usually taken in July/August after the first year of the MS program.

EXAMINATIONS

All candidates are required to pass the MS Written Examination. All candidates are required to take the examination after they have completed their first year in this Department: See page 42 for details. No formal oral examination is required (unless the student elects to write a Master's Thesis: see Master's Paper section).

APPLICATION FOR GRADUATION

Students must notify the Graduate School of their plan to graduate by applying to graduate through your ConnectCarolina portal and eGraduation Central no later than the deadline shown in the University Registrar's Calendar for the semester in which they expect to graduate. Applications should only be submitted when the student realistically intends to graduate that semester and are valid for one semester only. If a student does not graduate in the semester expected, s/he must submit another application for graduation in a future semester. The department registrar will also notify students via emai1 of deadlines. See List of Web Sites Page at the end for links.

Please refer to the Graduate School Handbook for additional information.

Master of Public Health with concentration in Public Health Data Science,
Offered by Gillings School of Global Public Health

The Gillings School of Global Public Health's Master of Public Health (MPH) is a comprehensive integrated program providing students with the skills and knowledge to help solve some of the most critical public health problems across the state of North Carolina and around the globe. MPH students choose from among 13 diverse concentrations, ranging from Environmental Health Solutions to Population Health for Clinicians, each anchored in the core Public Health curriculum. The Department of Biostatistics, in conjunction with the Department of Epidemiology, sponsors the concentration in Public Health Data Science (PHDS).

Data science draws upon multiple disciplines, combining the statistical skills to manipulate data and make inferences, the mathematical skills to model phenomena and make predictions, and the computer science skills to manage and analyze large data sets. Our MPH program with PHDS concentration offers a unique focus on leveraging the foundational statistical, mathematical and computer science elements of data science to generate useful information from data sources relevant to public health. As a student in this concentration, you will benefit from the instruction and mentorship of top-ranked faculty in the biostatistics department and across the Gillings School. Our chief focus is to optimize data science to help address the most critical public health problems in the world today.

In addition to the MPH core public health courses, PHDS students take five concentration courses that cover the basic concepts of probability and statistical inference, data science, machine learning, and epidemiologic methods. Students then choose elective courses from multiple disciplines offering data science methods and applications within the Gillings School and in other schools and departments across the UNC campus. The MPH Practicum gives students an opportunity to partner with communities and organizations for hands-on experience in solving public health problems during the summer following their first year in the program. A comprehensive Master's paper provides the MPH culminating experience to round out the program in the second year.

For more information about the Gillings MPH program, see: https://sph.unc.edu/resource-pages/master-of-public-health/. For details about the PHDS concentration, see: https://sph.unc.edu/resource-pages/master-of-public-health/public-health-data-science-concentration/.

DOCTOR OF PUBLIC HEALTH (DRPH)

PLEASE SEE THE AIM FOR THE YEAR YOU ENTERED THIS DEGREE PROGRAM AT https://sph.unc.edu/bios/current-students/

DEGREE DESCRIPTION

Fall 2018 is the final matriculating cohort for the existing Biostatistics DrPH program. Students entering the program in 2018 will work closely with their academic advisor to ensure compliance with CEPH criteria and timely completion of courses which may be discontinued in the future.

The Doctor of Public Health (DrPH) program is designed to prepare students who have at least one year of prior work experience at admission for positions of leadership in applied research related to health problems and delivery of statistical technical services in the health field. In order to accomplish this goal, the program ensures that students acquire: a thorough and broad knowledge of statistical techniques and their application to a range of health problems; a basic knowledge of public health and an area therein in which the student may specialize; suitable administrative and leadership experiences in applied research or technical assistance projects; and communication skills so that they can function effectively in a multidisciplinary environment.

DEGREE COMPETENCIES

Upon satisfactory completion of this program the student will have:

1. demonstrated ability to use state-of-the-art design and analysis methods to solve a wide variety of applied statistical problems in the health sciences, by successfully passing the DrPH Basic Written Examination in Biostatistics [https://www.bios.unc.edu/distrib/exam/];

2. learned advanced biostatistical techniques, including the ability to
   - design cost-effective surveys and experiments (including clinical trials) for collecting data on topics relevant to health, taking account of sampling error, measurement error, nonresponse, and other sources of bias and variability;
   - use advanced theory for estimation and statistical inference based on health data, including linear regression and mixed models; models for longitudinal discrete and continuous data, and survival models;
   - discern when standard methods are not appropriate, when nonparametric methods based on randomization and ranks may be substituted, or when new methods must be developed;

3. used computers for research data management (applying a defensible standard of documentation, archiving, protection of confidentiality, and audit trail) and for the analysis of data with standard statistical program packages;

4. carried out independent methodological research, including the writing of a scholarly dissertation and publishing papers based on this research in respected statistical journals;

5. gained successful practical experience in statistical consulting, including interaction with research workers in the health sciences, abstracting statistical aspects of substantive problems, and communicating the results to persons without specialized biostatistical training; if not outside academia, then this consulting experience can be obtained by serving in the Biometric Consulting Laboratory (BCL) or as a member of a university research project team.

ADMISSION REQUIREMENTS

1. An appropriate prior Bachelor's or Master's degree in Statistics, Biostatistics, or in a closely related field.

2. Prior mathematics training at least including multivariate calculus and linear algebra.

3. At least 12 months of acceptable fulltime, relevant post-baccalaureate work in public health, with an option to substitute an acceptable prior advanced degree (such as an MD degree) for the experience.

TIME/RESIDENCE REQUIREMENTS

Doctoral students are required to complete a minimum residence credit of four full semesters; at least two of the required four semesters of residence must be earned in contiguous (i.e., fall to spring or spring to fall) registration on this campus. Students attempting to obtain the DrPH degree simultaneously with another Graduate School degree must register full-time in the Gillings School of Global Public Health for at least two semesters. All requirements for the degree must be completed within eight years of the time the student matriculated in the program. ***Please refer to the Graduate School Handbook located in the appendix for additional information***.

COURSE REQUIREMENTS

The Gillings School of Global Public Health requires at least 18 semester hours in non-statistical courses relevant to Public Health, including EPID 600 or 710 (or an equivalent), as recommended by the student's committee and approved by the DGS. NOTE: These 18 hours must include the MPH core course requirements. The Department of Biostatistics requirements are as indicated below. Requirements (A), (B), and (C) may be waived for students who have had previous training or experience deemed equivalent by the Director of Graduate Studies (DGS). Courses counted toward the Gillings School of Global Public Health requirements, or taken at UNC prior to entry into the program, may be included in (D) and (E).

1. **Mathematics (advanced calculus and linear algebra)**
   - The student must take BIOS 672, BIOS 673, BIOS 762, and BIOS 767. This requires working knowledge of the material in MATH 416, 521, 577, and 547 at UNC-CH. A strong background in multivariable calculus is therefore necessary.

2. **Statistical Computing and Data Management**
   - BIOS 511 and BIOS 669 are appropriate. This is self-enforcing, however, since the Written Examination, and all non-service courses in BIOS, assume that students have mastered the topics covered therein.

3. **Basic Statistics**
   - Elementary and intermediate probability, statistical inference, statistical methods, linear regression, sampling and categorical data. Required courses are: BIOS 662, BIOS 663, BIOS 664, BIOS 665, BIOS 672, and BIOS 673.
   - For first year DrPH students who took BIOS 660 and/or BIOS 661 as a Masters student, the requirement for BIOS 672 and/or BIOS 673 will be determined on a case-by-case basis and approved by the Director of Graduate Studies. In general, if the first year DrPH students took BIOS 660 and/or BIOS 661 more than two years ago as a Masters student, they will need to take BIOS 672 and/or BIOS 673 in the DrPH program. For first year DrPH students who previously took BIOS 660 and BIOS 661 less than two years ago and got a grade of H in BIOS 660 and/or BIOS 661, they may be exempt from BIOS 672 and/or BIOS 673. They should take elective courses above BIOS 664 to replace the exempt courses. However, if such students received a grade lower than an H in BIOS 660 and/or BIOS 661, then they must take BIOS 672 and/or BIOS 673

4. **Advanced Statistics**
   - Required courses BIOS 762 and BIOS 767
   - Electives

At least 9 credit hours of electives are required. Acceptable course include all those numbered at the 700-level in Biostatistics or in (Mathematical) Statistics at UNC-CH, and equivalent courses in Statistics at other institutions as approved by the Director of Graduate Studies (DGS).

NOTE: BIOS 762 and 767 are typically taken during the second year of study, following completion of BIOS 662, 663, 672 and 673 during the first year of study.

5. **Supporting Program in Public Health**
   - At least 18 semester hours in non-statistical courses relevant to Public Health, including EPID 600 or 710 (or an equivalent) such as SPHG 712, as recommended by the student's committee and approved by the DGS.
   - These 18 hours must include the MPH core course requirements. SPHG 712 (2) [or EPI 600 (3) or EPI 710], SPHG 713 (2), 721 (2), 722 (4). DrPH Biostatistics students can exempt the SPHG 711 (Data Analysis for Public Health). SPHG 712 (Methods and Measures) and 713 (Understanding PH) are offered fall only and 721 (Conceptualizing PH Solutions), 722 (Implementing PH Solutions) are offered spring only.
     More MPH Core information here: https://sph.unc.edu/resource-pages/gillings-mph-core/
     More course substitutions and exemptions for the MPH Core Courses here: http://sph.unc.edu/students/academic-and-policies/.
   - Students who have already completed the "old PH core" (EPI 600/HBEH 600/ ENVR 600/ HPM 600) may exempt the new MPH core coursework.

6. **Practicum**
   - BIOS 841
   - BIOS 842. Part or all of this requirement may be waived, upon petition to the DGS, for students with considerable prior experience.
   - BIOS 843 (4 semesters (credits) are required). BIOS 843 can be taken only if the student has taken the written qualifying exam.
   - Must complete online form to report practicum experience. Visit www.sph.unc.edu/careers. Online form located in the second paragraph of the NEWS section.

NOTE: BIOS 841 should be taken before or concurrently with BIOS 842.

The practicum provides students on opportunity to apply the knowledge and skills being acquired through their coursework and further develop and demonstrate attainment of program competencies.

International students and BIOS 842: note that F-1 visa-holding students will need to apply for CPT (Curricular Practical Training) authorization from the UNC OISSS (Office of International Student and Scholar Services) in order to complete an internship at a company while on a F-1 visa. The UNC OISSS has a rule that F-1 visa-holding students are typically ineligible for CPT authorization if they have completed all coursework and have been approved to register for thesis or dissertation credits only. Therefore, it is suggested to use BIOS 842 enrollment as a mechanism for requesting CPT authorization BEFORE registering for thesis or dissertation credits, if the F-1 visa-holding student is interested in pursuing an internship. For more details, consult this link: http://isss.unc.edu/student-employment/cpt/

Bios 843:

Students in all graduate degree programs (MS, DrPH and PhD) are not allowed to miss more than two seminars in the semester for which they are registered for BIOS 843. If the student should miss more than two seminars, they will receive an automatic incomplete for the semester for which they are registered. To remove the incomplete, the student must makeup all missed seminars in the subsequent semester for which they are NOT registered for BIOS 843. The student must also write a one

paragraph summary about each seminar and submit these summaries to the Director of Graduate Studies.

Electronic devices WILL NOT be allowed during seminar presentations.

7. **Dissertation Registration**
   - All doctoral students must register for a minimum of 3 credit hours of dissertation work (BIOS 994).

8. **Transfer of Credits**
   - A doctoral student may request transfer credit from another institution. Courses transferred are subject to examination at the time of the Doctoral Oral Examination. The Committee may recommend the transfer of both course and residence credit in its report to the Graduate School, which has the final responsibility for approving the transfer. Transferred credit does not relieve the student of the residence requirement of at least one academic year of continuous full-time study, or the equivalent, at UNC-CH.
     See http://gradschool.unc.edu/academics/resources/forms.html

A "Typical" DrPH program* (The program may vary by the student's background, area of specialization, and interests).

Click her for the Doctor of Public Health Checklist

** Basic written examinations are usually taken early in the fall semester of the second year of the DrPH program.

DEGREE EXAMINATIONS AND DISSERTATION

Basic Written Examination

Each DrPH student is required to pass the DrPH Basic Written Examination (Doctoral Applications Exam): This examination is usually taken at the end of the first or second year in the program depending on student's prior obtained degree before entering the program. See page 42 for details.

Doctoral Committee

In the Department of Biostatistics, the Doctoral Committee combines the functions of two committees as specified by the Graduate School: (1) the Doctoral Oral Examination Committee, and (2) the Dissertation Committee.

After the candidate has entered the final stage of planned course work, has chosen a topic for DrPH dissertation research, and has been declared ready by the dissertation advisor, the student and advisor recommend the composition of the Doctoral Committee to the DGS for approval. The composition of each Doctoral Committee is to be approved in writing by both the chairperson of the Department and the DGS. An appropriate form to accommodate this approval process is available from the Departmental Registrar. This form will solicit information regarding the proposed dissertation topic. The student should first consult with the Registrar concerning completion of forms and acceptability of committee appointments.

> **No fewer than five persons shall constitute the Doctoral Committee. A majority of the members must be full members of the Graduate Faculty. Other members may be limited members of the Graduate Faculty or special appointees. The Committee must also include at least one representative of the supporting program in Public Health.**

Preliminary Doctoral Examinations

In the Department of Biostatistics, it is customary to combine the Doctoral Written Examination and the Doctoral Oral Examination specified by the Graduate School into a single Preliminary Oral Examination (or "Prelim", for short). The Preliminary Oral examination paper will consist of two parts:

(1) The first part is the student's review of the literature for the proposed dissertation topic, on which the student will be questioned by the Committee. This portion of the oral examination paper must be at least 12 pages in length, excluding the bibliography section.

(2) The second part is concerned with the research already obtained, and the feasibility of the proposed dissertation. This portion of the oral examination paper must be at least 20 pages in length, excluding the bibliography section. An appropriate maximum length for the literature review and proposal is about 40 pages.

As stated in the Graduate School Handbook, students should have fulfilled, or will have fulfilled by the end of the semester in which the preliminary oral examination is to be taken, all required course work and the minimum residence requirements for the doctorate.

NO DOCTORAL STUDENT IS ALLOWED TO TAKE THE DOCTORAL PRELIMINARY ORAL EXAMINATION UNTIL THEY HAVE PASSED ALL OF THE DOCTORAL BASIC WRITTEN EXAMINATIONS.

NO DOCTORAL STUDENT IS ALLOWED TO TAKE THE DOCTORAL WRITTEN EXAM WITHOUT HAVING COMPLETED ALL NECESSARY COURSEWORK COVERED ON THE EXAM.

A STUDENT MUST BE REGISTERED FOR AT LEAST THREE (3) CREDIT HOURS OF BIOS 994 IN ORDER TO TAKE THE PRELIMINARY ORAL EXAMINATION.

THE PRELIMINARY ORAL EXAMINATION MUST PRECEDE THE FINAL THESIS DEFENSE BY AT LEAST 4 MONTHS.

In addition, no preliminary doctoral examination can be scheduled until the student has obtained some tangible research results as judged by the dissertation advisor.

The literature review and proposal to be considered at the preliminary oral examination must be submitted to the Doctoral Committee at least three weeks before the oral is scheduled. An appropriate maximum length for the literature review and proposal is about 40 pages.

PRELIMINARY ORAL EXAM INSTRUCTIONS

*** It is important that the student follow the listed *TIMELINE* below. This section will be very helpful in planning their preliminary oral exam (prelim) presentation.**

THE STUDENT SHOULD START THIS PROCESS AS SOON AS THE STUDENT HAS CONFIRMED THEIR COMMITTEE WITH THEIR ADVISOR.

At the beginning of the online prelim process the system will have a checklist of things the student should complete or are in the process of completing ***BEFORE*** they can do their preliminary oral exam. Please pay close attention to the timeline provided.

1. The student must have completed and pass the comprehensive exam before they can do their prelim
2. The student must have an abstract

3. The student's full proposal – this can be added later ***BUT*** no less than (3) weeks before the prelim date
4. The student should have completed both the Report of Doctoral Committee Composition and Doctoral Exam Report forms. Once completed, save and upload these forms into a folder they have created that contain all of your dissertation materials.

The online prelim process can be found at ***internal.bios.unc.edu.*** Enter your ***ONYEN and PASSWORD, click OK.*** Proceed by clicking on ***ORAL EXAM REQUEST.***

5. **Complete section one.** Bypass room information; your Student Services Manager will reserve and enter the room information.
6. **Complete section two**. The drop down box will have names of all BIOS faculty. If your committee member is not in the list you will need to enter their name.
   a. If the committee member is not listed on Graduate School Designation, the student must upload a copy of his/her CV. In general tenure track/tenured professors are on the list and research or clinical track may or may not be on the list. Please click on Graduate School Designation to see if the committee member is listed. Once again, if the committee member is not listed, a CV will be required.
7. At **(5)** weeks out, the student will need to have their abstract uploaded, the Report of Doctoral Committee Composition and Doctoral Exam Report forms uploaded
8. At **(3)** weeks out, the student will need to have their proposal upload in the online system. Anything less than 3 weeks, the system ***WILL NOT*** allow the student to upload and they will be required to reschedule.
9. At **(2)** weeks out**,** the system will send out the prelim announcement, the doctoral committee composition and doctoral exam report forms, the proposal and abstract to the committee and to the student.

IMPORTANT: SAVE REQUEST only if the student ***is not*** ready to upload your abstract and proposal.

After the examination, the completed reporting forms should be returned to the Registrar. For any part of the preliminary oral examination, the student's Committee may award a PASS or FAIL, or a PASS subject to specified conditions (such as additional course work, or the passing of a special examination covering a specific topic). A student who fails a part of the preliminary oral examination is entitled to one re-examination, but not until at least 3 months have elapsed. Re-examination of the first part may be in writing, by request of the student. Appeals of Committee decisions may be made to the faculty of the Department through the Department Chair.

Doctoral Research

The research for the DrPH dissertation is a scientific and original project conducted by the student under supervision of the dissertation advisor or co-advisors. This research is expected to be of such scope, independence, and skillful presentation as to indicate that the candidate has acquired a mastery of the research methodology and its application, and has contributed new knowledge to this subject. The doctoral dissertation is expected to focus on applications of statistical methods for important issues in public health. The type of research expected is exemplified by that published in the *American Journal of Public Health, Journal of Clinical Epidemiology, American Journal of Epidemiology, and Statistics in Medicine*.

Advising Guidelines for Students and Faculty

Faculty with a primary appointment in the Department of Biostatistics or joint faculty with at least a 33% funding commitment from the Department of Biostatistics can serve as the dissertation advisor or co-advisor of at most 8 students at any given time. Taking on more students will require the authorization of the Department Chair in consultation with the Director of Graduate Studies.

All faculty with joint appointments with less than 33% funding commitment from the Biostatistics Department can be the doctoral dissertation advisor or co-advisor of at most four doctoral students at any given time, provided that the joint faculty member fully funds at least all but one of the students. For example, if they advise or co-advise three doctoral students, they must fully fund at least two of the students. If they advise or co-advise only one doctoral student, they are not required to fund that student.

All Adjunct Faculty members can be the doctoral dissertation advisor or co-advisor of at most three doctoral students at any given time, provided that the adjunct faculty member fully funds at least all but one of the students.

The doctoral thesis advisor and co-advisor(s) must be fully engaged in the student's doctoral dissertation and are expected to make substantial contributions on all papers submitted from the student's doctoral dissertation, regardless of their level of appointment.

A student can schedule a doctoral thesis defense only when at least one first authored paper (i.e., with the student as first author) has been submitted from their doctoral dissertation.

No student is allowed to start doctoral dissertation work and have formal doctoral thesis advising until they have passed the written doctoral examinations (both the Theory and Applications Exams for PhD students and the Applications Exam for DrPH students).

Any student who works as a GRA or is funded by a faculty member through a training grant or R01 is not obligated to work with that faculty member on their doctoral dissertation. The student is free to choose to work with any faculty member on their doctoral dissertation at any time.

A student must be notified at least 3 months in advance, except in extenuating circumstances, by their supervising faculty member if their funding will be discontinued for any reason.

Application for Graduation

Students must notify the Graduate School of their plan to graduate by applying to graduate through your ConnectCarolina portal and eGraduation Central no later than the deadline shown in the University Registrar's Calendar for the semester in which they expect to graduate. Applications should only be submitted when the student realistically intends to graduate that semester and are valid for one semester only. If a student does not graduate in the semester expected, s/he must submit another application for graduation in a future semester. The department registrar will also notify students via emai1 of deadlines. See List of Web Sites Page at the end for links.

Final Oral Examination

When a date for the final oral examination is chosen, the candidate should notify the Registrar, who will reserve a room and prepare a notice which is sent to the Biostatistics faculty, to members of the Doctoral Committee, and to members of the statistical profession in the Triangle area. The candidate should provide the following:

1. date of the examination;
2. names of the committee members of the Doctoral Committee, with addresses for any committee members who are not on the Biostatistics faculty;

3. title of the dissertation;
4. one copy of the abstract;
5. any biographical data which the candidate wishes to have included in the notice.

At least three weeks after distributing copies of the final draft of the dissertation to members of the Committee, the candidate takes the final oral examination. This includes a public exposition and defense of the dissertation, presented as a seminar or colloquium, at which time the candidate answers questions regarding the dissertation that are raised by the Committee and others present. Immediately after the public meeting, the Committee members meet to conclude the examination, at which time they may also ask questions about other areas.

The Graduate School form for reporting the results of this examination is sent by the Registrar to the Doctoral Committee Chair prior to the examination; this form, after completion, is returned to the Registrar after the examination.

A STUDENT MUST BE REGISTERED FOR BIOS 994 FOR THREE (3) CREDIT HOURS IN ORDER TO TAKE THE FINAL ORAL EXAMINATION

POLICY ON ENROLLMENT

The policy on enrollment for Master's Paper/thesis/doctoral dissertation only is stated below.

"Students who have completed all course work and residency requirements for their graduate degree program and who are using University resources (including faculty time) to conduct their Master's paper/thesis/doctoral dissertation research will be required to register and pay tuition for at least 3 hours of Master's paper/thesis/doctoral dissertation credit (992/993/994). As in the past, students must be registered in Master's paper/thesis/doctoral dissertation (992/993/994) for 3 hours during the semester in which they complete their graduate work or are scheduled to receive their degree."

"Students who are not using university resources may apply for a leave of absence. It should be emphasized, however, that students must be registered for at least 3 hours in order to receive a stipend, qualify for University Graduate Student Health Insurance, or maintain full-time student status for loan deferment or student visa status.

Please refer to the Graduate School Handbook link located in the appendix for additional information.

Electronic Theses and Dissertations Submission

Electronic Theses and Dissertations (ETDs) are a new initiative at UNC. ETDs provide students with digital publishing experience and an easier method for submission, plus the documents are much easier to search, retrieve and store than their paper versions. For more information on the benefits of ETDs, the process for changing to ETDs at UNC, how it affects you, to submit ETDs or search ETDs links, visit **http://gradschool.unc.edu/etdguide/submission.html**

Only the final document should be submitted after all relevant authorizations and department approvals are received. Once submitted, please patiently allow sufficient time for Graduate School staff to review the document for necessary format revisions. You will be notified if revisions are needed and/or if your document has been approved.

To submit click on Submit Electronic Thesis and Dissertations
The student is responsible for ensuring that the electronic version can be converted correctly (i.e., for making sure that graphs, tables and equations are in the appropriate place and in the correct layout design).

DOCTOR OF PHILOSOPHY (PHD)

DEGREE DESCRIPTION

The Doctor of Philosophy (PhD) program is designed to provide advanced, research-oriented training in theory and methodology to prepare individuals for academic careers or for research positions anywhere.

DEGREE COMPETENCIES

Upon satisfactory completion of this program the student will have:

1. demonstrated mastery of: (a) the theory of probability and statistical inference, by successfully passing the PhD Basic Written Examination in Biostatistics (Theory Exam), and (b) the application of said theory to solve a variety of applied statistical problems in the health sciences, by successfully passing the PhD Basic Written Examination in Biostatistics (Applications Exam) [https://www.bios.unc.edu/distrib/exam/];

2. learned advanced biostatistical techniques, including the ability to

    - design cost-effective surveys and experiments (including clinical trials) for collecting data on topics relevant to health, taking account of sampling error, measurement error, nonresponse, and other sources of bias and variability;

    - use advanced parametric and semiparametric models for the analysis of public health data, including linear regression, mixed models, methods for categorical data, generalized linear (mixed) models, generalized estimating equations, survival analysis, and Bayesian methods;

    - discern when standard methods are not appropriate, when nonparametric methods based on randomization and ranks may be substituted, or when new methods must be developed; and

    - estimate survival curves from time-to-event data which may involve censoring and time-dependent covariates, and test for differences among treatments and for the effects of covariates;

    - apply advanced statistical computing methods such as the EM algorithm, MCMC method, optimization procedures, and writing efficient R, SAS, and C++ code

3. used computers for research data management (applying a defensible standard of documentation, archiving, protection of confidentiality, and audit trail) and for the analysis of data with standard statistical program packages;

4. carried out independent methodological research, including the writing of a scholarly dissertation and publishing papers based on the dissertation in respected statistical journals;

5. gained successful practical experience in statistical consulting, including interaction with research workers in the health sciences, abstracting statistical aspects of substantive problems, and communicating the results to persons without specialized biostatistical training; if not outside academia, then this consulting experience can be obtained by serving in the Biometric Consulting Laboratory (BCL) or as a member of a university research project team;

6. taught basic statistical theory and applications effectively, not only to biostatistics majors, but also to other health science practitioners.

ADMISSIONS REQUIREMENTS

1. An appropriate prior Bachelor's or Master's degree in Statistics, Biostatistics, or in a closely related field.

2. Strong mathematical training including linear algebra. Advanced calculus/elementary analysis are strongly encouraged but on occasion exceptional students are admitted without it. In such cases, the student will take MATH 521 during the first year of study.

TIME/RESIDENCE REQUIREMENTS

Doctoral students are required to complete a minimum residence credit of four full semesters, at least two of the required four semesters of residence must be earned in contiguous (i.e., fall to spring or spring to fall) registration on this campus. All requirements for the degree must be completed within eight years of the time the student matriculated in the program. ***Please refer to the Graduate School Handbook located in the appendix for additional information***.

COURSE REQUIREMENTS

The Gillings School of Global Public Health requires a minimum of 18 semester hours of course work beyond the Master's degree for admission to candidacy and to dissertation and research courses. The Department of Biostatistics requirements are as indicated below. Requirements (A), (B), and (C) may be waived for students who have had previous training or experience deemed equivalent by the Director of Graduate Studies (DGS). Courses counted toward the Gillings School of Global Public Health requirements, or taken at UNC prior to entry into the program, may be included in (D) and (E).

1. Mathematics

- Advanced Calculus and /or Real Analysis

  The student is required to take BIOS 760 and BIOS 761. This requires working knowledge of advanced calculus equivalent to at least the level of MATH 521 at UNC-CH.

- Linear Algebra

  The student is required to take BIOS 762. This requires working knowledge of the material in MATH 422, 577, and 547 at UNC-CH.

  Students who have not taken advanced calculus and/or real analysis are required to take an equivalent course at UNC such as MATH 521

2.Statistical Computing and Data Management

- BIOS 611. This course is not technically required but strongly encouraged. This is self-enforcing, however, since the PhD Basic Written Examination (Applications Exam), and all non-service courses in BIOS, assume that students have mastered the topics covered therein.
- BIOS 735. This is a required advanced statistical computing course.

3. Basic Statistics

- The elements of probability, statistical inference, statistical methods, and linear regression. Required courses are: BIOS 662, BIOS 663, BIOS 672 and BIOS 673. Most of these courses are included in a typical MS program.

4. Advanced Statistics

- Required Courses BIOS 735, BIOS 760, BIOS 761 BIOS 762, BIOS 767, BIOS 780 and BIOS 850

- Electives
  At least 9 semester hours. Acceptable courses include all those numbered at the 700-level in Biostatistics or in (Mathematical) Statistics at UNC-CH, and equivalent courses in Statistics at other institutions as approved by the Director of Graduate Studies (DGS). Requests to count 700-level courses in (Mathematical) Statistics toward this requirement are considered individually.

NOTE: BIOS 735, 760, 761, 762, 767 are typically taken during the second year of study and 780 is typically taken during the third year, following completion of BIOS 662, 663, 672 and 673 during the first year of study for students wo are admitted to the PhD program with a bachelor degree.

5. Supporting Program

- A supporting program of at least 6 semester hours, including EPID 600 or 710 and SPHG 600 (or equivalent), is required.

6. Practicum

- BIOS 841, BIOS 843 (4 semesters (credits) are required). BIOS 843 can be taken only if you have taken theory and applications written qualifying exams.
- In addition, each PhD student may be required to grade up to 3 courses (up to 4 for a combined masters/doctoral program).

Bios 843: Students in all graduate degree programs (MS, DrPH and PhD) are not allowed to miss more than two seminars in the semester for which they are registered for BIOS 843. If the student should miss more than two seminars, they will receive an automatic incomplete for the semester for which they are registered. To remove the incomplete, the student must makeup all missed seminars in the subsequent semester for which they are NOT registered for BIOS 843. The student must also write a one paragraph summary about each seminar and submit these summaries to the Director of Graduate Studies.

Electronic devices WILL NOT be allowed during seminar presentations.

7. Dissertation Registration

- All doctoral students must register for a minimum of 3 credit hours of dissertation work (BIOS 994).

8. Transfer of Credits

- A doctoral student may request transfer up to 6 credit hours from another institution. Courses transferred are subject to examination at the time of the Doctoral Oral Examination. The Committee may recommend the transfer of both course and residence credit in its report to the Graduate School, which has the final responsibility for approving the transfer. Transferred credit does not relieve the student of the residence requirement of at least one academic year of continuous full-time study, or the equivalent, at UNC-CH. ***See the List of Web Sites for link to Graduate School forms.***

NOTE: This Department requires no "Research Skill" or "Language" as defined by the Graduate School. It may be beneficial to a student's program to take more computing or a foreign language (e.g., French may be desirable for a demography student). These individual arrangements are left to the students and their advisors.

See Doctor of Philosophy Checklist

To enhance your UNC experience, the department offers numerous ways for students to finance their education, get involved in volunteer service activities and participate in various student organizations.

DEGREE EXAMINATIONS AND DISSERTATION

Basic Written Examination

Each PhD student is required to pass the PhD Basic Written Examination (Theory Exam and Applications Exam). The PhD Basic Written Examination is usually taken at the end of the first or second year in the program depending on the student's prior obtained degree before entering the program. See page 42 for details.

Doctoral Committee

In the Department of Biostatistics, the Doctoral Committee combines the functions of two committees as specified by the Graduate School: (1) the Doctoral Oral Examination Committee, and (2) the Dissertation Committee.

After the candidate has entered the final stage of planned course work, has chosen a topic for PhD dissertation research, and has been declared ready by the dissertation advisor, the student and advisor recommend the composition of the Doctoral Committee to the DGS for approval. The composition of each Doctoral Committee is to be approved in writing by both the chairperson of the Department and the DGS. An appropriate form to accommodate this approval process is available from the Departmental Registrar. This form will solicit information regarding the proposed dissertation topic. The student should first consult with the Registrar concerning completion of forms and acceptability of committee appointments.

No fewer than five persons shall constitute the Doctoral Committee. A majority of the members must be full members of the Graduate Faculty. Other members may be limited members of the Graduate Faculty or special appointees. The Committee must also include a representative of the supporting program.

Preliminary Doctoral Examinations

In the Department of Biostatistics, it is customary to combine the Doctoral Written Examination and the Doctoral Oral Examination specified by the Graduate School into a single Preliminary Oral Examination (or "Prelim", for short). The Preliminary Oral examination paper will consist of two parts:

(1) The first part is the student's review of the literature for the proposed dissertation topic, on which the student will be questioned by the Committee. This portion of the oral examination paper must be at least 12 pages in length, excluding the bibliography section.

(2) The second part is concerned with the research already obtained, and the feasibility of the proposed dissertation. This portion of the oral examination paper must be at least 20 pages in length, excluding the bibliography section. An appropriate maximum length for the literature review and proposal is about 40 pages.

As stated in the Graduate School Handbook, students should have fulfilled, or will have fulfilled by the end of the semester in which the preliminary oral examination is to be taken, all required course work and the minimum residence requirements for the doctorate.

NO DOCTORAL STUDENT IS ALLOWED TO TAKE THE DOCTORAL PRELIMINARY ORAL EXAMINATION UNTIL THEY HAVE PASSED ALL OF THE DOCTORAL BASIC WRITTEN EXAMINATIONS.

NO DOCTORAL STUDENT IS ALLOWED TO TAKE THE DOCTORAL WRITTEN EXAM WITHOUT HAVING COMPLETED ALL NECESSARY COURSEWORK COVERED ON THE EXAM.

A STUDENT MUST BE REGISTERED FOR AT LEAST THREE (3) CREDIT HOURS OF BIOS 994 IN ORDER TO TAKE THE PRELIMINARY ORAL EXAMINATION.

THE PRELIMINARY ORAL EXAMINATION MUST PRECEDE THE FINAL THESIS DEFENSE BY AT LEAST 4 MONTHS.

In addition, no preliminary doctoral examination can be scheduled until the student has obtained some tangible research results as judged by the dissertation advisor.

The literature review and proposal to be considered at the preliminary oral examination must be submitted to the Doctoral Committee at least three weeks before the oral is scheduled. An appropriate maximum length for the literature review and proposal is about 40 pages

PRELIMINARY ORAL EXAM INSTRUCTIONS

*** It is important that you follow the listed *TIMELINE* below. This section will be very helpful in planning your preliminary oral exam (prelim) presentation.**

PLEASE START THIS PROCESS AS SOON AS YOU CONFIRM YOUR COMMITTEE WITH YOUR ADVISOR.

At the beginning of the online prelim process the system will have a checklist of things you should complete or are in the process of completing ***BEFORE*** you can do your preliminary oral exam. Please pay close attention to the timeline provided.

1. You must have completed and passed the comprehensive exam before you can do your prelim
2. You must have an abstract
3. Your full proposal – this can be added later ***BUT*** no less than (3) weeks before the prelim date
4. You should have completed both the Report of Doctoral Committee Composition and Doctoral Exam Report forms. Once completed, save and upload these forms into a folder you have created that contain all of your dissertation materials.

The online prelim process can be found at ***internal.bios.unc.edu.*** Enter your ***ONYEN and PASSWORD, click OK.*** Proceed by clicking on ***ORAL EXAM REQUEST.***

5. ***Complete section one***. You can bypass room information; your Student Services Manager will reserve and enter your room information.
6. ***Complete section two***. The drop down box will have names of all BIOS faculty. If your committee member is not in the list you will need to enter their name.
    a. If your committee member is not listed on Graduate School Designation, you must upload a copy of his/her CV. In general tenure track/tenured professors are on the list and research or clinical track may or may not be on the list. Please click on Graduate School Designation to see if your committee member is listed. Once again, if your committee member is not listed, a CV will be required.

7. At **(5)** weeks out, you will need to have your abstract uploaded, the Report of Doctoral Committee Composition and Doctoral Exam Report forms uploaded
8. At **(3)** weeks out, you will need to have your proposal upload in the online system. Anything less than 3 weeks, the system ***WILL NOT*** allow you to upload and you will be required to reschedule.
9. At **(2)** weeks out**,** the system will send out your prelim announcement, your doctoral committee composition and doctoral exam report forms, the proposal and abstract to the committee and to you.

IMPORTANT: SAVE REQUEST only if you ***are not*** ready to upload your abstract and proposal.

After the examination, the completed reporting forms should be returned to the Registrar. For any part of the preliminary oral examination the student's Committee may award a PASS or FAIL, or a PASS subject to specified conditions (such as additional course work, or the passing of a special examination covering a specific topic). A student who fails a part of the preliminary oral examination is entitled to one re-examination, but not until at least 3 months have elapsed. Re-examination of the first part may be in writing, by request of the student. Appeals of Committee decisions may be made to the faculty of the Department through the Department Chair.

Doctoral Research

The research for the PhD dissertation is a scientific and original project conducted by the student under supervision of the dissertation advisor or co-advisors. This research is expected to be of such scope, independence, and skillful presentation as to indicate that the candidate has acquired a mastery of the research methodology and its application, and has contributed new knowledge to this subject. Research for the PhD dissertation is expected to be of the type leading to articles in *Biometrics, Annals of Applied Statistics, Biometrika, Demography, the Journal of the American Statistical Association, the Annals of Statistics, American Journal of Human Genetics, Neuroimage, and Genetic Epidemiology.*

Advising Guidelines for Students and Faculty

Faculty with a primary appointment in the Department of Biostatistics or joint faculty with at least a 33% funding commitment from the Department of Biostatistics can serve as the dissertation advisor or co-advisor of at most 8 students at any given time. Taking on more students will require the authorization of the Department Chair in consultation with the Director of Graduate Studies.

All faculty with joint appointments with less than 33% funding commitment from the Biostatistics Department can be the doctoral dissertation advisor or co-advisor of at most four doctoral students at any given time, provided that the joint faculty member fully funds at least all but one of the students. For example, if they advise or co-advise three doctoral students, they must fully fund at least two of the students. If they advise or co-advise only one doctoral student, they are not required to fund that student.

All Adjunct Faculty members can be the doctoral dissertation advisor or co-advisor of at most three doctoral students at any given time, provided that the adjunct faculty member fully funds at least all but one of the students.

The doctoral thesis advisor and co-advisor(s) must be fully engaged in the student's doctoral dissertation and are expected to make substantial contributions on all papers submitted from the student's doctoral dissertation, regardless of their level of appointment.

A student can schedule a doctoral thesis defense only when at least one first authored paper (i.e., with the student as first author) has been submitted from their doctoral dissertation.
No student is allowed to start doctoral dissertation work and have formal doctoral thesis advising until they have passed the written doctoral examinations (both the Theory and Applications Exams for PhD students and the Applications Exam for DrPH students).

Any student who works as a GRA or is funded by a faculty member through a training grant or R01 is not obligated to work with that faculty member on their doctoral dissertation. The student is free to choose to work with any faculty member on their doctoral dissertation at any time.

A student must be notified at least 3 months in advance, except in extenuating circumstances, by their supervising faculty member if their funding will be discontinued for any reason.

Application for Graduation

Students must notify the Graduate School of their plan to graduate by applying to graduate through your ConnectCarolina portal and eGraduation Central no later than the deadline shown in the University Registrar's Calendar for the semester in which they expect to graduate. Applications should only be submitted when the student realistically intends to graduate that semester and are valid for one semester only. If a student does not graduate in the semester expected, s/he must submit another application for graduation in a future semester. The department registrar will also notify students via emai1 of deadlines. See List of Web Sites at the end of for links.

Final Oral Examination

When a date for the Final Oral Examination is chosen, the candidate should notify the Registrar, who will reserve a room and prepare a notice which is sent to the Biostatistics faculty, members of the Doctoral Committee, and to members of the statistical profession in the Triangle area. The candidate should provide the following:

1. date of the examination;
2. names of the members of the Doctoral Committee, with addresses for any committee members who are not on the Biostatistics faculty;
3. title of the dissertation;
4. one copy of the abstract;
5. any biographical data which the candidate wishes to have included in the notice.

At least three weeks after distributing copies of the final draft of the dissertation to members of the Committee, the candidate takes the Final Oral Examination. This includes a public exposition and defense of the dissertation, presented as a seminar or colloquium, at which time the candidate answers questions regarding the dissertation that are raised by the Committee and others present. Immediately after the public meeting, the Committee members meet to conclude the examination, at which time they may also ask questions about other areas.
The Graduate School form for reporting the results of this examination is sent by the Registrar to the Doctoral Committee Chair prior to the examination; this form, after completion, is returned to the Registrar after the examination.

A STUDENT MUST BE REGISTERED FOR BIOS 994 FOR THREE (3) CREDIT HOURS IN ORDER TO TAKE THE FINAL ORAL EXAMINATION

POLICY ON ENROLLMENT

The policy on enrollment for Master's Paper/thesis/doctoral dissertation only is stated below.

"Students who have completed all course work and residency requirements for their graduate degree program and who are using University resources (including faculty time) to conduct their Master's paper/thesis/doctoral dissertation research will be required to register and pay tuition for at least 3 hours of Master's paper/thesis/doctoral dissertation credit (992/993/994). As in the past, students must be registered in

Master's paper/thesis/doctoral dissertation (992/993/994) for 3 hours during the semester in which they complete their graduate work or are scheduled to receive their degree."

"Students who are not using university resources may apply for a leave of absence. It should be emphasized, however, that students must be registered for at least 3 hours in order to receive a stipend, qualify for University Graduate Student Health Insurance, or maintain full-time student status for loan deferment or student visa status."

Please refer to the Graduate School Handbook link located in the appendix for additional information.

Electronic Theses and Dissertations Submission

Electronic Theses and Dissertations (ETDs) are a new initiative at UNC. ETDs provide students with digital publishing experience and an easier method for submission, plus the documents are much easier to search, retrieve and store than their paper versions. For more information on the benefits of ETDs, the process for changing to ETDs at UNC, how it affects you, to submit ETDs or search ETDs links, visit **http://gradschool.unc.edu/etdguide/submission.html**

Only the final document should be submitted after all relevant authorizations and department approvals are received. Once submitted, please patiently allow sufficient time for Graduate School staff to review the document for necessary format revisions. You will be notified if revisions are needed and/or if your document has been approved.

To submit click on Submit Electronic Thesis and Dissertations

Students are required to provide a PDF file of their dissertation. The student is responsible for ensuring that the electronic version can be converted correctly (i.e., for making sure that graphs, tables and equations are in the appropriate place and in the correct layout design.

SUPPORTING PROGRAMS

The Department of Biostatistics requires a "supporting program" of at least 6 semester hours for the MS, 6 semester hours for the PhD, and 18 semester hours for the DrPH, in a field or fields of application. This supporting program typically includes EPID 600 or 710 (or equivalent) and SPHG 600**.** A "field of application" is loosely defined as a discipline whose members might reasonably be expected to seek statistical consultation on occasion. (For the DrPH, the field of application must be relevant to Public Health.) Statistics, Mathematics, and Computer Science are excluded. A proposal involving a course in Operations Research is judged on its individual merits.

A supporting program is intended to be more flexible than a minor as defined by the Graduate School Handbook. For example,

4. The supporting program of students specializing in Demography may include demography-related BIOS courses (e.g. BIOS 670, 771, 777). These cannot then be counted toward BIOS elective requirements.

2. When a supporting program is split into more than one field of application, it needs not have the exact hours in each field as specified by the Graduate School for a minor. However, the requirements of the Graduate School on splitting minors should serve as a strong guideline.

All supporting programs must be approved by the Director of Graduate Studies in consultation with the appropriate faculty in the field(s) of the supporting program.

Alternative to Supporting Program.

A student may elect to do a formal minor instead of a supporting program. Students choosing to do so should consult the current Graduate School catalogue for requirements.

Representation of Supporting Program (or minor) on Doctoral Committee.

The Doctoral Committee must include at least one member from the area of the supporting program or minor.

DEPARTMENT-WIDE WRITTEN EXAMINATIONS

INTRODUCTORY STATEMENT

The MS Written Examinations satisfy the Graduate School's requirement that every Master's candidate must pass a comprehensive examination covering all course work done for the degree. All Master's candidates are required to pass these examinations by the deadline established by the Graduate School for the commencement at which they expect to receive the degree.

The Doctoral Basic Written Examinations serve as intra-departmental qualifying examinations for students in the PhD and DrPH programs. PhD students are required to take both a Theory Exam and an Applications Exam. DrPH students are required to take an Applications Exam. These intra-departmental written qualifying examinations are different from the Doctoral Written Examination required by the Graduate School.

The Master's examinations and the Doctoral Basic Written Examinations (PhD and DrPH) are usually offered in July or August. The exact dates of the examinations are set by the faculty, upon the recommendation of the Examinations Committees, after consultation with student representatives. See departmental exam web site for exam dates.

The culminating experiences provide students an opportunity to synthesize, integrate and apply knowledge and skills learned in coursework and other learning experiences and require students to demonstrate attainment of program competencies.

Rules on the maximum number of years to pass the Basic Written Examinations

1. **Doctoral students**

   a. **Eligibility**

      i. **Doctoral Applications Exam** The student must (1) be admitted to the DrPH or PhD program prior to taking the exam (either officially by the university, or a formal conditional admissions offer from the Admissions Committee), (2) be formally registered for the Fall semester of the exam year, and (3) have completed BIOS 762 and BIOS 767.

      ii. **Doctoral Theory Exam** The student must (1) be admitted to the PhD program prior to taking the exam (either officially by the university, or a formal conditional admissions offer from the Admissions Committee), (2) be formally registered for the Fall semester of the exam year, and (3) have completed BIOS 760, 761, 762, and 767.

   b. **Timing of exams**

      i. **Doctoral students admitted directly to doctoral programs** Doctoral students are expected to take the Basic Written Examination right after they finish the required core courses, which is typically after their 1st or 2nd year in the program. In all cases, they are required to have taken all required PhD or DrPH Basic Written Examinations by the end of the 3rd year after they started in the doctoral program. In addition, they must pass all required PhD or DrPH Basic Written Examinations by the end of the 4th year.

ii. **Doctoral students proceeding from the Master's programs** Doctoral students who proceed from the Masters programs are expected to take the Basic Written Examinations at the end of the 1st year started as a doctoral student, and they are required to have taken all required PhD or DrPH Basic Written Examinations by the end of the 2nd year after they started in the doctoral program. They are required to pass all PhD or DrPH Basic Written Examinations by the end of the 3rd year in the doctoral program.

c. **Priority funding based on exam status**

i. Any doctoral student must pass the Basic Written Examinations by the end of the 3rd year in order to receive priority for funding. No student should receive more than four years of funding without passing all Basic Written Examinations for his or her program.

d. **Special considerations**

i. Part time students are allowed to have an extra year for these deadlines if requested.

ii. Medical leave of absence or other approved leave of absence will stop the clock for these deadlines/guidelines.

2. Master's students

a. **Eligibility**

i. **MS Exam Part I** The student must (1) be admitted to the MS program prior to taking the exam (either officially by the university, or a formal conditional admissions offer from the Admissions Committee), (2) be formally registered for the Fall semester of the exam year, and (3) have completed (or be formally exempted from) BIOS 660 and 661.

ii. **MS Exam Part II** The student must (1) be admitted to the MS program prior to taking the exam (either officially by the university, or a formal conditional admissions offer from the Admissions Committee), (2) be formally registered for the Fall semester of the exam year, and (3) have completed (or be formally exempted from) BIOS 511, 662 and 663

b. **Timing of exams**

i. Master's students are expected to take the Master's Written Examinations right after they finish the required core courses, which is typically after their first year in the program. They are required to have taken the Master's Written Examinations by the end of the 2nd year after starting in the Master's program. They are also required to pass the Masters Written Examination by the end of the 3rd year/beginning of the 4th year in the program.

c. **Special considerations**

i. Part time students are allowed to have an extra year for these deadlines if requested.

ii. Medical leave of absence or other approved leave of absence will stop the clock for these deadlines/guidelines.

FORMAT AND SCHEDULING

MS and PhD examinations are composed of two parts: Theory and Applications. The exam formats are as follows:

	Theory Exam	**Applications Exam**
MS:	3 Questions (6 hours, in-class, closed book)*	3 Questions (6 hours, in-class, open book)**
PhD:	2 Questions, Day 1 (4 hours)*** 2 Questions, Day 2 (4 hours)*** (in-class, closed book)	4 Questions (5 days, take-home, open-book)
DrPH:	(not applicable)	4 Questions (5 days, take-home, open-book)

*For the MS Theory exam, numerical and mathematical distribution tables will be provided. Students can bring one 8"*11" sheet of paper ("study guide") with hand-written notes **in blue ink on only one side**. These specifications of the study guide will be strictly enforced. Study guides not satisfying these specifications will not be allowed in the exam room. Calculators will be provided - students are not allowed to use their own calculators. Other electronic devices (e.g., laptops, tablets, phones) are not allowed.

**Students may only bring four text and reference books to the MS Applications exam. A printed set of class notes or set of slides counts as one book.
In the MS Applications exam, electronic copies, such as PDF files of instructor-supplied class notes from the UNC BIOS classes covered in the respective exams are allowed, and they do not count toward the totals given above. All files should be brought on a USB drive (online storage such as DropBox and Google Drive is not allowed). Electronic copies of class textbooks are also allowed. Internet access is allowed only for online SAS documentation at sas.com (not any other website), R help files and dictionary websites (including Google Translate). No other electronic media are permitted. Some specific examples: Access to online calculators, explanations, comments, blogs and forums, examples, courses, videos, instructional material, and class notes is not allowed. Any exceptions must be with explicit approval from the chair of the Masters Exam Committee (for example, a student who had BIOS 663 waived and would like to use class notes in PDF format from a similar class taken at another university).

The MS Theory exam will be proctored remotely if an in-class exam is discouraged. The 3-question exam will be divided into 3 sections. Each section includes 1 question for 2 hours. Students will be asked to scan their answers into a PDF file and send it out as instructed at the end of each section. Students will need to prepare the numerical and mathematical distribution tables, a study guide, and a basic calculator. A phone equipped with text/voice capability is also required for communication during the exam.

The MS Application exam will be taken at home if an in-class exam is discouraged. It will not be proctored remotely. The limitation of the resources use stated in the in-class exam will be lifted. Students will be asked to scan their answers into a pdf file and send it out as instructed at the end of the exam.

***Exams will be proctored remotely if an in-class exam is discouraged. For remote exams, the exam on the same day will be further divided into 2 sections. Each section includes 1 question for 2.5 hours.

NOTE: Students who plan to take any of the exams need to sign up with the Registrar by the date specified on the departmental exam website.

GRADING OF DEPARTMENT-WIDE WRITTEN EXAMINATIONS

The Examinations Committees prepare and conduct all department-wide written examinations and handle arrangements for their grading.

Papers are coded so that the graders are unaware of the students' identities. Each student is given a grade of Pass or Fail. For MS exams, a Provisional Pass can be given.

A team of two graders is appointed for each question. Where possible, all graders are members of the Department of Biostatistics and of the Graduate Faculty.

The student's answer to an individual question is marked independently by each of the two graders on a scale of 0 to 25. The mark awarded reflects the effective proportion of a question correctly answered. After grading, graders will resolve any major discrepancies in their respective marks.

A small committee consisting of the department chairs, the exam committee chairs, and the DGS make a recommendation on which students pass or fail, then the BIOS faculty vote to approve the recommendation.

Examination papers are not identified to author until after the verdicts of Pass and Fail (and Provisional Pass for MS exams) have been rendered.

The Chair of the Examinations Committee notifies all students by letter of the pass/fail/provisional pass decision and, if applicable, any special commendations. Advisors are also free to notify their advisees of the pass/fail results. No further information will be released to the students.

A student whose performance was not of the standard required may be re-examined at the next regularly scheduled examination, or at an earlier date set by the Examinations Committee. One re-examination is permitted automatically.

Rules for Master's Re-Exams in Jan/Feb

The purpose of offering the MS re-exams in Jan/Feb of a particular year is to provide the students an opportunity to satisfy the MS degree requirements for subsequent May or August graduation during that year. Students who are eligible for taking the re-exams are those who are in a terminal MS degree program, will have finished all the course requirements and the MS paper for May or August graduation, but have failed exactly one part of the two-part Written Examination in the previous year.

To be eligible for taking the re-examination, students: (i) must have failed exactly one part of the MS Written Examination; (ii) must not be admitted to a doctoral program in Biostatistics; and (iii) must have completed at least 1 full year of residency in the BIOS graduate program.

Taking the re-examination is counted as 1 attempt to pass the MS Written Examination. Students who did not pass the MS Written Examination are not obligated to take the re-examination in Jan/Feb if they prefer to take the next regularly scheduled MS Written Examination.

Rules for PhD Re-Exams in December

A retake examination for the PhD Theory Exam will be given after final exams in December. This retake will count as a second attempt and only students who fail the PhD Theory Exam will be eligible to sit the exam in December. In order to retake the exam in December, students must register for 3 credits of 990 and retake either 760 or 762 or both, depending on their performance on day 1 and day 2 of the July/August exam. Specifically, if the passing line is set at X% for the day 1 exam, then students, who score below X% on day 1 would retake 760 (under the 990 number), and students who score below X% on day 2 would retake 762. For the December retake only, a student only needs to retake the day or days upon which the July/August exam score was below X%. Students who do not pass the retake exam in December will need to petition for permission for a third attempt to take the exam again the following year. This retake is optional; students may elect to wait and take the entire PhD Theory exam again the following July/August.

AVAILABILITY OF OLD EXAMS

All recent and old examinations are available on the following web site: Please use Internet Explorer. https://www.bios.unc.edu/distrib/exam/.

TOPICS COVERED ON THE MS WRITTEN EXAMINATIONS

The questions in each part of the written examination for the **MS** degree in Biostatistics may cover topics in the following courses:

BIOS 511	Introduction to Statistical Computing and Data Management
BIOS 660, 661	Probability and Statistical Inference
BIOS 662	Intermediate Statistical Methods
BIOS 663	Intermediate Linear Models

TOPICS COVERED ON THE DOCTORAL BASIC WRITTEN EXAMINATIONS

The PhD Theory Exam covers theoretical aspects of statistics at the level and content of the following courses:

BIOS 760, 761, 762, 767 and relevant prerequisites.

The Doctoral Applications Exam covers applied aspects of statistics at the level and content of the following courses:

BIOS 762, 767 and relevant prerequisites.

Starting in 2022 the Doctoral Applications Exam will also cover Bios 735.

HONOR CODE - WORKING INDEPENDENTLY

In the performance of laboratory and homework assignments, the student may use all available sources of information and assistance. These include directions and suggestions by the instructor and course assistants, and **(IF PERMITTED)** consultations with other students. However, the final assembly and writing up of the report on an assignment are to be completely in the individual student's words.

Completely individual work is expected on both in-class and take-home examinations, without discussion among students and others after the examination has been distributed.

In accordance with the University's Honor Code, the submission of any homework report or test paper by a student implies a pledge of originality of the authorship. It is the student's responsibility to seek clarification from the appropriate faculty member in case of any question as to whether particular behavior might be perceived as an Honor Code violation. Evidence of violations will be reported directly to the Honor Court (http://honor.unc.edu).

INSTRUCTORS MAY MODIFY THIS POLICY AND PLEDGE AS APPROPRIATE FOR THEIR COURSES BY WRITTEN NOTIFICATION TO THEIR STUDENTS.

Typical honor pledge:

"In recognition of and in the spirit of the honor code, I certify that I have neither given nor received aid on this examination."

GUIDELINES FOR THE WRITTEN FORMAT DOCTORAL DISSERTATION

The Graduate School Thesis and Dissertation Guide
Visit: *http://www.gradschool.unc.edu/etdguide/* to access detailed instructions.

Introduction

Please read this manual carefully before preparing your thesis/dissertation. Staff in the Enrolled Student Office of The Graduate School is available to assist you in preparing and submitting your thesis/dissertation. You are encouraged to call the office at (919) 962-6313 (last names A-G) or (919) 962-6316 (last names H-Z) or stop by Bynum Hall if you have questions about these guidelines. **"IT IS THE RESPONSIBILITY OF THE STUDENT TO ENSURE THE DISSERTATION MEETS THE HIGHLY DETAILED, RIGOROUS GUIDELINES OF THE GRADUATE SCHOOL. STUDENTS ARE WARNED THAT IT MAY TAKE NUMEROUS ITERATIONS TO OBTAIN FORMAT APPROVAL FROM THE GRADUATE SCHOOL, AND STUDENTS SHOULD ANTICIPATE DELAYS. THE GRADUATE SCHOOL WILL PROVIDE FEEDBACK ON WHETHER DISSERTATIONS MEET THEIR GUIDELINES. STUDENTS WHO WAIT TO THE LAST MINUTE MAY BE DELAYED IN GRADUATION IF THEIR DISSERTATIONS ARE NOT IN THE APPROPRIATE FORMAT.** The format found on G:\dissertation\templates is an excellent starting place, but students should anticipate having to make formatting changes even with this format, as the graduate school guidelines may change."

This Guide is not meant to be an exhaustive manual. For specific questions of style, consult the most recent edition of the style manual used in your disciplinary field (e.g., Kate L. Turabian, *A Manual for Writers of Term Papers, Theses, and Dissertations*; *The MLA Style Manual*; and the *American Psychological Association (APA) Style Manual*). When using a style manual, follow the specifications for published documents, but do not include typesetting notations often used when submitting manuscripts to a publisher. Microsoft Word offers online assistance: Microsoft Word training courses.

If there is a discrepancy between a style manual and this guide, the regulations set forth in this Graduate School guide take precedence. **Please do not use another thesis/dissertation as a model for your work since a particular style or example in a previous year may not meet current guidelines.** Also, certain commonly used software packages may require format modifications in order to comply with Graduate School guidelines.

POLICIES FOR CHANGING DEGREE PROGRAMS

The Department of Biostatistics permits students matriculated into a program to switch (or proceed) to a different degree program. The following paragraph describes the process involved in this action:
1. The Graduate Admissions Committee will handle such requests and make a recommendation to the department Chair to approve/disapprove such requests.
2. Students currently enrolled in a doctoral program (PhD or DrPH program) will be permitted to enroll in MS degree concurrently with their current training in the doctoral program.

REQUESTS TO PROCEED/BYPASS TO (PHD) PROGRAM FROM THE (MS) PROGRAM
A student currently enrolled in a MS program and interested in continuing to the PhD program should discuss his/her interest with his/her academic advisor early about any supplementary mathematics (real analysis) or biostatistics (BIOS 611, 660, 661, 662, 663, 667 and 680) coursework needed.
Proceed request applies to MS students (typically 2nd year MS) who intend to satisfy all requirements for the master's degree before proceeding to the doctoral level. All proceed requests must be submitted by December 1 to the admissions committee.

Bypass request applies to MS students (typically 1st year MS) who intend to bypass the master's degree and proceed to the doctoral level. All bypass requests must be submitted by March 15 to the admissions committee. For those who intend to proceed/bypass to the doctoral level, it is highly recommended that you take the Bios 672 and Bios 673 sequence instead of the Bios 660 and Bios 661sequence.

To apply, students must provide a one-page statement of purpose that explains what they expect to gain from the PhD level training. In addition, each such student must request his/her advisor to provide a letter of support for the plans for the requested switch.

Comments on research promise (perhaps as shown plans for or progress in the masters' paper) will be especially valuable. Students can apply for admission to the PhD program after completion one year or beyond in the MS program. Requests for approval to proceed to the PhD program are subject to review and recommendation by the Graduate Admissions Committee which seek recommendations from the advisor and as well as instructors of MS core or equivalent courses the student has completed (BIOS 660, 661, 662, 663, 667 and 680 for each student). The department chair reviews the Admissions Committee's recommendation for each student to proceed to the PhD program and with concurrence notifies each such student the decision to proceed.

Notes: A graduate student who plans to switch to a new degree will not be permitted to take comprehensive examinations of new program until the student has been formally admitted to the new program. An exception to this rule is that the students in dual degree BSPH/MS program who have completed BSPH course work as well as the first year MS courses are allowed to take MS comprehensive exam before formally matriculated into the MS part of the degree. In such case, for each student the approval must come from the Director of Graduate Programs or examinations.

INSTRUCTIONAL ASSISTANTS

DEFINITIONS

Instructional Assistant (IA) includes:

- Grading Assistant (GA). These are paid assistants (graders) or students who must satisfy the requirement as part of their training grant who do not teach.
- Teaching Assistant (TA). These include students formally enrolled in BIOS 850 and graduates of BIOS 850.

Duties and Compensation of IAs

In what follows, the designation Instructional Assistant (IA) refers to either a Grading Assistant (GA) or a Teaching Assistant (TA). The TA designation refers to students who are taking BIOS 850 for credit in a particular semester. Without exception, TA positions are only available for service courses (e.g., BIOS 600 and BIOS 645) in the UNC Dept. of Biostatistics or for BIOS 662/663/664/665/667/680 if there are more than 20 non-bios SPH students (1 TA for 20-39 non-bios SPH students and 2 TAs for >= 40 non-bios SPH students). If there are more TA's than service courses require, they may petition the Director of Graduate Studies to TA for other non-service BIOS courses, such as BIOS 663 and 664. See page 61 for more details.

Assignment of IA's is as follows, BIOS classes having between 5 and 25 enrolled students will be permitted to have exactly one IA; BIOS classes having between 26 and 50 enrolled students will be permitted to have exactly two IAs; and, BIOS classes having between 51 and 75 enrolled students will be permitted to have exactly three IAs. Every additional 25 enrolled student will be permitted to have one additional IA.

GAs that are not on a training grant will be compensated for their services. TAs will not be compensated for their services since they are receiving academic credit for BIOS 850. Decisions concerning the amount of compensation per course for GAs in any academic year will be made by the Chair of the UNC Department of Biostatistics prior to the start of the academic year.

BIOS student supported as a predoctoral trainee by a Federally-funded training grant in the UNC Department of Biostatistics will be required to serve without compensation as a GA for one course in each academic year in which that student receives training grant support.

Duties of GAs (graders)

The primary duties of GAs are:

1. Grading of examination questions requiring no subjective judgment (e.g., multiple-choice type) and of homework problems (whether subjective or objective). Policies on work turned in late, turnaround time for grading, and the like, should be negotiated between instructors and GAs in advance.

2. Holding office hours for up to 2 hours per week, during which time students, on a one-on-one basis, may receive further help as necessary. The time for office hours should be negotiated by instructors and GAs in advance. GAs are responsible for securing a suitable place for office hours through the Rooms.

3. Graders are expected to grade roughly 5 hours/week over the course of a semester, though the work is highly variable so that students should expect that some weeks may involve no grading while others involve a greater number of hours. **NOTE:** Other duties of benefit to the course (e.g., copying, dataset management, maintaining class records) may be assigned to GAs when it is not convenient to use staff personnel instead. However, any such duties are to be at most incidental to the primary duties. Note also that Departmental policy does not permit GAs to grade subjective examinations, and **GAs are never required to teach classes or give lectures.**

4. The graders for 700 level courses should be initiated by the instructor for the course.

OBJECTIVES

By serving as GAs, BIOS students:

a. are stimulated to review and consolidate their knowledge;
b. receive a useful introduction to teaching activities, with which most will become involved as part of their careers;
c. acquire skill in communicating with members of other disciplines, which is essential for effectiveness as a biostatistician;
d. provide faculty with opportunities to observe their performance, which aid in evaluating the student and in writing effective and convincing recommendations.

Duties of TAs

While the complete duties of a TA will necessarily vary depending on the particular faculty member and course, TAs are usually required to perform the following:

1. Conduct weekly laboratory or review sessions. While much of the time spent in the laboratory may be devoted to answering questions arising from the instructor's lectures, homework, or examinations, the TA may be expected to prepare a brief review lecture or demonstration.

2. Meet with the instructor each week, prior to the laboratory session, to ensure that the TA understands the level and emphasis of the current lecture materials and homework assignments.

3. Present 1-2 regular class lectures during the semester, or weekly structured lab session, with the instructor observing and evaluating at least one lecture.

Subject to the limitation on time requirements stated below, the TA may additionally be required by the instructor to perform some or all of the following duties:

4. Maintain computer-based data files for homework and examination problems.

5. Assist in preparation of class materials such as handouts.

6. Assist in the preparation of homework and/or examinations, including solution guides.

7. Attend the instructor's lectures and/or personally do the assigned homework.

8. Read, and/or discuss with the instructor, material on statistical pedagogy. (TAs enrolled in BIOS 850.

Time Requirements

TAs must pre-register for 3 hours of BIOS 850. A student can receive credit for BIOS 850 only once. This translates into 10 hours of work per week on average. TAs may not be expected to work more than an average of 15 hours per week during the semester**. The instructor should be notified as soon as it appears that these time restrictions may be exceeded. All doctoral students are REQUIRED to register for BIOS 850 within three years of starting their program.**

Resolution of Problems

If TAs cannot resolve problems involving these guidelines with the instructor, they should contact the Director of Graduate Studies. All TAs are strongly encouraged to submit an evaluation of their experiences to the DGS at the end of the semester so that these guidelines may be monitored more effectively.

QUALIFICATIONS OF IAs

IAs must be given responsibilities that commensurate with their qualifications.

a. All IAs must be enrolled graduate students, and in "good academic standing" (which implies that their academic performance represents reasonable progress toward the degree and warrants continuation in the program).

b. All IAs must have taken the courses in which they assist, or equivalent courses, except for elementary service courses.

c. All TAs must have demonstrated oral proficiency in English, as approved by the instructors of the courses in which they are to assist. Those TAs whose native language is not English must have passed the ETS Test of Spoken English (TSE) or some other formal screening test approved by the University.

SUPERVISION AND MENTORING OF IAs

IAs must be properly supervised and mentored in their roles.

GAs:

1. The instructor should review and discuss this section of the AIM with the GA prior to the start of the semester.

2. The instructor must provide the GA with at least a rough sketch of acceptable answers for all homework exercises and must also provide instructions regarding how to distribute points among the assigned questions.

3. The instructor should meet with the GA as needed so that the GA is informed about such matters as: progress through the course's text, which parts of the course (i.e., topics) typically require emphasis/explanations in the GA's individual help sessions, coverage of homework assignments, and dates for assigned homework and examinations.

TAs:

1. The instructor should review and discuss this section of the AIM with the TA prior to the start of the semester.

2. The instructor should meet with the TA each week so that the TA is informed about such matters as: progress through the course's text, which parts of the course (i.e., topics) typically require emphasis/explanations in the TA's weekly review and individual help sessions, coverage of homework assignments, and dates for assigned homework and examinations. In addition, the instructor should discuss at least the general outline of what is to be covered by the TA in the review/laboratory session so that the TA can provide additional explanations/details regarding what was covered in lectures.

3. The TA will ordinarily be required to give one or two of the general lectures during the semester, with the instructor observing and evaluating. In addition, the TA and the instructor should consider the desirability of having the TA’s weekly help session observed at least once during the semester in order to assess further the TA's overall progress in teaching.

4. The TA experience may be enriched by bringing the TAs together at the end of the semester to facilitate discussions among them and the faculty in order to share their experiences and to offer suggestions about how to improve the TA process.

EVALUATION OF IAs

IAs must be fairly evaluated, with public recognition when performance is outstanding.

1, The instructor of a class with one or more IAs is expected to survey the class near the end of the semester, as part of the course evaluation, about the quality of the supplemental

instruction and assistance provided to the students by the IA. The results of the survey should be communicated to the IAs and reported to the DGS.

ASSIGNMENT OF IAs

IAs must be assigned in accordance with procedures that are open, reasonable, and fair.

1. The Registrar's Office, in conjunction with faculty input, makes all IA assignments for the entire academic year. Non-service courses are not guaranteed to be assigned an IA unless 5 or more students are enrolled for credit. As a general guideline, BIOS service courses get 1 IA if 5 students are enrolled and get an additional IA for each 25 students (total) enrolled. That is, a class with 25 students has 1 IA, 26 -50 students have 2 IA's, etc. Any petition by a BIOS faculty member for extra IAs should be submitted in writing to the Director of Graduate Studies, who will then review the petition with the Departmental Chair.

2. If more students request enrollment in BIOS 850 than are required by the service courses, these additional TAs may be assigned to non-service courses. If there are still too many requests, then priority will be given to students who need BIOS 850 to satisfy degree requirements. Within this group, the more advanced students will be given priority. Other TAs will be assigned only to service courses, when there is an insufficient number of TAs enrolled in BIOS 850 to cover them. Service courses are defined as those for which the primary audience is non-BIOS majors; currently, these are BIOS courses numbered 600 and below.

3, For courses that require both GAs and TAs, TAs will always be given priority in being offered the position.

DEPARTMENTAL LIBRARY AND PUBLICATIONS

Kuebler Library

McGavran-Greenberg Room 3102 is named the Roy R. Kuebler Jr. Conference Room & Library in honor of the late Professor Kuebler (1911-1990), who was Deputy Chair of the Department for many years and was known as a distinguished teacher of statistics. Here are housed two parts of the Departmental Library: the Archives and the Journal Collection. The Archives include Master's Papers and Doctoral Dissertations from the Department up to Spring 2019 (including some early ones by students who were considered "ours" before we had a formal major in Biostatistics); these are bound in black with gold imprinting. There are also bound volumes of the collected papers of three of its illustrious faculty members: Professors Bernard Greenberg, Regina Elandt-Johnson, and Mindel Sheps. The Journal Collection includes current issues, and many back issues of the most important scientific journals for biostatisticians. More extensive online collections of statistical journals can be found on *jstor* or *web of science* through the university library web link *hsl.unc.edu*. The Kuebler Library is available as a reading room except when conferences are in progress. The materials in the Archives and Journal Collection are not to be removed except briefly for copying, unless by express permission of the Department Librarian, TBD.

Students' Reference Collection

This collection is located in the Library, room 3102. It contains about 300 items, including elementary and advanced texts, dictionaries, books of tables, and computer manuals; a searchable list is available in the Bios Library section of *Bios Intranet* https://internal.bios.unc.edu/ . Checking out of materials is allowed via the website by selecting the 'Check out' button for that item. The time limit for checkouts is fourteen (14) days; fourteen (14) day renewals are allowed, but the item must be checked in and checked out again. Email notifications will be sent daily to anyone who has something checked out for more than 2 weeks. Reserved books are not allowed to be checked out.

BIOSTATISTICS COURSES

600 PRINCIPLES OF STATISTICAL INFERENCE (3). Prerequisite, knowledge of basic descriptive statistics. Major topics include elementary probability theory, probability distributions, estimation, tests of hypotheses, chi-squared procedures, regression, and correlation. Fall and spring. Herman-Giddens

610 BIOSTATISTICS FOR LABORATORY SCIENTISTS (3). Prerequisite, elementary calculus. Introduces the basic concepts and methods of statistics, focusing on applications in the experimental biological sciences. Not offered 2020-21.

500H INTRODUCTION TO BIOSTATISTICS (3). Prerequisites, Math 231 and 232. Co-requisite BIOS 511 recommended. Access to SAS software and MS Excel is required. A previous course in statistics (such as AP Statistics or STOR 151) is helpful but not required. Permission of the instructor is required for non-majors. An introductory course in probability, data analysis, and statistical inference designed for the background of BSPH Biostatistics students. Topics include sampling design, descriptive statistics, probability, confidence intervals, tests of hypotheses, chi-square distribution, sets of 2-way tables, power, sample size, ANOVA, non-parametric tests, correlation, and linear regression. Fall. Monaco

511 INTRODUCTION TO STATISTICAL COMPUTING AND DATA MANAGEMENT (4). Prerequisite, previous or concurrent course in applied statistics or permission of the instructor. Introduction to use of computers to process and analyze data, concepts and techniques of research data management, and use of statistical programming packages and interpretation. Focus is on the use of SAS for data management, with an introduction to use of SAS for reporting and analysis. Fall. Eslinger

512 DATA SCIENCE BASICS (3). Prerequisites, must be a MPH student with concentration in Public Health Data Science, appropriate for master's student in quantitative fields. This course will be an introductory course to data science and is required for MPH students with concentration in Public Health Data Science. The goals of the course are to (i) achieve proficiency in the R programming language, with particular emphasis on Tidyverse; (ii) gain familiarity with a suite of data science tools; and (iii) master the practices of good data science; and (iv) learn how to apply the methods and tools to public health datasets. Fall. Pepe-Ranney

540 PROBLEMS IN BIOSTATISTICS (1 or more). Prerequisites to be arranged with the faculty in each case. A course for students of public health who wish to make a study of some special problem in the statistics of the life sciences and public health. Fall, spring, and summer.

541 QUANTITATIVE METHODS FOR HEALTH CARE PROFESSIONALS I (4). Prerequisite, permission of instructor. Course is designed to meet the needs of health care professionals who need to be able to critically appraise the design and analysis of medical and health care studies and intend to pursue academic research careers. Basics of statistical inference, analysis of variance, multiple regression, categorical data analysis, and an introduction to logistic regression and survival analysis. Emphasis is on applied data analysis of major health care studies. Not offered 2020-21.

542 QUANTITATIVE METHODS FOR HEALTH CARE PROFESSIONALS II (4). Prerequisites, BIOS 541 and permission of instructor. Continuation of BIOS 541; main emphasis is on logistic regression; other topics include exploratory data analysis and survival analysis. Not offered 2020-21.

611 INTRODUCTION TO DATA SCIENCE (4). Topics will include gaining proficiency with R, tidyverse tools, data wrangling, data quality control and cleaning, data visualization, exploratory data analysis, introductory applied optimization, with an overall emphasis on the principles of good data science—particularly reproducible research and effective communication. Some emphasis will be given to large data settings such as genomics or claims data. The course will also develop familiarity with other common languages such as Python, and software tools for data science best practices, such as Git, Docker, Jupyter and Nextflow. Fall. Toups

635 INTRODUCTION TO MACHINE LEARNING (3). Prerequisite, BIOS 512, 650, or equivalents. Description: This course will be an introductory course to machine learning and statistical learning. While some technical details will be covered, emphasis will be made on understanding the models, intuitions, and strengths and weaknesses of the various approaches. The goal is to equip students with knowledge of existing tools for data analysis and to get students prepared for more advanced courses in machine learning. Programming language will be R – students will

learn how to use the free and powerful software R in connection with each of the methods exposed in the class. Spring. TBA

645 PRINCIPLES OF EXPERIMENTAL ANALYSIS (3). Prerequisites, BIOS 600 or equivalent; a basic familiarity with a statistical software package (preferably SAS) that has the capacity to do multiple linear regression analysis; permission of the instructor except for majors in Gillings School of Global Public Health. Continuation of Biostatistics 600; the analysis of experimental and observational data, including multiple regression, and analysis of variance and covariance. Spring. Laux

650 BASIC ELEMENTS OF PROBABILITY AND STATISTICAL INFERENCE I (GNET 150) (3). Prerequisite, MATH 232 or equivalent. Fundamentals of probability, discrete and continuous distributions; functions of random variables; descriptive statistics; fundamentals of statistical inference, including estimation and hypothesis testing. Fall. Truong

660 PROBABILITY AND STATISTICAL INFERENCE I (3). Prerequisite, MATH 233 or equivalent. Probability theory; discrete and continuous random variables; expectation theory; bivariate and multivariate distribution theory; regression and correlation; linear functions of random variables; theory of sampling. Fall. Ivanova

661 PROBABILITY AND STATISTICAL INFERENCE II (3). Prerequisite, BIOS 660. Distribution of functions of random variables; Helmert transformation theory; central limit theorem and other asymptotic theory; estimation theory; maximum likelihood methods; hypothesis testing; power; Neyman-Pearson Theorem, likelihood ratio, score, and Wald tests; noncentral distributions. Spring. F-C. Lin

662 INTERMEDIATE STATISTICAL METHODS (4). Corequisites, BIOS 511, 650, or equivalents. Principles of study design, descriptive statistics, and sampling from finite and infinite populations, with particular attention to inferences about location and scale for one, two, or k sample situations. Both distribution-free and parametric approaches are considered. Gaussian, binomial, and Poisson models, one-way and two-way contingency tables, as well as related measures of association, are treated. Fall. Couper

663 INTERMEDIATE LINEAR MODELS (4). Prerequisite, BIOS 662 or equivalent. Matrix-based treatment of regression, one-way and two-way ANOVA, and ANCOVA, emphasizing the general linear model and hypothesis, as well as diagnostics and model building. The course begins with a review of matrix algebra, and it concludes with some treatment of statistical power for the linear model and with binary response regression methods. Spring. Zou

664 SAMPLE SURVEY METHODOLOGY (4). Prerequisite, BIOS 650 or equivalent or permission of the instructor. Fundamental principles and methods of sampling populations, with primary attention given to simple random sampling, stratified sampling, and cluster sampling. Also, the calculation of sample weights, dealing with sources of nonsampling error, and analysis of data from complex sample designs are covered. Practical experience in sampling is provided by student participation in the design, execution, and analysis of a sampling project. Spring. Shook-Sa.

665 ANALYSIS OF CATEGORICAL DATA (3). Prerequisites, BIOS 650, 662, and 663 or equivalent. Introduction to the analysis of categorized data: rates, ratios, and proportions; relative risk and odds ratio; Cochran-Mantel-Haenszel procedure; survivorship and life table methods; linear models for categorical data. Applications in demography, epidemiology, and medicine. Fall. Koch and Schwartz

667 APPLIED LONGITUDINAL DATA ANALYSIS (3). Prerequisite: analysis of variance and (multiple) linear regression at the level of Bios 545 and/or Bios 663. Familiarity with matrix algebra is also useful. Univariate and multivariate repeated measures analysis of variance, general linear model for longitudinal data, linear mixed model, generalized linear and population-averaged models for non-normal responses. Estimation and inference, maximum and restricted maximum likelihood, fixed and random effects, balanced and unbalanced data. Fall. Qaqish

668 DESIGN OF PUBLIC HEALTH STUDIES (3). Prerequisites, BIOS 511, 545, 650, or equivalents. Statistical concepts in basic public health study designs: cross-sectional, case-control, prospective, and experimental (including clinical trials). Validity, measurement of response, sample size determination, matching and random allocation methods. Spring. Tan

669 WORKING WITH DATA IN A PUBLIC HEALTH RESEARCH SETTING (3). Prerequisite, BIOS 511, EPID 700, or permission of the instructor. This course provides a conceptual foundation and practical training to students

who will be working with data from clinical trials or other public health research studies. Topics include SQL, producing, checking, and using analysis data sets, advanced reporting tools, using metadata, look-up tables, web scraping, regular expressions, , and doing simulation with SAS. Spring. Roggenkamp

670 DEMOGRAPHIC TECHNIQUES I (3). Source and interpretation of demographic data; rates and ratios, standardization, complete and abridged life tables; estimation and projection of fertility, mortality, migration, and population composition. Not offered 2020-21

672 PROBABILITY AND STATISTICAL INFERENCE I (4). Prerequisite, MATH 233 or equivalent. Introduction to probability; discrete and continuous random variables; expectation theory; bivariate and multivariate distribution theory; regression and correlation; linear functions of random variables; theory of sampling; introduction to estimation and hypothesis testing. Taylor's series, Riemann, Stieltjes and Lebesgue integration, complex variables and Laplace transforms. Fall. Ivanova

673 PROBABILITY AND STATISTICAL INFERENCE II (4). Prerequisite, BIOS 660. Permission of the instructor for students lacking the prerequisite. Distribution of functions of random variables; central limit theorem and other asymptotic theory; estimation theory; hypothesis testing; Neyman-Pearson Theorem, likelihood ratio, score, and Wald tests; noncentral distributions. Advanced problems in statistical inferences, including information inequality, best unbiased estimators, Bayes estimators, asymptotically efficient estimation, nonparametric estimation and tests, simultaneous confidence intervals. Spring. F-C. Lin

680 INTRODUCTORY SURVIVORSHIP ANALYSIS (3). Prerequisite, BIOS 661 or permission of the instructor. Introduction to concepts and techniques used in the analysis of time to event data, including censoring, hazard rates, estimation of survival curves, regression techniques, applications to clinical trials. Spring. Zhou

691 FIELD OBSERVATIONS IN BIOSTATISTICS (1). Field visits to, and evaluation of, major nonacademic biostatistical programs in the Research Triangle area. (Field fee $25). Fall. Chen

735 STATISTICAL COMPUTING (4). Prerequisites, BIOS 660, 661, 662, and 663; one programming class at the undergraduate level or equivalent training; prior R experience. This class teaches important concepts and skills for statistical computing, numerical optimization, and machine learning using case studies. Topics include: writing efficient R code, building R packages, handling large datasets, general optimization, EM and variants, linear and quadratic programming, numerical integration, general and advanced MCMC, machine learning essentials, SVMs, random forests, gradient boosting, and deep learning. Spring. Rashid

740 INTRODUCTION TO PRECISION MEDICINE (3). Prerequisities, BIOS 661 or equivalent, a graduate course in advanced statistical methodology (BIOS 663 or equivalent), and familiarity with programming in R. seeks to maximize the quality of healthcare by individualizing the healthcare process to the uniquely evolving health status and circumstances of each patient. This endeavor spans many scientific disciplines, including biomedical science, genetics, statistical science, machine learning, psychology, and many other areas, all in support of evidence-based, data-driven decision support. In this course, we will address precision medicine from a statistical and machine learning perspective with numerous examples of application. We will develop a working knowledge of the following inter-related areas in the context of precision medicine and precision health: dynamic treatment regimes, causal inference for precision medicine; basic machine learning tools including support vector machines and random forests; the single decision setting, outcome weighted learning and extensions of outcome weighted learning; the multi decision setting, reinforcement learning, sequential multiple assignment randomized trials (SMARTs), mobile health, micro-randomized trials, and Markov decision processes; advanced machine learning including deep learning, Gaussian processes, and adversarial learning; relevant statistical inference issues; and several topics on the frontiers of the area. Not offered 2020-21

740 (002) INTRODUCTION TO MULTIVARIATE SURVIVAL ANALYSIS AND STUDY DESIGN (3). Prerequisites, BIOS 780 or permission of the instructor. This course will introduce statistical methods for analyzing correlated failure time data. Topics will include bivariate survival function estimation, various models for analyzing correlated failure time data (intensity models, marginal models, and frailty models), recurrent events, competing risks, cost-effective study designs involving survival outcomes (case-cohort study design, nested case-control sampling, other outcome-dependent sampling design), and joint modeling of survival and longitudinal outcomes. The course will cover recent developments in the literature and highlight potential areas for further research. Not offered 2020-21

740 (003) INTRODUCTION TO REGULATORY SCIENCE (3). Prerequisites, BIOS 668 OR 752, or EPID 733, or permission of instructor. This course will introduce regulatory science as it pertains to clinical trials conducted as part of drug development programs, with an emphasis on regulatory guidelines impacting statistical aspects of trial design, analysis, conduct, and reporting. Regulatory considerations of both pre-market and post-market studies will be reviewed. A brief history of drug regulation in the US will be provided, including the evolution of thought concerning what constitutes substantial evidence to support drug approval and marketing. International harmonization of regulatory requirements will also be discussed. Example topics include multi-regional clinical trials; estimands, missing data and sensitivity analyses; complex innovative trial designs; pharmacometric analyses; statistical methods for dose finding and dose-response estimation; meta-analysis for drug safety; post-market safety surveillance; and use of real-world data to support regulatory decisions. The class will cover recent advancements in regulatory science at FDA and highlight potential areas where further statistical research is needed. Not offered 2020-21

740 (004) INTRODUCTION TO STATISTICAL LEARNING AND PERSONALIZED MEDICINE (3)
The first part of the course gives an introduction to statistical learning methods, including a complete review of supervised learning methods (discriminant analysis, kernel methods, nearest neighborhood, tree methods, neural network, support vector machine, random forest, and boosting methods) and unsupervised learning methods (principal component analysis, factor analysis, cluster analysis, multidimensional scaling, self organizing map). R-functions and real data demo are used for illustration. It also includes learning theory for supervised learning methods such as Bayesian error, concentration inequalities, VC-theory, risk bound and etc. The second part of the course focuses on recent development of statistical methods for personalized medicine, with particular emphasis on using statistical learning methods. This part starts with potential outcome framework and concepts of dynamic treatment regimes, discusses the use of observational studies and sequentially randomized trials for this context, then introduces the methods based on reinforcement learning, Q-learning, A-learning, G-computation, and O-learning for optimal dynamic treatment regimes in personalized medicine. Spring. Zeng

752 DESIGN AND ANALYSIS OF CLINICAL TRIALS (3) Prerequisites, BIOS 660, and 661 or permission of the instructor. This course will introduce the methods used in clinical trials. Topics include dose-finding trials, allocation to treatments in randomized trials, sample size calculation, interim monitoring, and non-inferiority trials. Not offered 2020-21

759 APPLIED TIME SERIES ANALYSIS (3). Prerequisites, BIOS 661 and 663 or equivalents, and permission of the instructor. Topics include correlograms, periodograms, fast Fourier transforms, power spectra, cross-spectra, coherences, ARMA and transfer-function models, spectral-domain regression. Real and simulated data sets are discussed and analyzed using popular computer software packages. Not offered 2020-21.

760 ADVANCED PROBABILITY AND STATISTICAL INFERENCE I (4). Prerequisite, BIOS 673 or permission of the instructor. Measure space, sigma-field, Lebesgue measure, measureable functions, integration, Fubini-Tonelli theorem, Radon-Nikodym theorem, probability measure, conditional probability, independence, distribution functions, characteristic functions, exponential families, convergence almost surely, convergence in probability, convergence in distribution, Borel-Cantelli lemma, strong law of large numbers, central limit theorem, the Cramer-Wold device, delta method, U-statistics, martingale central limit theorem. Least squares estimation, uniformly minimal variance and unbiased estimation, estimating functions, maximum likelihood estimation, Cramer-Rao lower bound, information bounds, LeCam's lemmas, consistency, asymptotic efficiency, expectation-maximization algorithm, nonparametric maximum likelihood estimation. Fall. Kosorok

761 ADVANCED PROBABILITY AND STATISTICAL INFERENCE II (4). Prerequisite, BIOS 760 or permission of the instructor. Elementary decision theory, utility, admissibility, minimax rules, loss functions, Bayesian decision theory, likelihood ratio, Wald, and score tests, Neyman-Pearson tests, UMP and unbiased tests, rank tests, contiguity theory, confidence sets, parametric and nonparametric bootstrap methods, jackknife and cross-validation, asymptotic properties of resampling methods. Penalized likelihood, regularization methods, and classification. Spring. Q. Li

762 THEORY AND APPLICATIONS OF LINEAR AND GENERALIZED LINEAR MODELS (4). Prerequisites, BIOS 661 and 663, MATH 547, MATH 422or 577. Topics include matrix theory, the multivariate normal distribution, quadratic forms, estimability for linear models, estimation theory for linear and generalized linear models, weighted least squares, multivariate tests of linear hypotheses for linear and generalized linear models, multiple comparisons, confidence regions, analysis of variance, categorical data and contingency tables, case control studies, over-dispersion, quasi-likelihood, and generalized estimating equations. Fall, Ibrahim

764 ADVANCED SURVEY SAMPLING METHODS (3). Prerequisite, BIOS 664 or equivalent. Continuation of Biostatistics 664 for advanced students: stratification, special designs, multistage sampling, cost studies, nonsampling errors, complex survey designs, employing auxiliary information, and other miscellaneous topics. Not offered 2020-21.

765 MODELS AND METHODOLOGY IN CATEGORICAL DATA (3). Prerequisites, BIOS 661, 663, 665, or equivalents. Theory and application of methods for categorical data including maximum likelihood, estimating equations and chi-square methods for large samples, and exact inference for small samples. Fall. Preisser

767 LONGITUDINAL DATA ANALYSIS (4). Prerequisite, BIOS 762. Presents modern approaches to the analysis of longitudinal data. Topics include linear mixed effects models, generalized linear models for correlated data (including generalized estimating equations), computational issues and methods for fitting models, and dropout or other missing data. Spring. Psioda

771 DEMOGRAPHIC TECHNIQUES II (3). Prerequisites, BIOS 670 and integral calculus. Life table techniques; methods of analysis when data are deficient; population projection methods; interrelations among demographic variables; migration analysis; uses of population models. Not offered 2020-21.

772 STATISTICAL ANALYSIS OF MRI IMAGES (3). Prerequisite, BIOS 761and762. This course reviews major statistical methods for the analysis of MRI data and its applications in various studies. Fall. Zhu

773 STATISTICAL ANALYSIS WITH MISSING DATA (3). Prerequisite BIOS 761 and 762. This course will examine fundamental concepts in missing data, including classifications of missing data, missing covariate and/or response data in linear models, generalized linear models, models for longitudinal data, and survival models. Several missing data methodologies will be discussed including maximum likelihood methods, multiple imputation, fully Bayesian methods and weighted estimating equations. Applications in the biomedical sciences will be presented in detail and several cases studies will be examined. Software packages for analyzing missing data include WinBUSG, SAS and R. Not offered 2020-21.

775 STATISTICAL METHODS IN DIAGNOSTIC MEDICINE (3). Prerequisites Bios 761, 762. Material will involve statistical concepts and techniques for evaluating medical diagnostic tests and biomarkers for the detection of disease. Measures for quantifying test accuracy will be discussed. Statistical procedures will be presented for estimating and comparing these quantities, including regression modelling. Worked examples of real data will be used to illustrate the methods. Recent developments in the literature will be covered, with potential areas for further research highlighted and presented for discussion in class. Not offered 2020-21.

776 CAUSAL INFERENCE IN BIOMEDICAL RESEARCH (3). Prerequisite BIOS 661 and 663, or permission of instructor. This course will consider drawing inference about causal effects in a variety of settings using the potential outcomes framework. Topics covered include causal inference in randomized experiments and observational studies, bounds and sensitivity analysis, propensity scores, graphical models, and other areas. Spring. Hudgens

777 MATHEMATICAL MODELS IN DEMOGRAPHY (3). Prerequisite, permission of the instructor. A detailed presentation of natality models, including necessary mathematical methods, and applications; deterministic and stochastic models for population growth, migration. Not offered 2020-21.

779 BAYESIAN STATISTICS (4). Prerequisite, BIOS 762 or equivalent. Description: This course examines basic aspects of the Bayesian paradigm. Topics include Bayes' theorem, the likelihood principle, prior distributions, posterior distributions, and predictive distributions. General topics include Bayesian modeling (including linear, generalized linear, hierarchical, models for longitudinal dokumentation, non-parametric and semiparametric methods, and survival models), informative prior elicitation, model comparisons, Bayesian diagnostic methods, variable subset selection, and Bayesian computational methods. Markov chain Monte Carlo methods for computation are discussed in detail. Spring. Ibrahim

780 THEORY AND METHODS FOR SURVIVAL ANALYSIS (3). Prerequisites, BIOS 760 and 761 or permission of the instructor. Counting process-martingale theory, Kaplan-Meier estimator, weighted log-rank statistics, Cox proportional hazards model, nonproportional hazards models, multivariate failure time data. Fall. Cai

781 STATISTICAL METHODS IN GENETIC MAPPING (4). Prerequisites, BIOS 661 and 663 or permission of the instructors. An introduction to statistical methods commonly used in analyzing animal, plant and human genetic data, with a focus on decomposition of trait variation, linkage analysis, disease mapping and association studies. Specifically, the course covers 1) basic population and quantitative genetic principles, including classical genetics, chromosomal theory of inheritance, and meiotic recombination; 2) QTL mapping methods of complex quantitative traits and linkage methods to detect co-segregation with disease; 3) methods for assessing marker-disease linkage disequilibrium, including case-control approaches, and 4) methods for genome-wide association and stratification control. Not offered 2020-21.

782 STATISTICAL METHODS IN GENETIC ASSOCIATION STUDIES (3) Prerequisites, permission of the instructor. This course provides a comprehensive survey of the statistical methods that have been recently developed for the designs and analysis of genetic association studies. Specific topics include molecular and population genetics, candidate-gene and genome-wide association studies, likelihood inference and EM algorithm, case-control sampling and retrospective likelihood, secondary phenotypes in case-control studies, haplotypes and untyped SNPs, population stratification, meta-analysis, multiple testing, winner's curse, copy number variants, next-generation sequencing studies, rare variants, trait-dependent sampling, variable selection, and risk prediction. This course is targeted primarily at the PhD students and will be taught at a rigorous statistical level. The students will learn the theoretical justifications for the methods as well as the skills to apply them to real studies. They will also be exposed to current research topics and open problems. Fall. Lin and Y. Li.

784 INTRODUCTION TO COMPUTATIONAL BIOLOGY (3). Prerequisites, BIOS 661 and 663, or permission of the instructor. Description: basics of molecular biology and how high-throughput genomic and epigenomics datasets are used to answer biological or biomedical questions. Topics include: reproducible computational biology using git and Rmarkdown, R and Bioconductor for genomic data analysis, high-dimensional data analysis, distances and clustering, batch effects, factor analysis, multiple testing frameworks, EM algorithm, sequence motif analysis, dynamic programming, Bayesian hierarchical models, HMM, and network analysis. Spring. Love

785 STATISTICAL METHODS FOR GENE EXPRESSION ANALYSIS (3). Prerequisites, BIOS 661 and 663, or permission of the instructor. Description: This course is designed to provide students interested in statistical genetics and genomics with an opportunity to gain or enhance knowledge in gene expression and regulation. The course includes four modules: transcription by bulk RNA sequencing, single-cell transcriptomics, gene expression regulation, and integrative analysis. Each module starts with biological background, followed by statistical and computational methods, and finishes with biological interpretations and follow-ups. Topics include: normalization, measurement of error models, dimensionality reduction, zero-inflated factor analysis, clustering algorithms, peak calling, deconvolution, data integration, network analysis, etc. Fall. Jiang

791 EMPIRICAL PROCESSES AND SEMIPARAMETRIC INFERENCE (3). Prerequisites: BIOS 761 or consent of instructor. Description: Theory and applications of empirical process methods to semiparametric estimation and inference for statistical models with both finite and infinite dimensional parameters. Topics include the bootstrap, Z-estimators, M-estimators, semiparametric efficiency. Not offered 2020-21.

841 PRINCIPLES OF STATISTICAL CONSULTING (3). Instructor consent if not a major in the department. Familiarity with either SAS and/or R will be assumed. Students must have completed all courses required for their current degree program or be currently enrolled in remaining required courses. An introduction to the statistical consulting process, the goal of this course is to develop in each student the skills necessary for being a statistical collaborator/consultant of the highest caliber. Emphasized topics include problem solving, study design, data analysis, ethical conduct, teamwork, career paths, data management, and both written and oral communication with scientists and other potential collaborators. Spring. Stewart and Truong

842 PRACTICE IN STATISTICAL CONSULTING (3). Prerequisites, BIOS 511, 545, 650 or equivalents, and permission of the instructor. Bios 841 is a co-requisite. Under supervision of a faculty member, the student interacts with research workers in the health sciences, learning to abstract the statistical aspects of substantive problems, to provide appropriate technical assistance, and to communicate statistical results. *The practicum provides students on opportunity to apply the knowledge and skills being acquired through their coursework and further develop and demonstrate attainment of program competencies.* Fall, spring, and summer.

****International students and BIOS 842***: note that F-1 visa-holding students will need to apply for CPT (Curricular Practical Training) authorization from the UNC OISSS (Office of International Student and

Scholar Services) in order to complete an internship at a company while on a F-1 visa. The UNC OISSS has a rule that F-1 visa-holding students are typically ineligible for CPT authorization if they have completed all coursework and have been approved to register for thesis or dissertation credits only. Therefore, it is suggested to use BIOS 842 enrollment as a mechanism for requesting CPT authorization BEFORE registering for thesis or dissertation credits, if the F-1 visa-holding student is interested in pursuing an internship. For more details, consult this link: http://isss.unc.edu/student-employment/cpt/

843 SEMINAR IN BIOSTATISTICS (1). Prerequisites, (PHD) can be taken only if you have taken theory and applications written qualifying exams and (MS) can only be taken during second year of study. Fall and spring. Staff

844 LEADERSHIP IN BIOSTATISTICS (3). Prerequisites, BIOS 841. Using lectures, guest speakers and group exercises, students are taught fundamentals of leadership, plus where and how biostatisticians can offer leadership in both academic and non-academic public health settings. Topics include leadership styles, 1-on-1 communication, strategic planning, motivation, team management, presentation skills, financial leadership, negotiation, decision making, work-life balance, and more. Guest speakers are biostatisticians in prominent leadership roles in industry, government, academia, and service. Not offered 2020-21.

850 TRAINING IN STATISTICAL TEACHING IN THE HEALTH SCIENCES (3). Prerequisite, a minimum of one year of graduate work in statistics. Principles of statistical pedagogy. Students assist with teaching elementary statistics to students in the health sciences. Students work under the supervision of the faculty, with whom they have regular discussions of methods, content, and evaluation of performance. Fall, spring, and summer.

889 RESEARCH SEMINAR IN BIOSTATISTICS (1-3). Prerequisite, permission of the instructor. Seminar on new research developments in selected biostatistical topics. Fall and spring.

990 RESEARCH IN BIOSTATISTICS (2 or more). Individual arrangements may be made by the advanced student to spend part or all of his or her time in supervised investigation of selected problems in statistics. Fall, spring, and summer.

992 MASTER'S PAPER (3). This course is an introduction to research tools and methods in biostatistics. Topics include literature reviews, introduction to computational facilities in R and SAS, document preparation and writing skills. Students will write and present a proposal for a master's paper project, carry out the project, present it, and document it in the form of a master's paper that satisfies the School's requirements. Spring. Qaqish and Zou

994 DOCTORAL DISSERTATION (Minimum of 3). Fall, spring, and summer.

SPECIAL INTERESTS OF CURRENT BIOSTATISTICS FACULTY

Robert Agans
Associate Professor and Co-Director, Carolina Survey Research Laboratory (CSRL)
PHD 1992 – Texas A&M University
Interest(s): Population –based Research Methods, Multi-mode Data Collection Procedures Questionnaire Development, Standardization and Validation, Hard-to-reach Populations & Minorities

Jianwen Cai
Cary Boshamer Distinguished Professor and Interim Department Co-Chair
PhD 1992 - University of Washington
Interest(s): Survival Analysis, Regression Models, Clinical Trials, Analysis of Correlated Responses

Ding-Geng Chen
Wallace H. Kuralt Distinguished Professor (Joint with School of Social Work)
PhD 1995 – University of Guleph, Canada
Interest(s): Bayesian Model, Survival Analysis, Longitudinal Data Analysis, Multi-level Modelling, Structure Equation Models

David Couper
Professor and Deputy Director, Collaborative Studies Coordinating Center (CSCC)
PhD 1994 - University of Washington
Interest(s): Epidemiological Methods, Longitudinal Data, Data Quality Clinical Trials, Observational Studies,

Jamie L. Crandell
Associate Professor (Joint with School of Nursing)
PhD 2006 – University of North Carolina at Chapel Hill
Interest(s): Bayesian Methods, Longitudinal Data

Tanya P. Garcia
Associate Professor
PhD 2011 – Texas A&M University
Interest(s): High-Dimensional Variable Selection, Longitudinal Data Analysis, Neurodegenerative Diseases, Nonparametric Models, Prediction Models, Semiparametric Models, Survival Analysis

Annie Green Howard
Associate Professor
PHD 2012-University of North Carolina at Chapel Hill
Interest(s): Missing Data, Longitudinal and Correlated data, Latent variables, Structural Equation Models, Cardiovascular Disease, Global Health

Michael G. Hudgens
Professor
PhD 2000 – Emory University
Interest(s): Causal Inference, Epidemiology, Infectious Diseases, Survival Analysis

Joseph G. Ibrahim
Alumni Distinguished Professor and Director of Graduate Studies and Director, Center for Innovative Clinical Trials (Joint with Statistics and Operations Research-STOR)
PhD 1988 – University of Minnesota
Interest(s): Bayesian Inference, Missing Data Problems, Survival Analysis, Generalized Linear Models

Anastasia Ivanova
Professor
PhD 1992 – St. Petersburg State University, Russia
PhD 1998 – University of Maryland
Interest(s): Adaptive designs, Clinical trials

Yuchao Jiang
Assistant Professor
PhD 2017 – University of Pennsylvania
Interest(s): Statistical modeling, methods development, and data analysis in genetics/genomics

Gary G. Koch
Professor and Director, Biometric Consulting Laboratory (BCL)

PhD 1968 - University of North Carolina at Chapel Hill
Interest(s): Categorical Data Analysis, Nonparametric Methods

Michael R. Kosorok
W. R. Kenan, Jr. Distinguished Professor (Joint with Statistics and Operations Research-STOR)
PhD 1991 - University of Washington
Interest(s): Biostatistics, Data Science, Machine Learning, Precision Medicine

Lisa LaVange
Professor and Interim Department Co- Chair; Director, Collaborative Studies Coordinating Center
PhD – University of North Carolina at Chapel Hill
Interest(s): Biostatistical practice and data science, clinical trials, regulatory issues, analysis of complex survey data

Quefeng Li
Assistant Professor
PhD 2013 – University of Wisconsin at Madison
Interest(s): Classification, variable selection, robust estimation and inference of high dimensional data, meta-analysis, personalized medicine

Yun Li
Associate Professor (Joint with Department of Genetics)
PhD 2009 – University of Michigan
Interest(s): Statistical Genetics

Danyu Lin
Dennis Gillings Distinguished Professor
PhD 1989 – University of Michigan
Interest(s): Statistical Genetics, Survival Analysis, Design and Analysis of Medical Studies

Feng-Chang Lin
Associate Professor
PhD 2008 – University of Wisconsin, Madison
Interest(s): Point Process Models, Survival Analysis, Longitudinal Analysis, Neuroscience, Madison Cardiovascular Disease

Yufeng Liu
Professor (Joint with Statistics and Operations Research-STOR)
PhD – The Ohio State University
Interest(s): Statistical machine learning and data mining, bioinformatics

Michael Love
Assistant Professor (Joint with Department of Genetics) Dr. rer. . Nat. 2013, Freie Universitat, Berlin
Interest(s): Computational Biology, Statistical Methods for Investigating High-dimensional Biological Datasets

Jane H. Monaco
Associate Professor and Director of Undergraduate Studies
DrPH 2003 – University of North Carolina at Chapel Hill
Interest(s): Survival Analysis, Statistics Education

James S. Marron
Amos Hawley Distinguished Professor, (Joint with Statistics and Operations Research-STOR)
PhD1982 – University of California at Los Angeles
Interest(s): Smoothing Methods for Curve Estimation

Andrew B. Nobel
Professor (Joint with Statistics and Operations Research-STOR)
PhD 1992 – Stanford University
Interest(s): Statistical Analysis of Gene Expression Data Analysis and Simulation of Internet Traffic Pattern Recognition and Machine Learning Data Mining

John S. Preisser, Jr
Professor
PhD 1995 - University of North Carolina at Chapel Hill
Interest(s): Categorical Data, Longitudinal Data Analysis, Oral Health, Cluster-randomized Trials

Matt Psioda

Assistant Professor
PhD 2016 - University of North Carolina at Chapel Hill
Interest(s): Bayesian Clinical Trial Design, Computational and Statistical Epigenomics, Bayesian Computation

Bahjat Qaqish
Professor
PhD 1990 - Johns Hopkins University
Interest(s): Generalized Linear Models, Correlated Discrete Data, Survival Analysis, Statistical Computing, Statistical Methods in Epidemiology

Naim Rashid
Assistant Professor (Joint with Lineberger Comprehensive Cancer Center-LCCC)
PhD 2013 – University of North Carolina at Chapel Hill
Interest(s): High Dimensional Data Analysis, Cancer, Variable Selection, Genomics, Statistical Genetics, Next Generation Sequencing Data Analysis, Classification

Todd A. Schwartz
Associate Professor (Joint with School of Nursing)
DrPH 2004 – University of North Carolina at Chapel Hill
Interest(s): Mixed Models, GEE, Categorical Data Analysis, Clinical Trials

Bonnie Shook-Sa
Assistant Professor
DrPH 2020 – University of North Carolina at Chapel Hill
Interest(s): Causal Inference Methods, Survey Sampling

Richard L. Smith
Mark L. Reed Distinguished Professor (Joint with Statistics and Operations Research-STOR)
PhD 1979 – Cornell University
Interest(s): Spatial Statistics, Time Series Analysis, Extreme Value Theory and Bayesian Statistics

Daniela Sotres-Alvarez
Associate Professor
DrPH 2010 - University of North Carolina at Chapel Hill
Interest(s): Linear Mixed Models, Latent Variable Models, Dietary and Physical Activity Patterns

Paul W. Stewart
Professor
PhD 1981 - University of North Carolina at Chapel Hill
Interest(s): Linear Models, Incomplete or Censored Longitudinal Data, Pediatric Research, and Pulmonary Research

Xianming Tan
Associate Professor
PhD 2005 – Nankai University
Interest(s): Design and Analysis of Clinical Trails, Model-based Clustering, Longitudinal Data Analysis, Survival Data Analysis

Kinh N. Truong
Professor
PhD 1985 - University of California at Berkeley
Interest(s): Extended Linear Models, Functional Modeling, Hazard Regression, Time Series, Neuro Modeling, and Biochemical Epidemiology

Di Wu
Assistant Professor (Joint with School of Dentistry)
PhD 2011 – Walter and Eliza Institute of Medical Research, University of Melbourne, Australia
Interest(s): Statistical Methods for High Dimensional Omics Data

Donglin Zeng
Professor and Co-Director, Carolina Survey Research Laboratory (CSRL)
PhD 2001 – University of Michigan
Interest(s): High dimensional data, Survival Analysis

Haibo Zhou
Professor
PhD 1992 - University of Washington

Interest(s): Missing/auxiliary Data, Survival Analysis, Human Fertility, Statistical Methods in Epidemiology, Toxicology Risk Assessment

Hongtu Zhu

Professor
PhD 2000 – The Chinese University of Hong Kong
Interest(s): Imaging Statistics, Latent Variable Models

Baiming Zou

Assistant Professor (joint with School of Nursing)
PhD 2013 – University of North Carolina at Chapel Hill
Interest(s): Robust Modeling of Data with Complex Structures, Machine Learning Methods for Large Scale Electronic Health Record Data Analysis.

Fei Zou

Professor and Director of Graduate Admissions
PhD 2001 – University of Wisconsin
Interest(s): Statistical Genetics, Empirical Likelihood, Bioinformatics

LISTS OF IMPORTANT WEB SITES

- Calendars Fall 2020 and Spring 2021 and UNC Academic Calendars
  http://registrar.unc.edu/academic-calendar/

- Graduate School Handbook
  http://handbook.unc.edu/

- Graduate School Forms
  (To obtain a copy of these forms please visit
  http://gradschool.unc.edu/academics/resources/forms.html - OR - stop by the office of the registrar)

- UNC Graduate School and Student Life
  https://gradschool.unc.edu/
  http://gradschool.unc.edu/studentlife/

- Residency
  http://gradschool.unc.edu/studentlife/resources/residency/

- Cost to attend and funding
  http://cashier.unc.edu/
  http://gradschool.unc.edu/funding/

- University Registrar (links to graduation info, courses, residency, etc.)
  http://registrar.unc.edu/

- Departmental Committees and Members for 2020 - 2021
  https://sph.unc.edu/files/2013/08/Committees_2020-2021-Final.pdf

- Graduation Information and Deadlines
  http://gradschool.unc.edu/academics/resources/graddeadlines.html

- Office of Student Conduct-Honor System
  https://studentconduct.unc.edu/

- Student Review Forms
  MS, *DRPH*, *PHD*