The University of Iowa prohibits discrimination in employment, educational programs, and activities on the basis of race, creed, color, religion, national origin, age, sex, pregnancy, disability, genetic information, status as a U.S. veteran, service in the U.S. military, sexual orientation, gender identity, associational preferences, or any other classification that deprives the person of consideration as an individual. The university also affirms its commitment to providing equal opportunities and equal access to university facilities. For additional information on nondiscrimination policies, contact the Director, Office of Equal Opportunity and Diversity, the University of Iowa, 202 Jessup Hall, Iowa City, IA, 52242-1316, 319-335-0705 (voice), 319-335-0697 (TDD), diversity@uiowa.edu.

This handbook is available and updated on the Department of Biostatistics website, www.public-health.uiowa.edu/biostat, under information for current students. It is prepared and maintained by Ms. Terry Kirk, Biostatistics Graduate Program Administrator. Comments and questions may be directed to terry-kirk@uiowa.edu.

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Mission

The overall mission of the Department of Biostatistics has three components. The first is to provide excellent education in biostatistical theory and methods for students in the Department of Biostatistics, the College of Public Health, the Carver College of Medicine, and the University of Iowa. The second component is to conduct outstanding biostatistical research and to collaborate with investigators in conducting outstanding health science research. The third is to use our skills to serve the College of Public Health, the Carver College of Medicine, The University of Iowa, the State of Iowa, and the wider health science community.

Educational Mission

The teaching mission of the Department of Biostatistics is to provide an excellent education in the theory and application of statistical methods used in the health sciences. The scope of this mission covers courses tailored to the other departments within our college, especially epidemiology; introductory courses intended for other colleges, and courses for the training of biostatisticians at the M.P.H., M.S., and Ph.D. levels. For the training of biostatisticians, this program will prepare students to excel in a variety of occupations, including academic positions in colleges of medicine and schools of public health; positions in pharmaceutical and other health-related industries; and positions in local, state, and federal governmental health agencies. All students will be trained in the skilled use of a variety of relevant biostatistical procedures and their software implementation and will gain practical experience by working on collaborative medical projects. Furthermore, Ph.D. students will learn the fundamentals of statistical and biostatistical theory, enabling them to read the biostatistical research literature and to contribute to it.

Administrative Organization

The Department of Biostatistics is one of five departments in the College of Public Health: Biostatistics, Community and Behavioral Health, Epidemiology, Health Management and Policy, and Occupational and Environmental Health.

The Interim Head of the Department of Biostatistics is Dr. Joseph Cavanaugh, who is responsible for administration of the educational, research, and professional service functions of the Department. Dr. Joseph Cavanaugh also serves as Director of Graduate Studies. The department currently has 13 primary faculty (see Appendix A—Biostatistics Faculty and Staff Directory for a list), three emeritus faculty, ten secondary faculty, and five adjunct faculty. Ms. Terry Kirk is Graduate Program Administrator.

More information on the Department of Biostatistics and the College of Public Health can be found at the College of Public Health website: www.public-health.uiowa.edu/.
Centers

The Biostatistics Department maintains several centers; these centers often employ graduate research assistants in fulfilling their missions:

**Biostatistics Consulting Center (BCC)**
The BCC offers biostatistical consulting and data management services to health science researchers at The University of Iowa. Full-time and student consultants work with investigators during all phases of health science research: proposal development, study design, data form or questionnaire development, data entry, data management, statistical analysis, and report preparation. The Center is directed by Dr. M. Bridget Zimmerman.

**Center for Public Health Statistics (CPHS)**
The CPHS is a College of Public Health resource for identification of the databases needed for proper construction of critical public health statistics. The Center provides guidance on the statistical and epidemiologic methodologies for such construction, and produces estimates of rates for use in the development of public health policy. In collaboration with the Iowa Department of Public Health, it produces the *Iowa Health Fact Book*. The Center Director is Dr. Jacob Oleson.

**Clinical Trials Statistical and Data Management Center (CTSDMC)**
The CTSDMC serves the statistical design, data management, and analysis needs of a variety of multicenter clinical trials, for example treatment for internal carotid artery occlusion, a trial to determine efficacy of treatment to reduce depressive symptomatology and improving social functioning in postpartum depression, and islet cell transplantation for Type I diabetes.

The CTSDMC studies are funded by several Institutes of the NIH. The Center is directed by Dr. Christopher Coffey.

**Student Organizations, Committees, and Service Opportunities**

The Biostatistics Student Organization (BSO) is officially chartered with The University of Iowa Student Organization Business Office. Any Biostatistics student is automatically a member. Meetings and activities are arranged by students. Officers are elected annually to lead the organization and act as a liaison with departments and colleges.

The Biostatistics Student Association also conducts elections to select a departmental representative to the University of Iowa Graduate Student Senate (GSS). Students are occasionally called upon to interact with prospective faculty and students and other visitors, and to provide other services to the department, to the college, and to fellow students.

Each fall the Dean of the College of Public Health invites selected students to participate as members on standing and ad-hoc collegiate committees. These students act as sources of information for the student body and offer an opportunity for student concerns and opinions
to be aired. More information on collegiate committee opportunities is available in the College of Public Health Dean’s office.

The American Statistical Association (ASA) offers student memberships at reduced rates to full-time students. Application information is available at the ASA website. The International Biometric Society (Eastern North American Region or “ENAR”) also offers discounted memberships to students (see www.enar.org).

The College of Public Health Student Association (CPHSA) at The University of Iowa was established to advocate for opportunities in professional development and outreach, discuss student issues, and create a greater sense of community for all students in the College of Public Health. For more information about this organization, see web site.

Admission

Minimum Requirements for Admission

The minimum grade-point-average requirement is 3.0 for admission to either the M.S. program or the Ph.D. program. The Graduate Record Exam (GRE) is required. The recommended minimum score on the combined verbal and quantitative portions is 305; however, the average combined score for new students in recent years has been between 315-330.

Non-U.S. citizens are required to take the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS), unless they have a degree from an accredited college or university in the U.S., the UK, Canada (except Quebec), Australia, or New Zealand.

A TOEFL minimum score of 250 (computer-based), 600 (paper-based) or 100 (internet-based) is required.

The IELTS as certification of English language proficiency will be accepted. The minimum IELTS score is 7.0 to be considered for admission (with no subscore lower than 6.0). All students submitting scores from the IELTS must take the on-campus English Proficiency Evaluation (EPE) prior to their first UI registration. Remedial English courses may be required based on this evaluation.

Required prerequisites for admission are training in single-variable and multi-variable differential and integral calculus and vector algebra, as well as ability to program in at least one computer language. In addition, completion of a master’s in statistics or biostatistics is generally required for admission to the Ph.D. program.

Currently enrolled University of Iowa (UI) graduate students seeking a Master’s degree in Biostatistics concurrently with their primary major must complete a minimum of 15 of the 38 s.h. degree requirements after acceptance to the program. Approval of the home
Policy for “Internal” Application to Ph.D. Program

Students in the University of Iowa’s M.S. program in Biostatistics who have a desire to remain in the department to pursue a Ph.D. need to formally apply for the PhD program by December 1st of their second year, by submitting the following:

1. A “Request for Change of Graduate College Status” form.
2. An updated résumé
3. A new “Statement of Purpose”
4. Two letters of recommendation. One reference should be an individual who can comment on the applicant’s potential as a collaborative research and/or a teacher.

The Ph.D. Admissions Committee will consider the above items along with other information already contained in the applicant’s file (M.S. Core Exam scores, GRE scores, transcript, previous application materials, etc.). Students should be aware that excellent academic performance does not guarantee acceptance into the Ph.D. program. Many other factors are considered, such as communication skills, technical skills, ability to perform as a Research Assistant and/or a Teaching Assistant, demonstrated ability to take initiative, leadership skills, and the willingness and availability of faculty members to serve as the dissertation advisor. The Ph.D. Admissions Committee will attempt to make a decision on the application by mid February. Those who are offered admission for the Fall Semester will have until April 15th to accept or decline the offer.

Exceptional candidates who wish to transfer early into the Ph.D. program may, with the approval of their advisor, apply during the fall of their second year to be admitted effective in the subsequent Spring Semester. For these early applications, October 15th is the deadline for submitting the materials listed above, and the M.S. Core Exam must be passed prior to applying. The Biostatistics faculty will attempt to render one of the following decisions by the end of November: acceptance, denial, or deferral. Deferred applications will be reconsidered with others who make the usual December 1st deadline, for consideration for regular Fall admission. Students whose applications are denied or deferred are encouraged to consult with their advisor.

Readmission

If a student’s enrollment is interrupted for any reason so that s/he is not enrolled for three consecutive academic sessions (including the spring, summer, and fall sessions but excluding the winter session) the student must apply for readmission. A readmission application form must be submitted. The Graduate College will not require new letters of recommendation, a new Personal Statement section, a written explanation of the reasons for the absence, nor a plan for degree completion.
Financial Support

**Deadlines for Applicants**

The Biostatistics Department application deadline for admission and consideration of financial aid is December 1 for fall of the following year. The availability of financial aid is less likely for individuals who miss this deadline. Students who are accepted into the program may be offered a teaching assistant or research assistant position; some students are offered admittance without financial support.

**Graduate Assistantships**

Research assistantships are available for work in the Biostatistics Consulting Center or on specific research projects. Teaching assistantships are also available. Competitive fellowships may be available through the Department, The University of Iowa, pharmaceutical firms, and the National Institutes of Health.

Most Biostatistics students receive financial aid by working 10-20 hours per week as research assistants or teaching assistants. Working a minimum of 10 hours per week (a 1/4-time position) each semester reduces the graduate college tuition to the in-state level and provides a stipend, a tuition scholarship, and contributions toward health insurance (see Appendix E of COGS Contract).

**Policies Concerning Financial Support**

Some incoming graduate students are offered financial aid as graduate research assistants or teaching assistants for their first academic year. These offers are subject to satisfactory performance of duties, adequate academic performance in our program (GPA≥3.30), and full-time registration for at least 9 semester hours during both semesters. Should a student's GPA be less than 3.30 after one semester, his/her advisor, together with the Director of Graduate Studies, will determine whether it is in the student's best interests to continue with the assistantship, or whether the financial support should be decreased or eliminated to allow the student to focus on coursework. Similarly, a graduate assistant may lose financial aid if his/her job performance is unsatisfactory. Examples of unsatisfactory performance include, but are not limited to: unreliability in completing assignments; missing office hours, classes, lab sections, or required meetings; disrespectful treatment of others; etc.

Toward the end of each academic year, the Director of Graduate Studies and other departmental faculty will review the performance and progress of all graduate students to determine which assistantships should be renewed for the subsequent year. Financial aid will generally continue if a cumulative GPA of 3.50 is maintained, duties are performed in a satisfactory manner, and the student continues to be registered full-time each Fall and Spring semester.
New opportunities for assistantship positions sometimes arise during the year. In such cases, the Director of Graduate Studies will review the progress and status of all students and determine which student(s) to refer for an interview for such positions. Some of these opportunities are appropriate for students who do not yet hold an assistantship. Other opportunities require that a more advanced student be asked to switch efforts to the new position, which could potentially provide an opportunity for a less-experienced student to fill the vacancy created by the switch. All students should keep their résumés current should these opportunities arise.

Some financial aid is available in the summer through research assistantships, and through a limited number of teaching assistantships for the summer session. It is generally easier for research assistants to find summer support than it is for teaching assistants. In fact, some investigators outside of the department have needs for additional biostatistical support in the summer and may decide to increase the percent of time that they support a graduate research assistant. Furthermore, international students often have relatively few options for summer employment other than their assistantships. All of these factors may lead to perceived inequities among the students. In response to this, the department tries to balance financial support as much as possible; however, this is not always possible, as resources are limited and sometimes controlled by investigators outside of the department. Academic performance, previous experience, and aptitude are considered when determining the order of priority for financial support.

These policies only pertain to assistantships that are controlled or facilitated by the Department of Biostatistics. Students may also seek graduate assistantships in their areas of interest in departments outside of Biostatistics.

**University of Iowa Policies Affecting Students**

Students should review University of Iowa Policies Affecting Students. Topics addressed include the student bill of rights, standards of academic conduct, treatment of student educational records, policies on sexual harassment, disability policy, religious diversity, and grievance procedures. Students who believe there has been a violation can contact the Dean of Students Office to discuss options available for reporting incidents to the appropriate authorities.

**Graduate College Regulations**

All Biostatistics degrees are conferred through the Graduate College. Therefore, we adhere to all Graduate College rules, regulations, and requirements that are outlined in the Manual of Rules and Regulations of the Graduate College. Students should familiarize themselves with the Graduate College regulations. This site includes valuable information and advice about the Iowa City area and University of Iowa for current and prospective students.
Policy on Student Academic Conduct Standards and Procedures

Standards of Academic Conduct
The faculty of the College of Public Health expects the conduct of a student registered or taking courses in the College to be consistent with that of a professional person. Courtesy, honesty, and respect should be shown by students toward faculty, guest lecturers, administrative support staff, and fellow students. Similarly, a student should expect faculty to treat them fairly, showing respect for their ideas and opinions and striving to help them achieve maximum benefits from their experience in the College. Specific guidelines that address student conduct maybe found in the University of Iowa Operations Manual, Part IV, “Students, Chapter 1: General Regulations Applying to Students.

Student academic misconduct includes behavior involving plagiarism, cheating, fabrication, falsification of records or official documents, intentional misuse of equipment or materials, and aiding and abetting the perpetration of such acts. The preparation of reports, papers, and examinations, assigned on an individual basis, must represent each student’s own effort. Reference sources and citations should be indicated clearly and adequate attribution given. The use of assistance from other students or aids of any kind during a written examination, except when the use of books or notes has been approved by an instructor, is a violation of the standard of academic conduct. The program position supports the Graduate College policy which can be found in the Graduate College Manual, Section IV.

Useful discussions on plagiarism and how to avoid it can be found at the following websites:
http://www.northwestern.edu/uacc/plagiar.html
http://honorcouncil.georgetown.edu/system/policies/standards-of-conduct

Procedure for Handling Alleged Violations of Standards of Academic Conduct
Questions of academic dishonesty arising within the College are treated on an individual basis. In the Graduate College, the questions are handled at the departmental level. If the departmental decision is appealed, the Associate Dean for Education and Student Affairs may appoint an appeals committee of faculty and students from a slate of nominees prepared by the Graduate Council and the Graduate Student Senate to recommend an appropriate course of action. Students in professional graduate colleges should inquire at the office of their respective dean for further information. If the student disagrees with the decision made by the Dean, the student may request a review by the Provost.
Department of Biostatistics Requirements

Department of Biostatistics requirements, which are supplemental to the Graduate College regulations that can be found in the Manual of Rules and Regulations of the Graduate College, include:

Advising

When an applicant is admitted to the Department of Biostatistics, the student is assigned a faculty advisor by the Director of Graduate Studies and notified by the Department. If a student wishes to change advisors, the student initiates the change by determining which faculty advisor would be preferred and discussing the possibility with the preferred faculty advisor. Upon approval by the new faculty advisor, the student must then notify the prior advisor, the Director of Graduate Studies, and the Graduate Program Coordinator. It should be emphasized that the reason for change may be personal or because of the student’s interests, and that there is no requirement that a student remain with the same advisor throughout that student’s academic career.

Registration

Note: International students are subject to registration requirements in addition to those listed below. They are generally required to be registered full-time (at least 9 s.h.) in fall and spring semester, and there are restrictions on the number of courses they are allowed to register for via distance learning, e.g. web classes. International students should contact the Graduate Program Administrator and/or the Office of International Student and Scholar Services (ISSS) if they have questions about registration requirements in specific situations.

Nine or more semester hours constitutes full-time enrollment during fall and spring semester. An M.S. or Ph.D. student may register for no more than 15 semester hours per semester during fall and spring semester, 8 s.h. during the 8-week summer session, 6 s.h. during the 6-week summer session, or 3 s.h. during the 3-week summer session.

Doctoral students who are post comp may register for less than 9 s.h. and be considered full-time students for the purposes of financial aid. A short-hours registration form will need to be submitted to the Office of the Registrar. Please contact the Graduate Program Administrator to determine eligibility.

Computer registration is done on the University of Iowa ISIS registration system on the University of Iowa website. Registration instructions are available on the university website and at new student orientation. New students must have presented completed and valid health forms to the Student Health Service before being allowed to register; this is required of all students in any of the University of Iowa health sciences colleges. New international students must also participate in an orientation conducted by the Office of International Students and Scholars before being allowed to register for their first session at the University of Iowa.
To register, a student must first obtain electronic authorization from their faculty advisor. The student or the advisor should contact the Graduate Program Administrator for assistance with registration as needed.

**Changing Registration**

ISIS registration has a link with the Registrar listing significant academic deadlines for each semester, including deadlines for changes or withdrawal of registration and financial penalties involved.

Changes in registration must be initiated by the student. Students may change registration with no penalty via computer until midnight the day prior to the start of classes. During the first five days of the semester, any change should be completed electronically on ISIS; thereafter a paper change in registration form will need to be completed. Students should be aware that failure to drop classes by the established deadline will result in a successively increased percentage of tuition fee assessment.

**Grading**

**Plus/Minus Grading**

Plus/minus grading is an option in Department of Biostatistics courses. Students may check with each course instructor at the beginning of the semester to determine if the option will be used.

**Incompletes**

A grade of Incomplete (“I”) is to be used only when a student’s work during a session cannot be completed because of illness, accident, or other circumstances beyond the student’s control. The student must submit required work with sufficient time for the instructor to review it and submit a grade by the end of the next semester. Failure to do this results in a grade of “F.” Students with “I” from spring semester have until the end of the following fall semester to remove an “I.”

**Satisfactory/Unsatisfactory Grading**

A grading system of S/U (Satisfactory/Unsatisfactory) rather than letter grading may be used for courses taken outside the major department, provided that the course instructor and the student’s advisor approve the registration. Arrangements for S/U grading in these courses are accomplished by filing a form with appropriate signatures and submit to the Registrar’s Office at the time of registration or no later than the last day of the second week of a semester. Under S/U grading, the student receives credit for the course if the course is completed satisfactorily, but the course is not included in calculating the grade-point average.

In registrations for any thesis research, independent study, or seminar classes, S/U grading may be applied automatically at the discretion of the instructor.
**Departmental Plan of Study**

A departmental plan of study must be submitted within the first semester of study. The purpose of the plan is to ensure that any requested course waivers or transfer credits are approved, and that the student will have completed the appropriate coursework to receive the degree. Plans of study for new students will be discussed during a session conducted by the Graduate Studies Director at the department’s orientation.

The departmental Plan of Study should be completed and signed by the student and the student’s advisor, and submitted to the Graduate Program Administrator for review. The student and his/her advisor will then be informed if the Plan is being returned for modification, or if it is approved. Changes in the Plan of Study must be made within five days of the semester of change.

The Plan of Study for M.S. or Ph.D. students is available on the Department of Biostatistics website under Information for Current Students, or from the graduate program administrator. M.P.H. students should consult the 2015-2016 M.P.H. Student Handbook for the electronic form used in that program.

**Waiver of Courses**

Students may request that a required course be waived. A waiver means that the student is not required to enroll in the course, and the student does not receive credit for the course. Examples of appropriate use of a waiver include completion of the course more than ten years prior to anticipated graduation or completion of the course as an undergraduate student.

**Transfer Credits**

Students requesting transfer of credit hours must include information about the course (institution, course title, number of credit hours, and grade) and a course description sufficient to determine whether it is an acceptable substitute for the replaced course. Transfer credits from other colleges and universities are also evaluated by the Graduate Admissions Office. The department cannot approve transfer hours from other institutions unless the Graduate Admissions Office awards graduate credit hours.

**Academic Standing**

Any Biostatistics student who receives more than six semester hours of C+ or lower on courses included in the student’s plan of study, including any transfer hours, will be dismissed from the program. Any student who does receive more than six semester hours of C+ or lower may appeal the dismissal in writing to the Head of the Department. Student appeals must be voted on by the Department faculty within two semesters, including summer session, from the end of the semester in which the last C+ or lower grade was received.
While pursuing a degree, students are expected to maintain a 3.00 or better grade-point average. A student with less than a 2.75 G.P.A. (for M.S.) or 3.00 G.P.A. (for Ph.D.) after 8 or more semester hours of graduate work will be placed on probation by the Graduate College. Refer to Sec. IV. of the Manual of Rules and Regulations of the Graduate College for details on probation and dismissal standards, procedures, and appeals.

**Application for Degree**

A student is required to file an Application for Graduate College Degree by the posted deadline of the session (fall, spring, or summer) in which the student intends to graduate. A small non-refundable fee is charged to the student for filing the application. The Degree Application link is on ISIS in Student Records under Student Life Management.

The Graduate Program Administrator will file associated required Graduate College documentation for graduation in consultation with the student and the advisor.

**M.S. in Biostatistics**

**DEGREE REQUIREMENTS**

**Learner Objectives**

The objectives of the Biostatistics M.S. program are to train students who will be involved in the design and analysis of experiments, particularly in the areas of biomedical and public health research. Mathematical, statistical, and computer methods for dealing with quantitative information are emphasized. Students will have opportunities to gain experience as statistical consultants on a variety of research projects.

Upon completion of the M.S. in Biostatistics, the student should be prepared to function as a statistician or statistical consultant for projects in these areas. Therefore the student must have an extensive understanding of statistical theory and practice and should be proficient in the application of statistical methods to one or more areas in the health sciences. At the completion of the M.S. degree the graduate should demonstrate the following core competencies:

1. Demonstrate a broad knowledge and understanding of current statistical theory, methods, and practices in the health sciences.
2. Effectively collaborate on a research team.
3. Develop statistical designs and implement analyses for health science investigations.
4. Develop computer programs for the management and analysis of data sets.
5. Prepare reports and publications resulting from health science studies.
6. Effectively communicate key statistical principles to a non-statistical audience.
**Prerequisites**

A baccalaureate degree or equivalent in biological, mathematical or physical sciences is required. In addition, the applicant’s training should include basic coursework in computer science and mathematics. The level of training required in each of these areas is:

- **Mathematics.** The applicant should have training in 1) methods and techniques of single-variable and multivariable differential and integral calculus and 2) linear algebra.
- **Computer Science.** The applicant should have the ability to program in at least one computer language.

The University of Iowa courses that provide training in prerequisite work at the required level are:

<table>
<thead>
<tr>
<th>Computer Science</th>
<th>Mathematical Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS:1110</td>
<td>MATH:1850</td>
</tr>
<tr>
<td>Introduction to Computer Science, 3 s.h.</td>
<td>Calculus I, 4 s.h.</td>
</tr>
<tr>
<td></td>
<td>MATH:1860</td>
</tr>
<tr>
<td></td>
<td>Calculus II, 4 s.h.</td>
</tr>
<tr>
<td></td>
<td>MATH:2850</td>
</tr>
<tr>
<td></td>
<td>Calculus III, 4 s.h.</td>
</tr>
<tr>
<td></td>
<td>MATH:2700</td>
</tr>
<tr>
<td></td>
<td>Introduction to Linear Algebra, 4 s.h.</td>
</tr>
</tbody>
</table>

**Course Requirements**

Required Courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>(170:200)</td>
<td>MPH:6100 Essentials of Public Health</td>
<td>1 s.h.</td>
</tr>
<tr>
<td>(171:178)</td>
<td>BIOS:5510 Biostatistical Computing</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>(171:201)</td>
<td>BIOS:5710 Biostatistical Methods I</td>
<td>4 s.h.</td>
</tr>
<tr>
<td>(171:202)</td>
<td>BIOS:5720 Biostatistical Methods II</td>
<td>4 s.h.</td>
</tr>
<tr>
<td>(171:203)</td>
<td>BIOS:5730 Biostatistical Methods in Categorical Data</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>(171:266)</td>
<td>BIOS:6610 Statistical Methods in Clinical Trials</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>(171:280)</td>
<td>BIOS:7500 Preceptorship in Biostatistics*</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>(171:285)</td>
<td>BIOS:7270 Scholarly Integrity in Biostatistics</td>
<td>1 s.h.</td>
</tr>
<tr>
<td>(173:140)</td>
<td>EPID:5400 Epidemiology I: Principles</td>
<td>3 s.h.</td>
</tr>
<tr>
<td></td>
<td>or</td>
<td></td>
</tr>
<tr>
<td>(22S:193/194)</td>
<td>STAT:5100/ STAT:5101 Statistical Inference I and II</td>
<td></td>
</tr>
</tbody>
</table>

*Preceptorship may be taken for only 1 s.h. if the student has sufficient experience in biostatistical collaborations, as determined by the student’s advisor and the Director of Graduate Studies.*

**Total 31 s.h.**
Electives

Biology/Public Health Course. Must select one course from the following list:

- (002:170) BIOL:4213 Bioinformatics 3 s.h.
- (055:122) ECE:5220 Computational Genomics 3 s.h.
- (061:147) MICR:3147 Survey of Immunology 3 s.h.
- (061:157) MICR:2157 General Microbiology* 5 s.h.
- (069:270) PATH:5270 Pathogenesis of Major Human Diseases 3 s.h.
- (069:133) PATH:8133 Introduction to Human Pathology 4 s.h.
- (071:120) PCOL:2120 Drugs Their Nature Action and Use* 2 s.h.
- (127:191) GENE:7191 Human Molecular Genetics 3 s.h.
- (171:xxx) BIOS:7600 Statistical Genetics 3 s.h.
- (172:101) CBH:5105 Intro. to Health Promotion & Disease Prevention 3 s.h.
- (174:102) HMP:4000 Introduction to U.S. Health Care System 3 s.h.
- (175:197) OEH:4240 Global Environmental Health* 3 s.h.

*Not approved for Graduate Credit.

Must select two courses from the following list:

- (171:241) BIOS:6110 Applied Categorical Data Analysis 3 s.h.
- (171:242) BIOS:6210 Applied Survival Analysis 3 s.h.
- (171:174) BIOS:6310 Introductory Longitudinal Data Analysis) 3 s.h.
- (171:268) BIOS:6810 Bayesian Methods & Design 3 s.h.
- (171:251) BIOS:7110 Theory of Biostatistics I 4 s.h.
- (171:252) BIOS:7120 Theory of Biostatistics II 4 s.h.
- (171:261) BIOS:7210 Survival Data Analysis 3 s.h.
- (171:264) BIOS:7310 Longitudinal Data Analysis 3 s.h.
- (171:262) BIOS:7410 Analysis of Categorical Data 3 s.h.
- (22C:104) CS:3110 Introduction to Informatics 3 s.h.
- (171:290) BIOS:7600 Advanced Seminar 3 s.h.
- (22S:138) STAT:4520 Bayesian Statistics 3 s.h.
- (22S:161) STAT:6540 Applied Multivariate Analysis 3 s.h.
- (22S:156) STAT:6560 Applied Time Series Analysis 3 s.h.
- (22S:255) STAT:7200 Linear Models 4 s.h.
- (22S:248) STAT:7400 Computer Intensive Statistics 3 s.h.

Electives

The student may choose other graduate-level course electives in consultation with his/her advisor.

Total Semester Hours Required (minimum): 38 s.h.
Preceptorship Guidelines

The Preceptorship in Biostatistics (BIOS:7500) is a mentored research project involving the application of skills and knowledge acquired elsewhere in the curriculum. Preceptorship projects are supervised by Biostatistics faculty (primary, secondary, or adjunct), and may also involve other collaborators in the department, the college, the university, a governmental agency, or private industry. Other rules governing the preceptorship include the following:

1. The student and the faculty supervisor should meet at the beginning of the preceptorship to discuss the educational and scientific goals of the preceptorship. They should also discuss general expectations, such as the anticipated format and time frame of the components of the project.
2. Preceptorship projects must be motivated by real-world scientific questions, which may be addressed through data analysis, simulation studies, and/or methodological investigations.
3. The students are encouraged to demonstrate initiative and creativity in addressing the scientific questions, while incorporating the advice given by their preceptorship supervisor. In collaborative projects, students should demonstrate appropriate teamwork.
4. Generally, the preceptorship is taken for 3 s.h, and must involve approximately 135 hours of work (similar to lecture-style courses). If the student already has sufficient experience in Biostatistical collaborations (as determined by the student’s advisor and the Director of Graduate Students), a student may choose to take the preceptorship for 1 s.h. (approximately 45 hours of work). The hours spent on the preceptorship must be in addition to any work the student spends on their regular paid assistantship (e.g., work as a research assistant).
5. Letter grading must be issued.
6. A written report is a required component of the course. The supervisor will decide how to incorporate this in the overall grading of the course.
7. An oral presentation is required. The length of the presentation will be 15 minutes, and 5 minutes will be allowed for questions after the presentation.
8. A feedback form will be given to those who attend the oral presentation (faculty and other students), to be made available to the supervisor and student as part of the evaluation process.

Preceptorship presentations are generally scheduled towards the end of the fall and spring semesters. The scheduling of presentations at alternate times must be approved by the Director of Graduate Studies.

Master's Registration Requirement

Under most circumstances, a minimum of 24 semester hours must be completed under the auspices of The University of Iowa after admission to the graduate program. Extramural registration completed after admission may be accepted for residence under specific
circumstances. For a listing of these circumstances, refer to the Manual of Rules and Regulations of the Graduate College, Section X,D.

**Master’s Core Examination**

The Master’s core examination is a written in-class exam focusing on the required biostatistics and statistics coursework. This exam is offered twice per year. The exam may be repeated once. Copies of past exams are available for review on the shared network folder: U:\Shared by All\Biostat\MS Core Exams. Any student who has a disability that may require some modification of seating or testing must inform the Graduate Program Administrator when intent is declared to take the examination.

**Outline of Topics Covered on the M.S. Core Examination:**

I. **Probability**
   A. Definitions and basic rules
   B. Combinations and permutations
   C. Conditional probability and Bayes’ theorem
   D. Probability density functions, probability mass functions, cumulative distribution functions
   E. Joint, conditional, and marginal distributions
   F. Expected values and moments
   G. Moment-generating functions
   H. Discrete distributions—Bernoulli and binomial, hypergeometric, Poisson, multinomial
   I. Continuous distributions—uniform, normal, $\chi^2$, t, F, exponential and gamma, beta, Cauchy
   J. Distributions of functions of random variables; order statistics
   K. Chebyshev’s inequality, central limit theorem

II. **Inference**
   A. Properties—sufficiency, unbiasedness, completeness, consistency
   B. Point estimation—method of moments, maximum likelihood, least-squares
   C. Cramer-Rao inequality
   D. Confidence intervals
   E. Simple and compound hypotheses, Neyman-Pearson Lemma, uniformly most powerful tests
   F. Likelihood ratio tests
   G. Gauss-Markov theorem
   H. Exponential family
   I. Permutation tests
   J. Delta Method
   K. Rao-Blackwell Theorem
III. Biostatistical Methods I
A. Data types and scales
B. Graphs and tables
C. Descriptive statistics
D. Confounding
E. Probability laws
F. Bayes’ Theorem
G. Random variables and expectations
H. Discrete and continuous distributions
I. Sampling distributions
J. Estimation and confidence intervals
K. Hypothesis testing
L. 1-Sample and 2-Sample Techniques
M. F-tests, t-tests, and chi-square tests
N. Nonparametric tests
O. One-way ANOVA
P. Regression concepts

IV. Biostatistical Methods II
A. Linear regression
   • Matrix formulation
   • Least squares and maximum likelihood estimation
   • Inference
   • Model selection and diagnostics
B. Analysis of variance (ANOVA)
   • Single and multifactor models
   • Random and fixed effects
   • Crossed and nested factors
   • Sums of squares, mean squares, and expected mean squares
   • Multiple comparisons
C. Sample size and power considerations

V. Biostatistical Methods in Categorical Data
A. Prevalence and incidence, calculation of exposure time
B. Relative risk and odds ratio
C. Effect modification and confounding
D. Adjustment of data using stratification
E. Contingency tables
F. Case-control study
G. Logistic regression
H. Generalized Linear Models (GLM)
I. Receiver operating characteristic (ROC) analyses
J. Poisson regression
K. Sample size
M.P.H. Subtrack in QUANTITATIVE METHODS

Information about College of Public Health programs, including the M.P.H. Subtrack in Quantitative Methods, can be found on the College of Public Health website http://www.public-health.uiowa.edu/degree-programs/ or by contacting Lexie Just, S259-CPHB, 384-1539, lexie-just@uiowa.edu.

MPH students should consult the current edition of the M.P.H. Student Handbook for information and regulations one must follow pertaining to their degree program.

M.P.H. in Quantitative Methods

DEGREE REQUIREMENTS

The M.P.H. in Quantitative Methods (42 s.h.) provides the professional training that is common to all M.P.H. subtracks in the College of Public Health (the Core M.P.H. requirements) as well as substantive and meaningful training in Biostatistics. The degree is designed to train public health professionals who can provide leadership in the analysis of public health data and the design of studies for public health investigations.

The goal of the program is characterized by the following competencies.

**Competencies**

Graduates of the M.P.H. in Quantitative Methods will be able to:

- Demonstrate a broad knowledge and understanding of statistical techniques used in public health studies and health related scientific investigations.
- Function as a collaborator on public health projects, taking a leadership role in the design and implementation of projects.
- Assume responsibility for the design and implementation of analyses in investigations of public health questions.
- Apply appropriate statistical methods for inference about public health related questions, and describe the results to public health professionals and educated lay audiences.
- Manage the data for public health and health related projects such as large community surveys, laboratory investigations, and multi-center clinical trials.
- Serve as an advocate for good statistical design in public health investigations.
- Interpret the results of statistical analyses in public health related publications for public health professionals and educated lay audiences.
- Promote the use of sound statistical methods to answer open questions in public health practice.
- Demonstrate effective written and oral communication skills when communicating quantitative information and statistical inferences to different audiences of public health professionals.
Prerequisites

An undergraduate degree is required. The cumulative grade point average should be a minimum of a 3.0 on a 4.0 scale. No specific major is required.

Familiarity with the mathematics of single variable calculus and matrix algebra are requirements for admission. These requirements can be satisfied by a one semester college course in calculus equivalent to AP Calculus AB and a high school algebra course involving matrices. There is also a requirement of elementary computer programming. Programming in any commonly used basic programming language (e.g. Python, Java, C++) is acceptable. Applicants who do not have such experience may be conditionally admitted on the understanding that they will gain such experience through self-study in the first semester of enrollment.

Course Requirements

Core M.P.H. Requirements (18-19 s.h.)

MPH:5100 Introduction to Public Health Practice 3 s.h
BIOS:4120 Introduction to Biostatistics OR 3 s.h
BIOS:5710 Biostatistical Methods I 4 s.h.
CBH:5105 Intro to Health Promotion and Disease Prevention 3 s.h
EPID:5400 Epidemiology I: Principles 3 s.h
HMP:4000 Introduction to the US Healthcare System 3 s.h
OEH:4240 Global Environmental Health 3 s.h

Required Biostatistics Courses (12 s.h.) *

BIOS:4120 Design and Analysis of Biomedical Experiments 3 s.h. (9 s.h.)
BIOS:5120 Applied Categorical Data Analysis 3 s.h.
BIOS:5310 Research Data Management 3 s.h.
BIOS:5510 Biostatistical Computing 3 s.h.

* Advanced Biostatistics Sequence Substitution (This advanced sequence has the additional prerequisites of undergraduate multivariable calculus and linear algebra. The advanced sequence requires 2 fewer s.h. of elective credit.)

BIOS:5710 Biostatistics Methods I 4 s.h.
BIOS:5720 Biostatistics Methods II 4 s.h. (11 s.h.)
BIOS:5730 Biostatistics Methods in Categorical Data 3 s.h.

A student with sufficient mathematical background can substitute: BIOS:5710 Biostatistics Methods I, BIOS:5720 Biostatistics Methods II, BIOS:5730 Biostatistics Methods in Categorical Data (11 s.h.) in place of BIOS:4120 Introduction to Biostatistics, BIOS:5120 Design & Analysis of Biomedical Studies, BIOS:6110 Applied Categorical Data Analysis (9 s.h.).
Practicum Requirement (3 s.h.)
The experience from this course, including a final written report and poster presentation, constitute the final examination for the MPH.

MPH:7000 MPH Practicum 3 s.h.

Pre-Requisite to M.P.H. Practicum:
Students must complete all MPH core courses prior to registering for the practicum. For information, visit The Practicum Experience.

Approved Electives (9 s.h.)
Electives may be selected from the following list, any course offered by the College of Public Health, or a related course approved by the student’s advisor.

**Biostatistics**
- BIOS:6310 Introductory Longitudinal Data Analysis 3 s.h.
- BIOS:6610 Statistical Methods in Clinical Trials 3 s.h.
- BIOS:6210 Applied Survival Analysis 3 s.h.
- BIOS:7600 Advanced Biostatistics Seminar 1-3 s.h.

**Statistics**

**Probability and Statistics**

STAT 3120 (4 s.h.) is recommended to those with the appropriate prerequisites of two semesters of calculus.

For students with two semesters of calculus, one of the following two course sequences can be used as electives towards the 42 s.h. total.

- STAT: 3100 and 3101 Introduction to Mathematical Statistics I & II 6 s.h.
- STAT: 4100 and 4101 Mathematical Statistics I & II 6 s.h.
- STAT: 5100 and 5101 Statistical Inference I & II 6 s.h.

**Additional Statistics (STAT) electives**
- STAT:4200 Statistical Methods and Computing 3 s.h.
- STAT:4520 Bayesian Statistics 3 s.h.
- STAT:6560 Applied Time Series Analysis 3 s.h.
- STAT:3210 Experimental Design & Analysis 3 s.h.
- STAT:6220 Statistical Consulting 3 s.h.
- STAT:6540 Applied Multivariate Analysis 3 s.h.

**Bioinformatics/Informatics**
- BIOL:4213 Bioinformatics 3 s.h.
**Bioscience**  
MICR:3147 Survey of Immunology 4 s.h.

As specified by the Graduate College, a maximum of 6 s.h. can be transferred from another graduate or professional degree.

**Total Semester Hours Required for M.P.H. (minimum)**  
42 s.h.

**M.P.H. in Quantitative Methods Compared to the M.S. in Biostatistics**

<table>
<thead>
<tr>
<th>M.P.H. in Quantitative Methods</th>
<th>MS in Biostatistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Prerequisite: 1 semester calculus</td>
<td>• Prerequisite: 3 semesters calculus</td>
</tr>
<tr>
<td>• Prerequisite: Matrix algebra (high school Algebra 2 or pre-calculus)</td>
<td>• Prerequisite: College level linear algebra involving vector spaces</td>
</tr>
<tr>
<td>• Requires quantitative ability, but without advanced mathematics training</td>
<td>• Includes required coursework in mathematical statistics</td>
</tr>
<tr>
<td>• Practicum is the capstone project</td>
<td>• MS Core Examination after 2nd semester</td>
</tr>
<tr>
<td>• No core or final examination</td>
<td>• Program total 38 s.h.</td>
</tr>
<tr>
<td>• Degree focus is on applications</td>
<td></td>
</tr>
<tr>
<td>• Program total 42 s.h.</td>
<td></td>
</tr>
</tbody>
</table>

**Undergraduate to Graduate Degree**

B.S. Statistics (Business, Industry, Government and Research track)/M.P.H. Quantitative Methods

**Program Description**

Combined undergraduate to graduate programs provide an opportunity for students interested in health sciences to earn both their undergraduate and graduate degrees in 5 years. Benefits of pursuing the combined degrees are as follows:

- Allows students to further explore their interest in the field of public health
- Expedites time to degree—5 years vs. the typical 6 years
- Saves money by cutting one year of tuition

**Degree Requirements**

The MPH program requires that all core public health requirements be completed before enrollment in the capstone MPH practicum. The Quantitative Methods subtrack of the MPH also requires that certain core Biostatistics courses be completed in sequence as each one serves as a prerequisite for the next. It is therefore important that the student apply immediately upon meeting the application requirements as described below. The student will apply in the second semester of the junior year.
The application requirements are:

1. Completion of 80 s.h. of undergraduate work. A student who did not start his/her academic career at The University of Iowa must take 30 s.h. of coursework at the University of Iowa prior to applying.
2. At least a 3.25 GPA.
3. A letter of application including a statement of purpose.
4. Three letters of recommendation.
5. Completion of the Mathematics and Computer Science prerequisites for admission to the MPH in Quantitative Methods. (These are satisfied by MATH:1850 Calculus I; CS:1210 Computer Science 1: Fundamentals; and MATH:2700 Introduction to Linear Algebra, all of which are requirements for the BS in Statistics and all of which are recommended to be completed by the end of the sophomore year, as diagrammed in Figure 1.)
6. All students must submit Graduate Record Examination (GRE) scores.
7. International students must submit Test of English as a Foreign Language (TOEFL) scores.

The application will be reviewed by both the MPH Program and the Department of Biostatistics, and will require support from the student’s undergraduate advisor in the Department of Statistics & Actuarial Science. Recommendations for admission will be sent to the Graduate College for approval.

Students must have a GPA of at least 3.0 at the time of transition to graduate only status. Figure 1 represents a recommended plan of study for a student entering the joint program in the Fall of the senior year.

**Tuition and Fees Assessment**

The student pays undergraduate tuition/fees during the first semester of joint program enrollment (normally semester 7).

The student pays graduate tuition/fees including the MPH fees beginning with the second semester of joint program enrollment (semester 8), and for all academic terms thereafter.

The student may hold a graduate appointment beginning with the second semester of the joint program enrollment.

**Cross-crediting**

Twelve (12) semester hours of appropriately-numbered coursework [3000-7000 in the new-course-numbering system], earned after the student is enrolled in the combined program, will be cross-credited. This will be credit earned in the student’s senior year (year 4). If a required MPH course was taken before admission to the joint program, then that MPH requirement may be waived and corresponding additional semester hour (s.h.) credits taken to bring the total number of credits on the MPH plan of study to 42s.h.

In the following Figure 1, the recommended plan of study, the 12 semester hours of cross listed course work are STAT:4520 Bayesian Statistics, BIOS:5730 Biostatistical Methods in Categorical Data, STAT:3210 Experimental Design and Analysis and CBH:5105 Introduction to Health Promotion and Disease Prevention (denoted with a purple triangle in the lower right corner).
Figure 1: Recommended Plan of Study for Statistics BS-MPH. Statistics track: Business, Industry, Government, Research

In general, 12 s.h. can double count for BS and MPH s.h., but these courses must be taken after applying to MPH program (so, they occur in the 4th year of study).

- BIOS 5120/STAT 5810 Design and Analysis of Biomedical Studies can substitute for BIOS 5720.
- MPH 5100, OEH 4240, and EPID 5400 are semester-exchangeable fall/spring electives and can be completed in any order.
- MPH 4000 is a spring elective likely taken in either the 4th year or in the summer after the 4th year (recommended).
- The internship should be taken in the 5th year after all public health core requirements are completed.

BS students must take a set of 4 acceptable statistics electives beyond the core courses and one must be 171.184/STAT 5810 for the business, industry, govt, research track (one possible set shown above in red). Common prerequisites for statistics electives are 222.131 and/or 222.152 and/or 222.158.
Coursework and Deadlines by Semester

<table>
<thead>
<tr>
<th>Semester 1 [Fall]</th>
<th>Calculus I</th>
<th>4 s.h.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH:1850/22M:025</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 General Education Requirement Courses</td>
<td>12 s.h.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester 2 [Spring]</th>
<th>Calculus II</th>
<th>4 s.h.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH:1860/22M:026</td>
<td>Intro to Linear Algebra</td>
<td>4 s.h.</td>
</tr>
<tr>
<td>MATH:2700/22M:027</td>
<td>3 General Education Requirement Courses</td>
<td>9 s.h.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester 3 [Fall]</th>
<th>Intro to Mathematical Statistics I</th>
<th>3 s.h.</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT:3100/22S:130</td>
<td>Statistical Methods and Computing OR</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>STAT:4200/22S:105</td>
<td>3 General Education Requirement Courses</td>
<td>9 s.h.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester 4 [Spring]</th>
<th>Intro to Mathematical Statistics II</th>
<th>3 s.h.</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT:3101/22S:131</td>
<td>Computer Science I: Foundations</td>
<td>4 s.h.</td>
</tr>
<tr>
<td>CS:1210/22C:16</td>
<td>3 General Education Requirement Courses</td>
<td>9 s.h.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester 5 [Fall]</th>
<th>Calculus III</th>
<th>4 s.h.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH:2850/22M:028</td>
<td>Applied Linear Regression</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>BIOS:5310/171:164</td>
<td>Research Data Management</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>2 General Education Requirement Courses</td>
<td>6 s.h.</td>
<td></td>
</tr>
</tbody>
</table>

Students will have completed 80 s.h. at this point and will have completed their Graduate Required Examination (GRE) by December 1st

<table>
<thead>
<tr>
<th>Semester 6 [Spring]</th>
<th>Applied Time Series Analysis</th>
<th>3 s.h.</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT:6560/22S:156</td>
<td>4 General Education Requirement Courses</td>
<td>12 s.h.</td>
</tr>
</tbody>
</table>

Apply to the MPH program by February 1
Acceptance notice by mid-April in time for preregistration

<table>
<thead>
<tr>
<th>Semester 7 [Fall]</th>
<th>Biostatistical Methods I</th>
<th>3 s.h.</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS:5710/171:201</td>
<td>Biostatistical Computing</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>BIOS:5510/171:178</td>
<td>Bayesian Statistics</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>STAT:4520/22S:138</td>
<td>1 General Education Requirement Course</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester 8 [Spring]</th>
<th>Biostatistical Methods II OR</th>
<th>4 s.h</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS:5720/171:202</td>
<td>Design and Analysis of Biomedical Studies</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>BIOS:5120/171:162</td>
<td>Biostatistics Methods in Categorical Data</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>BIOS:5730/171:203</td>
<td>Experimental Design and Analysis</td>
<td>3 s.h.</td>
</tr>
</tbody>
</table>
CBH:5105/172:101  Intro to Health Promotion and Disease Prevention  3 s.h.

*The Baccalaureate will be conferred at this point*

<table>
<thead>
<tr>
<th>Semester 9 [Fall]</th>
<th>Course Code/Department</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interim [Summer]</td>
<td>HMP:4000/174:102</td>
<td>Intro to the US Healthcare System</td>
<td>3 s.h.</td>
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<tr>
<td>OEH:4240/175:197</td>
<td>OEH:4240/175:197</td>
<td>Global Environmental Health</td>
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<td>OEH:4240/175:197</td>
<td>Public Health Elective</td>
<td>3 s.h.</td>
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<table>
<thead>
<tr>
<th>Semester 10 [Spring]</th>
<th>Course Code/Department</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>Interim [Summer]</td>
<td>MPH:7000/170:299</td>
<td>MPH Practicum Experience</td>
<td>3 s.h.</td>
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</table>
Ph.D. in Biostatistics

DEGREE REQUIREMENTS

Learner Objectives

The objective of the Biostatistics Ph.D. program is to prepare students for professional and academic careers in biostatistics. Graduates will be able to assume positions in academic or research settings where the emphasis is on developing and applying statistical methodology to solve important biological and public health problems.

The Ph.D. program is designed to produce biostatisticians who can develop biostatistical methodology that can be used to solve problems in public health and the biomedical sciences. In addition, graduates of the Ph.D. program will be prepared to apply biostatistical and epidemiology methodology for the design and analysis of public health and biomedical research investigations. Graduates of the Ph.D. program will also be well suited to function as collaborators or team leaders on research projects in the biomedical and public health sciences. The program requires competency in the theory of statistics and probability, in introductory and advanced biostatistical methods and theory, and in fundamentals of epidemiologic study design. The doctoral dissertation will be the culminating experience in the Ph.D. program. Graduates of the doctoral program will have written a doctoral dissertation which focuses on the development of a new methodology or on the innovative application of biostatistical methods to a health sciences research problem. Graduates of the Ph.D. program will be in a position to develop new biostatistical methods, begin careers in academia, government, or pharmaceutical research institutions, and have demonstrated proficiency in matters of biomedical and public health study design, data management, analysis, and presentation of findings.

The goals of the Ph.D. program are to train students in the application of appropriate statistical methods for diverse problems in medicine and public health, and to provide a solid theoretical foundation for the development and investigation of new statistical methods. In addition to the formal statistical training, students will have adequate flexibility in choosing statistical and non-statistical electives to tailor their curriculum towards a specific application area such as genetics, epidemiology, or environmental health. Graduates of the Ph.D. program in Biostatistics should demonstrate the following core competencies:

1. Master M.S. competencies.
2. Demonstrate an increased level of knowledge and understanding of current statistical theory, methods, and practices in the health sciences.
3. Develop new statistical methods.
4. Design, manage data, analyze and interpret data from a variety of experimental and observational studies.
5. Communicate research findings, including new statistical methods developed, effectively to various audiences in writing and through oral presentation.
Prerequisites

The entrance requirements are the same as stated for the M.S. degree. In addition, completion of an M.S. program in biostatistics or statistics, either at The University of Iowa or elsewhere, is generally required.

Course Requirements

M.S. Level Background

Ph.D. students must take the following 26 s.h. of Required Courses listed in the M.S. Program in Biostatistics: BIOS:5510, BIOS:5710, BIOS:5720, BIOS:5730, BIOS:7500, EPID:5400, STAT:4100/4101 (or STAT:5100/5101), and an approved Biology/Public Health elective. (Students may request waivers and/or transfer of credit if they have already had the material at another institution. Course credits are automatically transferred for students who received their M.S. in Biostatistics from the University of Iowa.)

Core Courses

The following 21 s.h. of courses are required:

- (171:251) BIOS:7110 Theory of Biostatistics I 4 s.h.
- (171:252) BIOS:7210 Theory of Biostatistics II 4 s.h.
- (171:261) BIOS:7210 Survival Data Analysis 3 s.h.
- (171:264) BIOS:7310 Longitudinal Data Analysis 3 s.h.
- (171:262) BIOS:7410 Analysis of Categorical Data 3 s.h.
- (22S:255) STAT:7200 Linear Models 4 s.h.

Electives and Dissertation

Electives 15-22 s.h.

With approval by a student’s academic advisor, students choose 15-22 s.h. of courses according to their interest in biostatistics, statistics, genetics, microbiology, etc. No more than 5 s.h. of credit in non-quantitative courses (e.g., microbiology, epidemiology, community and behavioral health, etc.) may count towards this requirement. Courses required for the MS degree that are not listed above (i.e., BIOS:6610) may also count towards this requirement.

Dissertation Requirement

(171:300) BIOS:7900 Dissertation (minimum of two semesters in residence) 10-17 s.h.

Total Semester Hours for Ph.D.

79 s.h.
Examples of Electives

Following is a list of elective courses a student may choose, as well as other graduate level courses in consultation with his/her advisor.

**Biostatistics**

- BIOS:5510 Biostatistical Computing 3 s.h.
- BIOS:6310 Introductory Longitudinal Data Analysis 3 s.h.
- BIOS:6410 Microarray Data Analysis 3 s.h.
- BIOS:6610 Statistical Methods in Clinical Trials 3 s.h.
- BIOS:6710 Statistical Data Mining in Public Health 3 s.h.
- BIOS:6810 Bayesian Methods and Design 3 s.h.
- BIOS:7220 Advanced Survival Analysis 3 s.h.
- BIOS:7600 Advanced Biostatistics Seminar 1-3 s.h.

**Statistics**

- STAT:4520 Bayesian Statistics 3 s.h.
- STAT:6300 Probability and Stochastic Processes I 3 s.h.
- STAT:6540 Applied Multivariate Analysis 3 s.h.
- STAT:6560 Applied Time Series Analysis 3 s.h.
- STAT:7400 Computer Intensive Statistics 3 s.h.
- STAT:7520 Bayesian Analysis 3 s.h.

**Bioinformatics/Informatics**

- BIOL:2512 Fundamental Genetics 3 s.h.
- PEDS:8104 Medical Genetics 2 s.h.
- CS:3110 Introduction to Informatics 3 s.h.

**Community and Behavioral Health**

- CBH:5220 Health Behavior and Health Education 3 s.h.

**Environmental Health**

- OEH:4240 Global Environmental Health 3 s.h.
- OEH:6110 Rural Health and Agricultural Medicine 3 s.h.
- OEH:6410 Occupational Health 3 s.h.
- OEH:6210 Theories of Environmental Policy 3 s.h.
- OEH:6710 Environmental Toxicology 3 s.h.

**Epidemiology**

- EPID:5550 Diagnostic Microbiology for Epidemiology 3 s.h.
- EPID:6250 Genetics and Epidemiology 4 s.h.
- EPID:6350 Nutritional Epidemiology 2 s.h.
- EPID:6400 Epidemiology II: Advanced Methods 3 s.h.
- EPID:6510 Injury Epidemiology 3 s.h.
- EPID:6550 Epidemiology of Infectious Diseases 3 s.h.
<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>EPID:6560</td>
<td>Hospital Epidemiology</td>
<td>2 s.h.</td>
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<tr>
<td>EPID:6600</td>
<td>Epidemiology of Chronic Diseases</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>EPID:6610</td>
<td>Epidemiology of Aging</td>
<td>1-2 s.h.</td>
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<tr>
<td>EPID:6620</td>
<td>Neuroepidemiology</td>
<td>1 s.h.</td>
</tr>
<tr>
<td>EPID:6630</td>
<td>Epidemiology of Reproductive Diseases</td>
<td>2-3 s.h.</td>
</tr>
<tr>
<td>EPID:6650</td>
<td>Cardiovascular Disease Epidemiology</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>EPID:6670</td>
<td>Psychiatric Epidemiology</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>EPID:6700</td>
<td>Cancer Epidemiology and Control</td>
<td>3 s.h.</td>
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<tr>
<td>EPID:6900</td>
<td>Intervention and Clinical Trials (same as 171:267)</td>
<td>3 s.h.</td>
</tr>
<tr>
<td>EPID:6910</td>
<td>Pharmacoepidemiology</td>
<td>3 s.h.</td>
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<tr>
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<td><strong>Microbiology</strong></td>
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<tr>
<td>MICR:3147</td>
<td>Survey of Immunology</td>
<td>4 s.h.</td>
</tr>
<tr>
<td>MICR:2157</td>
<td>General Microbiology*</td>
<td>5 s.h.</td>
</tr>
<tr>
<td>MICR:3159</td>
<td>Pathogenic Bacteriology</td>
<td>5 s.h.</td>
</tr>
<tr>
<td>MICR:5264</td>
<td>Directed Study in Microbiology</td>
<td>Arr</td>
</tr>
<tr>
<td>MICR:6267</td>
<td>Graduate Introduction to Animal Viruses</td>
<td>3 s.h.</td>
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**Professional and Technical Writing**

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<th>Course Code</th>
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<td>RHET:7900</td>
<td>Special Project: Writing in the Disciplines</td>
<td>3 s.h.</td>
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*Not approved for Graduate Credit.*

The student must complete at least 79 s.h. (including thesis hours) of coursework.

**Registration Requirement**

A minimum of 39 s.h. must be earned while registered in the University of Iowa Graduate College. After completing 21 s.h. of graduate work under Graduate College registration and in compliance with the Graduate College policy for time limits on academic credit (i.e., courses ten years or older may not be counted toward the degree), students must complete an additional 18 semester hours to be taken as follows: (1) enrollment as a full-time student (9 semester hours minimum) in each of two semesters, or (2) enrollment for a minimum of 6 semester hours in each of three semesters. [See XXII, C in Manual of Rules and Regulations of the Graduate College](#).
**Ph.D. Comprehensive Examination**

See also *Section XII K. in the Manual of Rules and Regulations of the Graduate College*. The Ph.D. comprehensive examination is administered by the departmental Ph.D. Comprehensive Examination Steering Committee. The examination consists of two parts, an in-class component and a take-home component.

The Ph.D. Comprehensive Examination Steering Committee will be comprised of at least five faculty members from the Department of Biostatistics. The committee is responsible for (1) assigning individual sections of the exam to the faculty members who will write the problems for these sections, (2) reviewing the exam sections and recommending revisions (if warranted), (3) approving the final version of the exam, and (4) providing feedback, and possibly recommendations, to the faculty once the exam has been administered and graded. The faculty members who write the problems for the individual exam sections will comprise the Ph.D. Comprehensive Examination Committee. The problems on a section for a course will typically be written by the most recent course instructor; otherwise, the problems will be reviewed by the most recent instructor.

**In-Class Component**

The in-class component is a two-day in-class exam; each day is three hours in length. The in-class examination will be comprised of four courses. The student will choose three of the courses for the examination. At least one of these courses must be selected from among Theory of Biostatistics II and Linear Models. Additional courses will be chosen from the remaining three core courses and approved electives.

The structure of the exam is outlined below.

- The following core course is required for all students:
  - Theory of Biostatistics I

- At least one of the remaining courses may be selected from among the following core theoretical courses:
  - Theory of Biostatistics II
  - Linear Models

- The remaining course (or courses) may be selected from among the following core and elective courses:
  - Survival Data Analysis
  - Longitudinal Data Analysis
  - Analysis of Categorical Data
  - Bayesian Methods and Design
  - Advanced Clinical Trials
  - Time Series Analysis
  - Advanced Biostatistics Seminar (when appropriate)
Other doctoral level courses in statistics or biostatistics can serve as examination electives, provided that (1) the student obtains the approval of his/her advisor and the Director of Graduate Studies (DGS), and (2) a faculty member is available to write problems for the examination component.

Students are encouraged to discuss course selections with their advisors. Course selections must be approved by the advisor as well as the DGS. If a student does not pass the examination on the first attempt, the student is allowed to change his/her selections when the examination is retaken. However, the selections must again be approved by the advisor as well as the DGS.

**Take-Home Component**

The Take-Home examination will be distributed the Monday following the administration of the in-class exam, and collected the subsequent Friday.

- The Take-Home examination will be comprised of three sections:
  - Data Analytic Problem
  - Simulation Problem
  - Open Problem
- The student will choose the topic for the Data Analytic Problem from among the following courses:
  - Survival Data Analysis
  - Longitudinal Data Analysis
  - Analysis of Categorical Data
  - Bayesian Methods and Design
  - Advanced Clinical Trials
  - Time Series Analysis
  - Advanced Biostatistics Seminar (when appropriate)
- It is expected that each section can be written and completed in one day (i.e., six to eight hours of work).
- The Simulation Problem will involve some programming, generally in R, and will be focused on an investigation with practical implications.
- The Open Problem will consist of a challenging applied problem (e.g., a sample size computation), a problem that is on the periphery of the material the student might encounter in his/her coursework (e.g., principal components regression, ridge regression, the false discovery rate, instrumental variables, model selection criteria, etc.), a problem that requires some independent exploration (e.g., a question regarding a recently published result), etc.
- The Simulation Problem and Open Problem will be written so that every student will have the appropriate background to complete the section.
The student should meet with his/her advisor by the end of the spring semester prior to the PhD Comprehensive Examination to discuss the topic selections and complete the “Course Approval Request” form. This form should be submitted to the Graduate Program Administrator by the end of the spring semester prior to the examination.

**Grading Policy for the Ph.D. Comprehensive Examination**

The examination results will be summarized and reported to the entire faculty for discussion and evaluation. Students' identities will be blinded during grading and the initial faculty discussion. For each student, the faculty will determine whether the performance constitutes a passing performance, a failing performance, or a borderline performance. For any student deemed to have a borderline performance, the blind will be removed, and additional information regarding the student’s academic performance may be discussed and taken into account before a decision is reached (e.g., grades in coursework, prior research experience, etc.).

One decision will be made based on the overall performance on both the in-class and take-home components. An overall result of Satisfactory will be reported to the Graduate College if the performance is ultimately determined to be passing; an overall result of Unsatisfactory will be reported if the performance is judged to failing. Otherwise, an overall result of Reservations will be reported to the Graduate College, along with specific remedial measures to address the faculty concerns. These measures may include (yet are not limited to) retaking one component of the exam or retaking one or more courses. The students will be required to complete these remedial requirements before a specified deadline.

The steering committee members will sign the required Graduate College examination reporting form consistent with the departmental vote.

If a student fails the exam, he/she must retake both exam components the following year. A second failure generally leads to dismissal from the doctoral program.

The Ph.D. Comprehensive Examination is offered once yearly. Copies of past written exams are available for review in the shared network folder: U:\Shared by All\Biost PhD Comprehensive Exams. Any student who has a disability that may require some modification of seating or testing must inform the Biostatistics Graduate Program Administrator when intent is declared to take the examination.

The following outline features possible topics covered by the Ph.D. comprehensive examination.
BIOS:7110 Theory of Biostatistics I

Primary Reading List
- BIOS:7110 Course Notes

Supplementary Reading List

Topics List
1. Probability theory (CN,BD)
   a. Conditional expectation
   b. Distribution theory of transformations
   c. Multivariate normal distribution
2. Statistical models (CN,L,BD,CH)
   a. Sufficiency
   b. Exponential family
   c. Frequentist and Bayesian models
   d. Parameter space types: parametric, nonparametric, semiparametric
3. Methods of estimation (CN,L,BD,CH)
   a. Substitution methods, including method of moments
   b. Least squares methods
   c. Maximum likelihood estimates and Newton-Raphson algorithm
   d. Bayesian estimators
4. Optimal Estimation (CN,L,BD,CH)
   a. Criteria of estimation
   b. Uniformly minimum variance unbiased estimators
   c. Information inequality (Cramer-Rao)
5. Basic asymptotic theory (CN,R,F,S)
   a. Modes of convergence; probability inequalities
   b. Laws of large numbers
   c. Continuous mapping theorem
   d. Central limit theorems: Levy, Lindeberg-Feller
   e. Distributions of transformed sequences: Taylor series, approximations to moments, delta method, variance stabilizing transform
6. Asymptotic likelihood theory and methods (CN,L,S)
   a. Estimation; consistency, asymptotic normality, efficiency
   b. Testing and confidence intervals: score, Wald and likelihood ratio tests with and without nuisance parameters
   c. Reparametrization
BIOS:7210 Theory of Biostatistics II

Primary Reading List
Course Notes

Supplementary Reading List
- Articles referenced in class

Topics List
1. Generalized linear models
   a. Framework of a GLM
   b. Parameter estimation
   c. Full likelihood with applications to logistic and Poisson regression
2. Model and data problems
   a. MLEs and variance estimation for misspecified models
   b. Missing data classification: MCAR, MAR, MNAR
   c. ML and Bayes estimators with missing data
3. Nuisance parameters
   a. Similar tests and Neyman structure
   b. Permutation tests
   c. Randomization and population models
4. Some extensions of likelihood theory
   a. Profile likelihood
   b. Conditional likelihood with applications to conditional logistic regression
   c. Generalized linear mixed models: Framework, modeling and likelihood
5. Estimating equations
   a. Quasi-likelihood with application to overdispersion
   b. Generalized estimating equations
6. The EM Algorithm
   a. The algorithm
   b. Missing data
   c. Theory of EM algorithm; EM for exponential family
   d. Missing information principle
   e. Standard error estimation for the EM
BIOS:7210 Survival Data Analysis

Reading List

BIOS:7210 Course Notes


Topics List

1. Functions of survival time
   a. Survival, hazard and density functions
   b. Continuous and discrete versions
2. Censoring and truncation
   a. Right, left and interval censoring
   b. Left and right truncation
   c. Likelihood construction for censored and truncated data
3. Parametric survival analysis
   a. Classical survival models (exponential, Weibull, lognormal, log-logistic)
   b. Accelerated failure time model
   c. Proportional hazards model
   d. Newton-Raphson algorithm
   e. Score, Wald and likelihood ratio tests with and without nuisance parameters
4. Nonparametric survival analysis
   a. Product Limit estimator and Nelson-Aalen estimator
   b. Two-sample weighted logrank tests
   c. Sample size calculation for the logrank test*
   d. K-sample tests
   e. Stratified tests
5. Cox regression
   a. Proportional hazard regression model
   b. Partial likelihood; tied failure times
   c. Estimation and testing
   d. Estimation of the survival function under the PH model*
   e. Stratification of the Cox model
   f. Regression diagnostics*
   g. Robust variance estimator
   h. Analysis with time-dependent covariates
   i. Checking the proportional hazards assumption
6. Competing risks
   a. Challenges of competing risk data
   b. Cumulative incidence function

* Note: Some of these topics are more appropriate for a takehome exam rather than an in-class exam. They include 4.c, 5.d, 5.f.
BIOS:7310 Longitudinal Data Analysis

Reading List
- BIOS:7310 Course Notes
- Davis (2002). Statistical Methods for the Analysis of Repeated Measurements. This is the primary reference for classical approaches to longitudinal data, covered mostly in the first part of the course.
- Verbeke and Molenberghs (2001). Linear Mixed Models for Longitudinal Data, Springer Series in Statistics. This is a good source reference for the linear mixed model.
- Molenberghs and Verbeke (2005). Models for Discrete Longitudinal Data. This is a good source reference for the non-Gaussian section of the course.
- Fitzmaurice, Laird, and Ware (2002). Applied Longitudinal Analysis. This is actually a lower-level text on this general topic. It includes some nice discussions on modeling issues.

Course Outline
1. Historical Perspectives and Response Feature Methods
   a. Pros and cons of collapsing longitudinal measures into a single summary measure.
   b. Impact on error rates
2. Terminology
   a. split plot, repeated measures, cross-over designs
   b. distinction from time series data
   c. transition modeling
   d. subject-specific versus population-averaged
   e. cluster-specific, cluster-varying, time-invariant, time-stationary, time varying covariates
3. Repeated Measures ANOVA
   a. Typical and generalized models and assumptions
   b. Definition of sphericity
   c. Role of randomization in meeting the sphericity assumption
   d. Mauchly's test of sphericity
   e. Impact of sphericity on $F$ tests
   f. Degrees of freedom adjustments for non-sphericity
   g. Programming in SAS
4. Linear Model with multivariate normal responses
   a. Review of matrix notation and linear regression model
   b. Overview of MANOVA modeling and assumptions
   c. Modeling with fixed effects and a pre-specified covariance structure
   d. Types of covariance structures
   e. Programming in SAS
5. REML estimation
   a. Definition
   b. Comparison to ML estimation
   c. Programming in SAS
6. Mean and Covariance Model Comparisons without Random Effects
   a. Nesting of models
b. Likelihood Ratio Tests (LRTs)
c. Information Criteria (AIC, AICC, BIC)
d. Impact of over- and under-specifying the covariance structure

7. Modeling Issues
   a. Difference from baseline versus baseline as covariate
   b. Piecewise linear models

8. Gaussian Mixed Model in the Longitudinal Data Setting
   a. Model notation and assumptions
   b. Conditional versus marginal moments and interpretations
   c. Maximizing the marginal likelihood; impact on interpretation of covariance parameters.
   d. Hierarchical modeling
   e. Issues with LRT comparisons of covariance structures / Mixture of chi-square distributions
   f. Asymptotic tests of mean parameters; approximate $F$ tests; degrees of freedom issue
   g. Programming in SAS

9. Review of generalized linear model (GLM) (Covered in 171:203)
   a. Notation
   b. Interpretation of $\beta$ parameters
   c. Offsets, over-and under-dispersed

    a. Motivation and definition
    b. Quasi-likelihood
    c. Starting values
    d. Working correlation/covariance
    e. Asymptotic tests of mean parameters
    f. Interpretation of $\beta$ parameters
    g. Impact of misspecified working covariance on $\beta$ parameters and their standard errors
    h. Naïve (empirical) and robust (sandwich) estimators of covariances
    i. Impact of over- and under-specifying the structure of the working covariance
    j. Estimation issues
    k. Model selection measures (QIC, QICu, CIC)

11. Generalized Linear Mixed Models
    a. Theoretical model and assumptions
    b. Interpretations of mean ($\beta$) parameters
    c. Comparison to $\beta$ estimates obtained through GEE
    d. Estimation methods used, strengths/weaknesses
    e. Asymptotic tests of mean parameters
    f. Approaches to model selection and residual graphs

12. Choice of appropriate method(s) – throughout the class, as more options are discussed
BIOS:7410 Analysis of Categorical Data

Reading List
- BIOS:7410 Course Notes

Topic List
1. Distributions and Inference for Categorical Data (Chapter 1)
   a. Categorical Response Data
   b. Common Study Designs
   c. Binomial, Poisson, and Multinomial Distributions
   d. Overdispersion / Negative Binomial Distribution
   e. Likelihood Functions / Maximum Likelihood Estimation
   f. Wald, Score, Likelihood Ratio (LR) Tests
   g. Confidence Intervals Based on Test Inversion
   h. Inference for Binomial Parameters
   i. Inference for Multinomial Parameters / Pearson’s and LR Chi-Squared Tests
2. Analysis of Contingency Tables (Chapters 2 and 3)
   a. Sampling and Probability Distribution Models
   b. Relative Risk, Odds Ratio, and Measures of Association for 2 × 2 Tables
   c. Conditional and Marginal Associations in Three-Way Tables
   d. Odds Ratios and Measures of Association for I × J Tables
   e. Confidence Intervals for Association Measures
   f. Testing Independence in Two-Way Tables
   g. Pearson Residuals
   h. Partitioning Chi-Squared Test Statistics
   i. Two-Way Tables Based on Ordinal Variables
   j. Fisher’s Exact Test / Exact Tests of Independence for I × J Tables
3. Generalized Linear Models (GLM’s) (Chapter 4)
   a. Components of the GLM
   b. GLM’s for Binary and Count Data
   c. Moments, Likelihood, and Likelihood Equations for GLM’s
   d. Inference for GLM’s
   e. Deviance / Model Fit / Estimation of Dispersion Parameter
   f. Pearson and Deviance Residuals
   g. Maximum Likelihood / Newton-Raphson / Fisher Scoring
   h. Quasi-Likelihood Estimation
   i. Overdispersed GLM’s and Quasi-Likelihood Estimation
4. Logistic Regression: Logit Models for Binary Responses (Chapters 5 and 6)
   a. Parameter Interpretation and Model Structure
   b. Logistic Regression with Case-Control Studies
   c. Inference and Model Fit
   d. Categorical Explanatory Variables
   e. Logit Models for I × 2 × K and 2 × 2 × K Tables
5. Logit Models for Multicategory Responses (Chapter 7)
   a. Nominal Responses and Baseline Category Models
   b. Ordinal Responses / Cumulative Logit Models / Proportional Odds Models
6. Loglinear Models (Chapter 8)
   a. Loglinear Models for Two-Way and Three-Way Tables *
   b. Conditional and Marginal Associations / Independence Relations *
7. Generalized Linear Models for Longitudinal Data Analysis
   a. Quasi-Likelihood Estimation for Longitudinal Data
   b. Generalized Estimating Equations (GEE’s)
8. Generalized Linear Mixed Models and Longitudinal Data Analysis *
   a. Longitudinal Data Structure *
   b. Traditional Linear Mixed Models for Longitudinal Data *
   c. Generalized Linear Mixed Models (GLMM’s) for Longitudinal Data *

Topics marked with an asterisk (*) would be more suitable for the take-home examination than the in-class examination.

STAT:7200 Theory of Linear Models

Reading List
- STAT:7200 Course Notes

Topics List
1. Basic matrix algebra including transposes, ranks, determinants, inverses, generalized inverses, eigenvalues and eigenvectors, spectral decompositions, and related topics
2. Concepts of estimability and identifiability of linear models
3. Unweighted, weighted and generalized least squares estimation for linear models, including classical unconstrained fixed-effects models. Orthogonal projections, reparameterizations, Gauss-Markov Theorem, and algebraic and geometric structure of the analysis of variance
4. Least-squares estimation for constrained linear models
5. Distributions in linear models, including the multivariate normal; central and noncentral F, chi-square and t distributions
6. Operations involving quadratic forms, including expectations, variances, covariances, moment-generating functions, and distributions of linear and quadratic forms, independence of quadratic forms, Cochran’s Theorem
7. Hypothesis testing, confidence intervals and regions, simultaneous inference, i.e., multiple confidence intervals and multiple comparisons
BIOS:6810 Bayesian Methods and Design

Primary Reading
- BIOS:6810 Course Notes

Topics List
- Bayesian Concepts
  - Prior Distributions
  - Sampling Distributions
  - Posterior Distributions (Derivation, Summaries, Inference)
  - Full Conditional Distributions
  - Hierarchical Modeling Framework
- Bayesian Analysis
  - Single and Multi-Parameter Models
  - Model Assessment (Posterior Predictive Checks)
  - Model Selection (DIC, Bayes Factors)
- Bayesian Design
  - Axiomatic Development of Subjective Probability
  - Bayesian Decision Theory
  - Design of Experiments as a Bayesian Decision Problem
  - Sequential Bayesian Design Procedures
  - Optimal Bayesian Design
- Bayesian Computing
  - Markov Chain Monte Carlo (MCMC) Algorithms (Gibbs, Metropolis-Hastings, SMCMC, Slice, Rejection)
  - Implementation with the R Programming Language
  - MCMC Performance Evaluation and Tuning
  - MCMC Convergence Assessment
Continuous Registration after Completion of the Comprehensive Examination

A student is required to register each fall and spring semester after passing the Ph.D. comprehensive examination until the degree is awarded. If a student has no courses to take, the student can fulfill this requirement by registering for 1 s.h. Graduate College course GRAD:6002 (000.002) Doctoral Continuous Registration. For details, see Section XII.L. of the Manual of Rules and Regulations of the Graduate College.

PH.D. DISSERTATION

Students should refer to the Graduate College website Theses and Dissertations for specifics on Graduate College regulations and resources for preparation of doctoral dissertations.

The final examination (dissertation defense) may not be held until the next session after passing the comprehensive examination; however, a student must pass the final examination no later than five years after passing the comprehensive examination. Failure to meet this deadline will result in reexamination of the student to determine his or her qualifications for taking the final examination.

The goal of the dissertation is to produce a document from which at least one manuscript can be composed that is publishable in a peer-reviewed journal. Original thought is required in the formulation and conduct of the research, although neither original data collection nor data analysis is strictly required. The structure of the dissertation shall be determined by the dissertation committee in accordance with the Graduate College Rules and Regulations. The doctoral dissertation defense is an oral presentation of the purpose, methods, and results of the dissertation research. A specially formed committee will thoroughly examine the student’s area of knowledge associated with the content of the work.

Dissertation costs are the responsibility of the student, including associated costs such as copying.

Dissertation Committee

The student is responsible for naming a dissertation advisor. The dissertation advisor should have a primary, secondary, or joint faculty appointment in the Department of Biostatistics. If a secondary faculty has agreed to advise a dissertation, the student should consult the DGS to determine whether a primary faculty member should serve as co-advisor. The student, in collaboration with the dissertation advisor(s), will constitute a dissertation committee consisting of five members of the Graduate College faculty, to include at least two faculty members with a primary appointment in the Department of Biostatistics and at least one tenure-track faculty whose primary appointment is outside the Department of Biostatistics. This dissertation committee must approve the topic area of research and will provide direction during the preparation of the dissertation by participation in the evaluation, revision, and approval of the dissertation prospectus.


**Dissertation Prospectus**

When the dissertation research has progressed to the point where the student and dissertation advisor feel comfortable outlining the eventual contents of the dissertation, the student is required to arrange a meeting to present a summary of proposed research to the dissertation committee. This prospectus should include some completed work, some work in preparation, and some planned work. The prospectus meeting must take place after forming the dissertation committee, and at least one semester prior to the dissertation defense.

The prospectus meeting serves two purposes:
- It provides an opportunity for the student and dissertation advisor to receive feedback, advice, and commentary on the direction of their research from other faculty members.
- It informs the dissertation committee of the direction of the dissertation research.

Ideally, the meeting results in a consensus among the committee members and the student that the scope of the proposed research is consistent with departmental and university dissertation standards. Unanimous written confirmation of this consensus is required on the [Dissertation Prospectus Approval Form](#).

The primary component of the prospectus is the oral presentation to the committee. However, to prepare the committee for the meeting, students are expected to provide a written document one week in advance of the prospectus meeting. The form of this document is left to the discretion of the student and advisor, and may consist of a short written description of the proposed research, an electronic copy of the slides to be presented at the meeting, or a preliminary version of the thesis itself with early drafts of some chapters and rough outlines of others.

**Dissertation Defense**

The student schedules a final examination (doctoral dissertation defense) meeting with the committee. The student is required to: a) have met the dissertation prospectus requirement, b) have met all other requirements for graduation, including passing the comprehensive examination, c) submit thesis first deposit in accordance with the Graduate College rules, and d) distribute the written copy of the dissertation to the dissertation committee members no later than two weeks before the scheduled dissertation defense.

During the defense, the dissertation committee will thoroughly examine the student’s knowledge in the content area of the research. Doctoral dissertation defense examinations are open to the public. Members of the University community are free to attend the open portions of the session.

The final examination (dissertation defense) will be evaluated as satisfactory or unsatisfactory. Two unsatisfactory votes will make the committee report unsatisfactory. In case of a report of unsatisfactory in the final examination, the candidate may not present himself or herself for re-examination until the next session or later. The examination may be repeated only once.
The student must deposit a final copy of the dissertation, which has been approved by the dissertation committee, to the Graduate College by its deadline in order to receive the degree.

**Time Considerations**
Deadlines are set by the Graduate College for scheduling the dissertation defense and for the initial and final deposits of the dissertation to the Graduate College. Refer to the Graduate Program Administrator and/or posted deadlines for a particular academic session. See [Office of the Registrar](#) for posted deadlines.
Satisfactory Progress in the M.S. and Ph.D. Programs

Students are expected to make satisfactory progress in earning their graduate degrees. Satisfactory progress is defined by the following criteria.

- Students must register for courses each fall and spring semester until course requirements are completed. Students who hold assistantships or fellowships must register for a minimum of 9 s.h.
- Students are expected to complete and submit a plan of study to the Graduate Program Administrator by the end of their second semester.
- Students must maintain a minimum GPA of 3.3 if receiving financial aid. Failure to maintain a 3.3 GPA may result in the decrease or elimination of financial support. Students who do not receive financial aid are required to maintain a minimum GPA of 3.0.
- For courses included in the plan of study, students must not receive a grade of C+ or lower in more than 6 s.h. of coursework.
- Students in the M.S. program are expected to take the M.S. Core Examination at the beginning of their third semester. Exemptions can only be granted by the Director of Graduate Studies.
- Students who enter the Ph.D. program without an M.S. degree in Statistics or Biostatistics are expected to take the M.S. Core Examination at the beginning of their third semester in the graduate program, and the PhD Comprehensive Examination by the beginning of their seventh semester in the graduate program. Students who enter the Ph.D. program with an M.S. degree in Statistics or Biostatistics (or equivalent training) are expected to complete the Ph.D. Comprehensive Examination by the beginning of their fifth semester in the Ph.D. program. Exemptions can only be granted by the Director of Graduate Studies.
- Students in the Ph.D. program are expected to complete and present their doctoral prospectus within three semesters after passing the Ph.D. Comprehensive Examination.
- Students in the M.S. program are expected to complete their degree requirements in two years. Students who enter the Ph.D. program without an M.S. degree in Statistics or Biostatistics are expected to complete their degree requirements in five years. Students who enter the Ph.D. program with an M.S. degree in Statistics or Biostatistics (or equivalent training) are expected to complete their degree requirements in four years. Failure to adhere to these timelines may result in the decrease or elimination of financial support.
- Students are expected to regularly attend departmental seminars and to document their attendance by completing the “sign up” sheet.

In addition, students receiving financial support in the form of an assistantship will be evaluated at the end of every semester by their assistantship supervisor(s). Students must perform satisfactorily in fulfilling their responsibilities. Failure to do so may result in the decrease or elimination of financial support.

At the end of each academic year, current students will meet with their advisors to review a report prepared by the academic advisor to assess the student’s progress, and to document any
unfulfilled requirements for maintaining satisfactory progress. This report must be signed by both the advisor and the student, and submitted to the Director of Graduate Studies. To request exemptions from any of the preceding requirements, a written statement must be submitted by the student to both the academic advisor and the Director of Graduate Studies. This statement must include a written plan for completing the program.

Students who fail to make satisfactory progress will be asked to meet with their academic advisor and the Director of Graduate Studies, to discuss the expectations and requirements for continuing in the program. Requirements will be provided to the student in writing, along with a timeline for fulfilling them. If the requirements are not fulfilled within the specified timeline, the student is subject to dismissal from the program. This decision is based on a majority vote of the Biostatistics faculty.

Student Progress Report: M.S. Degree  
Student Progress Report: Ph.D. Degree

Certificate in Biostatistics

Description of Certificate in Biostatistics

The purpose of this certificate is to provide all University of Iowa graduate students a mechanism to recognize a substantial biostatistics emphasis in their course work. A number of graduate students already incorporate substantial training in biostatistics into their MS or PhD programs, and this certificate will provide formal recognition.

In exceptional circumstances, an individual who is not currently in a University of Iowa graduate program, but who has completed a graduate degree in a scientific area or a health related professional degree such as an MD, PharmD or equivalent, and who is currently involved in biomedical research, may also apply for admission to the Certificate Program. For example, a postdoctoral scholar, or a fellow or resident with an MD degree, may want to enrich their postdoctoral training with additional courses in Biostatistics. Such applicants will need to apply to the Graduate College for admission as a “Graduate Non Degree Seeking Student” as well as to the Certificate Program. Such applicants will also be expected to have approval of their supervisor and are encouraged to contact biostatistics@uiowa.edu for information before completing an application. Credits earned as a "Graduate Non Degree Seeking Student" are transferable to a graduate program such as the Certificate with approval of the Department of Biostatistics.

Qualifications for Admission

Graduate students at The University of Iowa in degree programs outside of Biostatistics are eligible to apply. Applications for this Certificate Program will require the signature of the student’s academic advisor from his/her home department, as well as a proposed Plan of Study showing the course requirements to be fulfilled.
Enrollment in the Certificate Program is limited by capacity. Applicants who have already completed at least one of the required courses and whose research will be advanced by training in biostatistics will be given priority for admission.

**Requirements for the Certificate**

An approved Plan of Study including at least 15 s.h. credits in Biostatistics is very important for this Certificate, since some of the courses require special permission to enroll, have specific prerequisites, and/or are offered less than annually. The minimum acceptable grade for each course used to fulfill certificate requirements is a B-; the minimum cumulative GPA requirement for the 15 s.h. Certificate Program is 3.0. A minimum of 6 s.h. of certificate course work must be completed after formal acceptance into the program (certificates will not be awarded retrospectively for course work already completed).

In accordance with Graduate College regulations, no more than 6 s.h. of the Certificate may be credited to any other university degree or credential. At least 6 s.h. of the Plan of Study must be solely dedicated to the Certificate. If a waiver is granted on a required core course, then additional elective credits must be completed to replace the waived course, so that the total remains at 15 s.h. The Certificate will typically be awarded in the same semester as a student receives the graduate degree from his/her home department. It should be noted that the Certificate Program in Biostatistics is generally not a step towards receiving an MS or PhD in Biostatistics, but will enhance completion of the student's primary graduate degree and independent research.

**Certificate Course Requirements (15 s.h. total)**

Required “Core” Courses (6 s.h.)
- BIOS:4120 (171:161) Introduction to Biostatistics (3 s.h.) (formerly BIOS:5110)
- BIOS:5120 (171:162) Design and Analysis of Biomedical Studies (3 s.h.)

Elective Courses (9 s.h. chosen from the following):
- BIOS:5310 (171:164) Research Data Management (3 s.h.)
- BIOS:6310 (171:174) Introductory Longitudinal Data Analysis (3 s.h.)
- BIOS:6110 (171:241) Applied Categorical Data Analysis (3 s.h.)
- BIOS:6210 (171:242) Applied Survival Analysis (3 s.h.)
- BIOS:6220 (171:243) Cohort Data Analysis (1 s.h.)
- BIOS:6610 (171:266) Statistical Methods in Clinical Trials (3 s.h.)

*Other courses in Biostatistics, as approved by the Director of Graduate Studies in Biostatistics*

Refer to [Certificate in Biostatistics](#) on our website for additional information and sample plans of study.
Seminars

Throughout the academic year, biostatisticians and statisticians from academia and industry are invited to present research seminars in the department. The Biostatistics seminars are normally scheduled twice monthly on Mondays from 3:30-4:30 p.m. These seminars provide an excellent opportunity for students to meet and network with leaders in the field and learn about current research. Biostatistics students are expected to attend the Biostatistics seminars. Please refer to the listing of Biostatistics events on the department website for upcoming seminars. Seminar announcements are emailed to Biostatistics students and faculty.

The Department of Statistics and Actuarial Science Colloquium is scheduled on Thursdays at 3:30 p.m. in Schaeffer Hall during the academic year. Many of the topics covered in these colloquia are of interest to biostatisticians as well.

General Information for Students

Computer Lab
The Department of Biostatistics computer lab in C310-CPHB is available for use by Biostatistics students when it is not in use for a class. Students are assigned College of Public Health computer accounts at orientation, and will be given 24/7 electronic access for evening and weekend access to the computer lab. Food or drink is not allowed in the computing lab.

Other university computer labs (ITCs) are available throughout campus, including one at nearby Hardin Library. A complete list of available ITCs can be obtained through the university’s Information Technology Services Office. A variety of software applications are available to you via the Virtual Desktop at the University of Iowa.

Scan to Email
The College of Public Health has two “scan to e-mail” stations which are located in S206 and S207. These stations will allow you to scan a document directly to your e-mail account. Information on regarding use of this email technology is located on the CPH IT Support website. You may also scan documents to your email from the copier/scanner in Room N335 in the Department of Biostatistics.

Printing
Printers are available for student use in the Biostatistics Computing Lab (C310), in the east wing (N321) and one on the west wing (N374) of the Biostatistics Department. Students are given a printing allowance per semester (currently free print credit of $10 per semester). Anything above and beyond the allowance will be charged to the student’s University Bill (U-Bill). Black and white printing is $0.05 per print side. Color printing is $0.50 per print side. The six locations in CPHB include both black and white, as well as color laser printing. The ITC Student Printing service is a campus-wide/enterprise service. In other words, students can print to any ITC on campus and their account will remain the same, such as the Main Library, Hardin Library and the Iowa Memorial Union. For printing/supplies for your assistantship, please contact your supervisor.
**Web Print Release Stations in CPHB**
There are two Web Print Release Stations, which are located in S206 and S207. These stations will allow you to print from your personal laptop or home computer (with internet connectivity). Here are further instructions -- [http://its.uiowa.edu/support/article/102875](http://its.uiowa.edu/support/article/102875). Once you print from your wireless laptop or home system, the print job is not released (and or charged) until you go to the Web Print Release Station (located in S206 or S207) and release it.

**Confidential Resources**
- **Rape Victim Advocacy Program** [http://rvap.uiowa.edu/](http://rvap.uiowa.edu/)
- **Office of the Ombudsperson** [http://www.uiowa.edu/ombuds/](http://www.uiowa.edu/ombuds/)
- **Women’s Resource and Action Center** [http://wrac.uiowa.edu/](http://wrac.uiowa.edu/)
- **Family Services** [http://hr.uiowa.edu/family-services/](http://hr.uiowa.edu/family-services/)
- **University Counseling Services** [http://counseling.studentlife.uiowa.edu/](http://counseling.studentlife.uiowa.edu/)
- **Student Disabilities Services** [http://sds.studentlife.uiowa.edu/](http://sds.studentlife.uiowa.edu/)

**Desk Space**
Limited space is available for graduate students either working as graduate assistants or on a dissertation. Priority is given for students who are graduate research assistants or teaching assistants. Graduate students with office space elsewhere on campus will only be given space if available. Desk allocations are reviewed each semester and are renewed in August. However, designated space can be reassigned at any time as needed or if space is unused.

**E-mail**
Every student must apply for a university e-mail account upon enrollment. The student will then be connected to the College of Public Health network individually and included in the Biostatistics Student Group e-mail distribution list. Via email, students receive information such as seminar announcements, job announcements, program information, etc. E-mail messages should be checked regularly.

**Forms**
Terry Kirk, the Graduate Program Administrator, has a supply of most forms necessary for the academic program, or she can direct students to the appropriate university office. Commonly used forms are available electronically on the department’s website under “Current Students” and in Appendix –E of this handbook.

**Job and Internship Announcements**
Announcements of employment and internship opportunities are communicated to students via e-mail. Recent [employment opportunities](#) are posted on the Biostatistics website under “Alumni”.

**Student Commons**
The second floor Student Commons (CPHB) is available to all College of Public Health students. Students are welcome to use all facilities in the Commons, which include the microwave, refrigerator, and other kitchen facilities. However, they should clean up after themselves and keep use to single servings. All items in the refrigerator, including any bowls and other containers, are disposed of after 2 p.m. every Friday.

A limited number of lockers are available for students in the lower level of the CPHB. Interested students should contact Katie-boland@uiowa.edu.

**Travel Funds**
Each year the department earmarks limited funds for student travel to meetings and conferences. Requests for funding should be addressed to the Director of Graduate Studies, and should include information about the meeting and its URL, the reason for attending (for instance, a poster or oral presentation), and an itemization of funding requested.

**Website**
An electronic version of this manual, forms commonly used by students, and significant dates for students is available on the Biostatistics Department website at http://cph.uiowa.edu/biostat/. The department and college website also contain much general information of interest to students, including an event calendar which includes seminars and other departmental events.
## Primary Faculty

<table>
<thead>
<tr>
<th>Name</th>
<th>Office</th>
<th>Extension/Phone</th>
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<tbody>
<tr>
<td>Breheny, Patrick J.</td>
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<tr>
<td>Assistant Professor</td>
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<td>Cavanaugh, Joseph E.</td>
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<tr>
<td>Professor and Interim Department Head and Director of Graduate Studies</td>
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<td>Coffey, Christopher S.</td>
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## Staff

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<tr>
<td>Department Secretary</td>
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Appendix B—Course Descriptions

Brief course descriptions, including the sessions these courses are typically offered, for Biostatistics courses and selected other courses of special interest to Biostatistics students. For more detailed information about a specific course, contact the course instructor or the Graduate Program Coordinator.

Biostatistics Courses

BIOS:4110 (171:121) Introduction to Biostatistics, 4 s.h.
Provides undergraduates with math/biology background exposure to biostatistics and biostatistical computation. Emphasizes the biostatistical aspect of health-related areas, i.e., clinical trials, disease modeling, disease mapping, genetics and epidemiology, and a brief introduction to survival and longitudinal analyses. Offered in summer.

BIOS: 4710 (171:199) Biostatistical Methods Laboratory; 1 s.h.
Computational aspects of one-sample and two-sample problems; analysis of frequency data, linear regression, and correlation analysis; examples using these computational methods in public health. Offered fall semesters.

BIOS: 5050 (171:151) Biostatistics for Biomedical Research, 1 s.h.
An introduction to the application of statistical techniques to biological data with R applications, targeted to beginning researchers in the biomedical sciences. At the end of the semester, students are expected to apply and appropriately interpret basic statistical tests that are covered in the class. Course format consists of lectures and laboratory sections. Same as BISC:5204 (Home Department).

BIOS: 4210 (Formerly BIOS:5110/171:161) Introduction to Biostatistics, 3 s.h.
Introduction to the application of statistical techniques to biological data. Topics include descriptive statistics, probability, binomial, Poisson, and normal distributions, sampling distributions; tests of significance, confidence intervals, analysis of frequency data, and simple linear regression. Prerequisite: college algebra. Offered fall and spring semesters and summer session.

BIOS: 5120 (171:162) Design and Analysis of Biomedical Studies, 3 s.h.
Simple and multiple linear regression and correlation; one- and two-way layout considerations in planning experiments; factorial experiments; multiple comparison techniques; orthogonal contrasts. Prerequisites: BIOS:4120 or equivalent. Same as STAT:5610. Offered spring semester and summer session.

BIOS: 5310 (171:164) Research Data Management, 3 s.h.
Overview of problems encountered in gathering and processing data from biomedical investigations; introduction to various data management techniques useful in biomedical studies; introduction to Microsoft Access. Prerequisite: Python, Java or C++ programming capability. Same as STAT:5810. Offered fall semesters.

BIOS: 5510 (171:178) Biostatistical Computing, 3 s.h.
The course is designed for Biostatistics students, with some C—C++ skills, to build a solid ground work in SAS and R programming with emphasis on data management, Monte Carlo simulations and expectation maximization techniques. Co-requisite: BIOS:5710. Offered fall semesters.

BIOS: 5710 (171:201) Biostatistical Methods I, 4 s.h.
Problem-oriented probability distributions, moments, estimation, parametric and nonparametric inference for one-sample and two-sample problems, analysis of frequency data, linear regression, correlation analysis; emphasis on using computers. Prerequisites: two semesters of calculus; linear algebra, consent of instructor. Offered fall semesters.
BIOS:5720 (171:202) Biostatistical Methods II, 4 s.h.
Continuation of BIOS:5710 (171:201), which is prerequisite: linear regression correlation, multiple linear regression, multiple factor experiments, multiple comparisons, orthogonal contrasts, block and split-plot designs, confounding, interactions, analysis of covariance, mixed models. Prerequisite: BIOS:5610. Offered spring semesters.

BIOS:5730 (171:203) Biostatistical Methods in Categorical Data, 3 s.h.
This course provides an introduction to methods for applied categorical data analysis including estimation of proportions, rates, and risks; measures of relative risk and odds ratios; stratified analysis; case control studies; and logistic regression. Prerequisites: BIOS:5510 BIOS:5710, Co-requisite: BIOS:5720, STAT:4101 or STAT:5101. Offered spring semesters.

BIOS:6110 (171:241) Applied Categorical Data Analysis, 3 s.h.
Overview of the methods used to analyze categorical data from health science investigations, including estimation of rates and risks, measures of relative risk, stratified analysis, and logistic regression analysis. Prerequisite: BIOS:5120. Offered fall semesters.

BIOS:6210 (171:242) Applied Survival Analysis, 3 s.h.
Covers nonparametric, parametric, and semi-parametric methods for time to event data and incorporates censoring of event times into the analysis. Topics include types of censoring, Kaplan-Meier estimation, Weibull model estimation, Cox proportional hazards models, including methods for assessing the adequacy of the proportional hazards assumption, time varying covariates, and sample size calculations for comparison of two or more groups. The course will focus on the analysis of real data sets and examples using statistical software. Prerequisites: BIOS:5730 or BIOS:6110. Offered spring semesters.

BIOS:6220 (171:243) Cohort Data Analysis, 1 s.h.
Methods of comparing directly standardized rates and standardized mortality ratios; Poisson regression for cohort data. Prerequisites: STAT:6110, consent of instructor. Arr

BIOS:6310 (171:174) Introductory Longitudinal Data Analysis, 3 s.h.
Introduction to statistical models and estimation methods that can be used to analyze correlated data, such as when the same subject is measured repeatedly. Use of statistical software is emphasized. Prerequisite: BIOS:5730, BIOS:6110, STAT:3200 or STAT:6510 or consent of instructor. Same as STAT:6550. Offered fall of odd years.

BIOS:6610 (171:266) Statistical Methods in Clinical Trials, 3 s.h.
Surveys statistical methods commonly utilized in clinical trials. Also provides a methodologic perspective to the design, conduct and analysis of clinical trials. Phase III randomized controlled clinical trials are emphasized. Prerequisites: BIOS:5720, STAT:3101, STAT:4101, STAT:5101, or equivalent. Offered spring semesters.

BIOS:6650 (171:269) Comparative Effectiveness Research Methods for Observational Data, 3 s.h.

BIOS:6710 (171:230) Statistical Data Mining in Public Health, 3 s.h.
This course introduces a set of supervised statistical methods such as regression, decision tree, neural network, and some unsupervised methods such as association rules, and clustering for the data analysis in health related applications. Prerequisites: BIOS:5720, STAT:4100 or STAT:5100 or equivalent. Arr

BIOS:6810 (171:268) Bayesian Methods and Design, 3 s.h.
Theory and application of Bayesian methods in biomedical research; foundations of Bayesian statistics, including axiomatic development of subjective probability and decision theory, study design, model development, inference, and implementation of computational algorithms. Prerequisites: BIOS:5510, BIOS:5720, BIOS:5730, STAT:4101
and STAT:4101. Offered spring semesters of odd years.

**BIOS:7110 (171:251) Theory of Biostatistics I, 4 s.h.**
Intermediate level study of sufficiency, exponential families, methods of estimation, uniform minimum variance unbiasedness, information, likelihood theory, confidence intervals, Neyman-Pearson lemma, and asymptotic theory and its applications. Prerequisites: STAT:4101, 5101, BIOS:5720, or equivalent. Offered fall semesters.

**BIOS:7120 (171:252) Theory of Biostatistics II, 4 s.h.**
Nonparametric hypothesis tests, semiparametric estimation, generalized linear models and related topics, EM algorithm, computer-intensive methods; application of theory of BIOS:7110 to classical and new methods in biostatistics. Prerequisites: BIOS:7110. Offered spring semesters.

**BIOS:7210 (171:261) Survival Data Analysis, 3 s.h.**
Types of censoring and truncation; survival function estimation; life tables; parametric inference using exponential, Weibull and accelerated failure time models; nonparametric tests; sample size calculation; Cox regression with stratification and time-dependent covariates; regression diagnostics; competing risks; analysis of correlated survival data. Prerequisites: STAT:4101, 5101, BIOS:5720, or equivalent. Same as STAT:7570. Offered fall semesters.

**BIOS:7220 (171:271) Advanced Survival Analysis, 3 s.h.**
Counting process/martingale theory leading to asymptotic results of survival methods; semiparametric regression of the accelerated failure time and additive hazard models; multivariate survival models for clustered, multiple event and recurrent event data; special topics. Prerequisite: BIOS:7210. Arr

**BIOS:7270 (171:285) Scholarly Integrity in Biostatistics, 1 s.h.**
Training in the responsible conduct of research, with emphasis on issues of particular relevance to biostatisticians, including authorship, communication, student/mentor relationships, plagiarism, fabrication and falsification of data, bias, Type I/II errors, reproducible research, data confidentiality and security, conflicts of interest, and human/animal subjects. Spring semesters. (Post Docs register for BIOS:7406)

**BIOS:7310 (171:264) Longitudinal Data Analysis, 3 s.h.**
Introduction to statistical methodology for analyzing data from observational and experimental studies in which the response variable from each subject is measured repeatedly. Use of statistical software packages and specialized programs is emphasized. Prerequisites: STAT:4101, 5101, BIOS:5720, or equivalent. Offered spring semesters of odd years.

**BIOS:7410 (171:262) Analysis of Categorical Data, 3 s.h.**
Models for discrete data, distribution theory, maximum likelihood and weighted least squares estimation for categorical data, tests of fit, model selection. Prerequisite: STAT:4101, STAT:5101, STAT:5200 or BIOS:5720, or equivalent. Same as STAT:7510. Offered spring semesters.

**BIOS:7500 (171:280) Preceptorship in Biostatistics, arr.**
Individual work experience in using knowledge, skill acquired in classroom; arranged in conjunction with ongoing activities in the department, the College of Public Health or College of Medicine, or off-campus in governmental agency or private industry. Prerequisite: Consent of instructor.

**BIOS:7600 (171:290) Advanced Biostatistics Seminar, 1, 3 s.h.**
Each semester focuses on selected current topics in biostatistics; the seminar is chaired by different faculty members each semester who select the topics and organize core readings; format is a mix of student presentations and open discussion.

**BIOS:7800 (171:281) Independent Study in Biostatistics, arr.**
In-depth pursuit of an area of special interest in biostatistics requiring substantial creativity and independence. Prerequisite: Consent of instructor.
Didactic material in biostatistics that may include tutorial, seminar, faculty-directed independent work (e.g. literature search, project, short research project). Prerequisite: Consent of instructor.

For students engaged in research that may lead to a dissertation. Prerequisite: consent of instructor.

Work on Biostatistics Ph.D. dissertation with the dissertation advisor. Prerequisite: consent of instructor.

Selected Statistics Courses

Contact the Department of Statistics, 241 Schaeffer Hall, 335-0712, for questions regarding course availability and scheduling.

STAT:4520 (22S:138) Bayesian Statistics, 3 s.h.
Bayesian statistical analysis, with focus on applications; Bayesian and frequentist methods compared; Bayesian model specification, choice of priors, computational methods; hands-on Bayesian data analysis using appropriate software; interpretation and presentation of analysis results. Prerequisite: STAT:3120 or equivalent. Offered fall semesters. Same as PSQF:4520.

STAT:4100 (22S:153) Mathematical Statistics I, 3 s.h.
Probability, conditional probability, random variables, distribution and density functions, joint and conditional distributions, various families of discrete and continuous distributions, mgf technique for sums, convergence in distribution, convergence in probability, central limit theorem. Prerequisites: MATH:2700 and MATH:2850 or equivalents. Offered fall and spring semesters.

STAT:4101 (22S:154) Mathematical Statistics II, 3 s.h.
Transformations, order statistics, point estimation, sufficient statistics, Rao-Blackwell Theorem, delta method, confidence intervals, likelihood ratio tests, applications. Prerequisite: STAT:4100. Offered fall and spring semesters.

STAT:6560 (22S:156) Applied Time Series Analysis, 3 s.h.
General stationary, nonstationary models, autocovariance autocorrelation functions. Stationary, nonstationary autoregressive integrated moving average models. Identification, estimation, forecasting in linear models. Use of statistical computer packages. Prerequisites: STAT:3101, and either STAT:3200 or STAT:5200. Offered spring semesters.

STAT:6540 (22S:161) Applied Multivariate Analysis, 3 s.h.
MANOVA, discriminant analysis, factor analysis, principal components, canonical analysis, nonmetric scaling, cluster analysis, categorical data analysis, use of multivariate statistical computer packages. Prerequisites: STAT:3200 and STAT:3210 or equivalents, and facility with matrix algebra. Same as PSQF:6245. Offered fall semesters of odd years.

STAT:6530 (22S:167) Environmental and Spatial Statistics, 3 s.h.
The goal of this course is to learn how to statistically analyze and interpret environmental and spatial data. The course covers methods for sampling environmental populations, geostatistics and kriging, and spatial lattice and point pattern analysis. Applications to environmental monitoring data and spatial disease mapping are featured. Offered spring semesters of odd years. Prerequisites: STAT:3200 and STAT:4101, or equivalents.

STAT:5100 (22S:193) Statistical Inference I, 3 s.h.
Review of probability, distribution theory (multiple random variables, moment-generating functions, transformations, conditional distributions), sampling distributions, order statistics, limit theory, principles of data reduction. Offered fall semesters. Prerequisites: MATH:2850 and STAT:3101, or equivalents.
STAT:5101 (22S:194) Statistical Inference II, 3 s.h.
Continuation of STAT:5100, which is prerequisite, point estimation theory (MLE, Bayes, UMVU), hypothesis testing, interval estimation, decision theory. Offered spring semesters.

STAT:6300 (22S:195) Probability and Stochastic Processes I, 3 s.h.
Conditional expectations; Markov chains including random walks and gambler’s ruin, classification of states, stationary distributions, and branching processes. Prerequisite: STAT:3100 or STAT:3120 and consent of instructor. Offered fall semesters.

STAT:7520 (22S:238) Bayesian Analysis, 3 s.h.
Decision theory, coherence and utility, subjective probability, likelihood principle, conjugate families, structure of Bayesian inference, asymptotic approximations for posterior distributions, sequential experiments, exchangeability, hierarchical models, nonparametric Bayes procedures, empirical Bayes methods, numerical and Markov chain Monte Carlo methods. Offered fall semesters of even years. Prerequisites: STAT:5120 and STAT:5101.

STAT:7400 (22S:248) Computer Intensive Statistics, 3 s.h.
Computer arithmetic; random variate generation; numerical optimization; numerical linear algebra; smoothing techniques; bootstrap methods; cross-validation; MCMC; EM and related algorithms; other topics per student/instructor interests. Offered spring semesters. Prerequisites: STAT:3101 and STAT:5200 or BIOS:5710. and proficiency in Fortran or C or C++ or Java.

STAT:7200 (22S:255) Linear Models, 4 s.h.
Linear spaces and matrix theory, best linear unbiased estimation, multivariate normal distribution and distributions of quadratic forms, full-rank and non-full rank linear models, estimability, interval estimation, hypothesis testing, random and mixed models, applications. Prerequisites: STAT:5200, STAT:5101, STAT:5201. Offered fall semesters.

Selected Other College of Public Health Courses

MPH:5100 (170:101) Introduction to Public Health Practice, 3 s.h.
Introduces concepts, structures, and activities in public health practice. Offered fall and spring semesters and summer session.

CS:3110 (22C:104) Introduction to Informatics, 3 s.h.
Fundamentals of computer science: algorithms, complexity, relational databases, systems concepts, programming concepts in Perl. Prerequisites: CS:1050 or graduate standing.

Community and Behavioral Health

MPH:5100 Introduction to Health Promotion and Disease Prevention, 3 s.h.
Basic concepts, strategies, and methods of health promotion and disease prevention; places health promotion within context of public health; provides broad overview of policy formation planning, implementation, and evaluation. Offered fall and spring semesters.

CBH:5220 Health Behavior and Health Education, 3 s.h.
Health behavior theory and its applications relevant to public health practice, designed to introduce students to concepts fundamental to the understanding of human health behavior. Offered spring semesters.
Epidemiology

EPID:5400 (173:140) Epidemiology I: Principles, 3 s.h.
Epidemiologic concepts and methods including design of descriptive and analytic studies, such as aggregate, case series, cross-sectional, case-control, and cohort studies; application of epidemiology to public health practice; communication and dissemination of epidemiologic findings. Offered fall and spring semesters and summer session.

EPID:5550 (173:155) Diagnostic Microbiology for Epidemiology, 3 s.h.
Introduces public health students to microbiological culture, antigen detection, immunological and molecular amplification laboratory techniques for bacteria, viruses, parasites, and fungi. Prerequisite: MICR:8202 or MICR:2157 or MICR:3164. Offered spring semesters.

EPID:6200 (173:220) Environmental and Occupational Epidemiology, 3 s.h.
Environmental and occupational epidemiologic study designs; basic and novel methods of exposure assessment; methodologies to improve study validity. Prerequisites: EPID:5400. Corequisites: BIOS:4120 and OEH:5240. Same as OEH:6510.

EPID:6250 (173:225) Genetics and Epidemiology, 4 s.h.
Basic human genetic and population genetics principles; methods of integrating genetic principles into epidemiologic studies; analytical methods for case control and family data. Prerequisites: BIOS:4120 and EPID:5400.

EPID:6350 (173:235) Nutritional Epidemiology, 2 s.h.
Course focuses on applying epidemiology study designs to nutrition variables and chronic disease. It includes analysis of nutrition epidemiology studies and design of research protocols. Offered spring semesters.

EPID:6400 (173:240) Epidemiology II: Advanced Methods, 3 s.h.
Epidemiological study design and analysis; bias, confounding, and effect modification; matching; descriptive studies; case-control studies; cohort studies; intervention studies; measurement principles; data sources, questionnaire design, conduct of surveys, relation to disease classification; examples from acute, communicable, chronic, and genetic diseases. Prerequisites: EPID:5400, EPID:5600, and BIOS:4120. Offered spring semesters.

EPID:6510 (173:251) Injury Epidemiology, 3 s.h.
How epidemiology can be applied to injury prevention and control: epidemiology literature, specific methodological problems involved in the epidemiology of injuries, critical evaluation of research articles. Prerequisite: EPID:5400 or consent of instructor. Offered spring semesters of odd years.

EPID:6550 (173:255) Epidemiology of Infectious Disease, 4 s.h.
Underlying epidemiological concepts of infection and disease, causation, transmission, surveillance, sero and molecular epidemiology; prevention and control of infectious diseases. Lectures, seminar discussions and case studies of specific infectious diseases of public health importance, organized by mode of transmission. Prerequisite EPID:5400 or equivalent. Offered fall semesters.

EPID:6560 (173:256) Hospital Epidemiology, 2 s.h.
Addresses infectious and noninfectious adverse outcomes of medical care and appropriate investigative methods. Other topics: surveillance, resistant organisms, molecular epidemiology, tuberculosis control, device-associated infections, latex allergies, isolation, construction, sterilization, and regulatory agencies. Prerequisite: EPID:5400 or
equivalent.

**EPID:6600 (173:260) Epidemiology of Chronic Diseases, 3 s.h.**
Introduces chronic disease epidemiology and survey and biologic methods for exposure measurement in epidemiologic studies. The course includes lectures and readings of leading chronic diseases and on measurement of disease, lifestyle, nutrition, occupation and family history. Prerequisite: EPID:5400 or consent of instructor. Offered spring semesters.

**EPID:6610 (173:261) Epidemiology of Aging, 1 s.h.**
Epidemiological methods for studying the health and social problems of older persons in the community. Applications include research and public health practice and policy. Prerequisite: EPID:5400 or consent of instructor. Offered spring semesters.

**EPID:6620 (173:262) Neuroepidemiology, 1 s.h.**
Expands basic epidemiologic concepts to neurologic disease. Includes readings from a variety of diseases and methods. Prerequisite: EPID:5400 or consent of instructor.

**EPID:6630 (173:263) Epidemiology of Reproductive Diseases, 2 s.h.**
Evaluate current epidemiological findings regarding underlying etiologic, behavioral, and genetic causes and known preventive mechanisms for reproductive diseases or conditions. Prerequisite: EPID:5400 or consent of instructor. Offered fall semesters of odd years.

**EPID:6650 (173:265) Cardiovascular Disease Epidemiology, 3 s.h.**
Natural history of atherosclerotic disease in human factors affecting its development; atherosclerotic disease in different populations (global), different ages of men and women; clinical trials to delay onset, reduce incidence, impose outcome of cardiovascular disease. Prerequisites EPID:5400 and BIOS:4120. Offered fall semesters of odd years.

**EPID:6670 (173:267) Psychiatric Epidemiology, 3 s.h.**
Population-based studies of psychiatric disorders and associated etiologic tools; diagnostic criteria used in psychiatric research, common structured interviews and rating scales; recent research relevant to common psychiatric disorders; experience writing a research idea using NIH PHS grant form. Offered spring seminars. Same as PSYC:8267. Prerequisites: EPID:5400. Recommendations: EPID:6400 or two years of resident training in psychiatry. Offered spring semesters.

**EPID:6700 (173:270) Cancer Epidemiology and Control, 3 s.h.**
Incidence, mortality, survival; risk factors, cancer control options for major cancer sites; principles and methods of cancer registration in Iowa. Prerequisites: EPID:5400 or BIOS:4120; and a college pathology course. Offered spring semesters of even years.

**EPID:5900 (173:190) Problems and Special topics in, arr.**
Didactic material in epidemiology may include tutorial, seminar, faculty-directed independent work (e.g., literature search, project, short research project). Prerequisite: Consent of instructor.

**EPID:6910 (173:291) Pharmacoepidemiology, 3 s.h.**
Drug approval process, methods for identification and attribution of adverse drug events, current understanding of the epidemiology of adverse drug events; study designs, data sources for pharmacoepidemiology, pharmaeconomics. Prerequisites: EPID:5400 or consent of instructor. Offered fall semesters of even years.

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**Health Management and Policy**

**HMP:4000 (174:102) Introduction to US Healthcare System, 3 s.h.**
Socioeconomic, political, and environmental forces influencing the organization, financing, and delivery of personal and public health services; emphasis on health services, policy concepts, access to care, system integration, policy development, and federalism governing recognition, intervention. Offered spring semesters and summer sessions.
SLIS:5900 (021:275) Health Informatics, 3 s.h.
Technological tools that support health care administration, management, and decision making. Graduate standing or consent of instructor required. Same as: BME:5250, HMP:5370, ID:5860, IGPI:5200, MED:5300, NURS:5300, RSNM:3195. Fall semesters.

Environmental and Occupational Health

OEH:4240 (175:197) Environmental Health, 3 s.h.
Survey of all aspects of environmental health. Assessment of contemporary human health issues associated with biological, chemical, physical factors of environment; critical review of environmental factors affecting health; public policies governing recognition, intervention, and control. Offered fall and spring semesters and summer sessions.

OEH:6110 (175:209) Rural Health and Agricultural Medicine, 3 s.h.
Health care delivery issues, environmental health problems, and occupational medical problems commonly encountered by practicing rural physicians. Course is conceptual so that principles can be applied to rural-agricultural areas. Prerequisites: enrollment in medical curriculum or EPID:5400 or consent of instructor.

OEH:6410 (175:230) Occupational Health, 3 s.h.
Course focuses on recognition and prevention of occupational diseases, workplace environmental assessment and control, populations at special risk for occupational disease and injury, and legal and regulatory issues in occupational health. Offered fall semesters.

OEH:5810 (175:260) Environmental Toxicology, 3 s.h.
Sources, routes of absorption, effects of environmental toxicants affecting man; pathophysiology of toxicant actions, including those of air and water pollutants, metals, pesticides, solvents, food toxicants, other chemicals. Prerequisite: college organic and inorganic chemistry, physiology, or biochemistry. Offered spring semesters.

Selected Other Biology Courses

BIOL:4213 (002:170) Bioinformatics, 3 s.h.
Overview of bioinformatics and genomics; requires working knowledge of basic concepts in genetics and molecular biology. This class is suitable for upper level undergraduates and graduate students with a strong background in genetics, biochemistry and/or molecular biology.

BIOL:5117 (002:191) Topics in Molecular Genetics, 2 s.h.
This course will focus upon mechanisms whereby cells assess the integrity of their genome, and when problems are detected, use checkpoint systems to arrest or delay progression through the cell cycle. (Most of the course will focus on eukaryotic organisms.) At the end of the course, we will briefly examine how defects in checkpoint mechanisms can result in carcinogenesis in more complex eucaryotes.

BME:5320 (051:123) Bioinformatics Techniques, 3 s.h.
Tools and techniques relevant to bioinformatics and genomics with theoretical and design issues; genetics, algorithms, Perl, bio-Perl, XML, databases, datamining, systems software. Fall semesters.
BME:5330 (051:122) Computational Genomics, 3 s.h.

MICR:3147 (061:147) Survey of Immunology, 3 s.h.
Major features of the evolutionary, ontogenic, and comparative development of innate and adaptive immune systems and their functions at the cellular and molecular levels. Prerequisite: strong background in biology, including physiology. Pre- or corequisite: biochemistry or consent of instructor. Offered Fall semester.

MICR:2157 (061:157) General Microbiology, 5 s.h.
This course covers the principles of microbial diversity, microbial genetics, physiology and metabolism, pathogenic microbiology, virology, immunology, industrial and environmental microbiology; lab emphasis on basic techniques. Prerequisites: 002:010. Offered Spring semester only. **Not for graduate credit.

MICR:3159 (061:159) Pathogenic Bacteriology, 5 s.h.
Pathogenic bacteria, with emphasis on mechanisms of pathogenicity, lab methods for isolation, and identification; lab emphasis on advanced methods for study of pathogenic bacteria. Prerequisite: MICR:2157 with a grade of C or higher. Offered Spring semester only. By permission of the instructor, Biostatistics students can register for 3 s.h. for the course work alone, without the laboratory component.

MICR:5264 (061:264) Directed Study in Microbiology, arr
Advanced level experimental research under faculty supervision. Open only to non-microbiology advanced degree candidates. Consent of instructor and an instructor number are required.

MICR:6267 (061:267) Graduate Introduction to Animal Viruses, 3-5 s.h.
Basic physical, chemical, biological properties of animal viruses, their association with human diseases; optional laboratory with emphasis on methods in basic, clinical, and molecular virology; discussion topics in the primary literature. Prerequisite: grade of C or higher in 061:157 or equivalent. By permission of the instructor, Biostatistics students can register for 3 s.h. for the course work alone, without the laboratory component.

PEDS:8104 (070:110) Medical Genetics, 2 s.h.
The course includes an overview of chromosomal disorders, principles of Mendelian inheritance, mechanisms that produce genetic disorders, non-traditional inheritance, prenatal genetics, genetic counseling, population screening, population genetics, biochemical genetics, and principles of multifactorial disorders with selected examples of genetic approaches to common disorders such as Alzheimer’s disease and cancer. In addition, there will be a series of small group sessions that will focus on case studies that illustrate basic principles discussed in the lectures, as well as social and ethical issues. Special permission code required for graduate students.

**Technical Writing**

RHET:7900 (010:550) Special Project for Graduate Students: Writing in the Disciplines, 3 s.h.
This course prepares graduate students for the tasks of writing in their home disciplines and moving between different rhetorical registers in their professional writing. The course addresses a variety of genres germane to graduate writing (cover letters, dissertation chapters, grant proposals, etc.) while making room for more discipline-specific forms such as posters and websites. We will discuss the practice of communicating the same information in different forms and styles as well as the particular limits and advantages of doing so.
The course fosters cross-disciplinary conversations about writing conventions and practices while refining discipline-specific writing strategies and pedagogy. Students will pursue pragmatic, tangible outcomes over the course of the semester. Students should be prepared to bring ongoing writing projects to class, as time will be devoted to workshopping student writing.
## M.S. in Biostatistics

Graduates of the **M.S. in Biostatistics** will be able to:

<table>
<thead>
<tr>
<th>Primarily Gained through These Required Courses</th>
<th>Secondarily Gained through These Elective or Other Required Courses</th>
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</table>
| Demonstrate a broad knowledge and understanding of current statistical theory, methods, and practices in the health sciences. | BIOS:5710 Biostatistical Methods I  
BIOS:5720 Biostatistical Methods II  
BIOS:5730 Biostatistical Methods in Categorical Data  
BIOS:6610 Statistical Methods in Clinical Trials  
STAT:4100 Mathematical Statistics I  
STAT:4101 Mathematical Statistics II  
STAT:5100 Statistical Inference I  
STAT:5101 Statistical Inference II  
EPID:5400 Epidemiology I: Principles | BIOS:6510 Design of Sample Surveys  
BIOS:6410 Microarray Analysis and Statistics in Bioinformatics  
BIOS:6650 Comparative Effectiveness Research Methods in Observational Data  
BIOS:6710 Statistical Data Mining in PH  
BIOS:6810 Bayesian Methods and Design  
BIOS:6210 Applied Survival Analysis  
BIOS:7110 Theory of Biostatistics I  
BIOS:7210 Theory of Biostatistics II  
BIOS:7210 Survival Data Analysis  
BIOS:7410 Analysis of Categorical Data  
BIOS:7310 Longitudinal Data Analysis  
STAT:4520 Bayesian Statistics  
STAT:6540 Applied Multivariate Analysis  
STAT:7400 Computer Intensive Statistics  
STAT:7200 Linear Models |
| Effectively collaborate on a research team. | BIOS:7500 Preceptorship in Biostatistics | BIOS:7270 Scholarly Integrity in Biostatistics  
BIOS:7700 Biostatistical Consulting |
| Develop statistical designs and implement analyses for health science investigations. | BIOS:7500 Preceptorship in Biostatistics | BIOS:6510 Design of Sample Surveys  
BIOS:5710 Biostatistical Methods I  
BIOS:5720 Biostatistical Methods II  
BIOS:5730 Biostatistical Methods in Categorical Data  
BIOS:6610 Statistical Methods in Clinical Trials |
| Develop computer programs for the management and analysis of data sets. | BIOS:5510 Biostatistical Computing  
BIOS:5710 Biostatistical Methods I  
BIOS:5720 Biostatistical Methods II  
BIOS:5730 Biostatistical Methods in Categorical Data | BIOS:5310 Research Data Management |
| Prepare reports and publications resulting from health science studies. | BIOS:7500 Preceptorship in Biostatistics | BIOS:5710 Biostatistical Methods I  
BIOS:5720 Biostatistical Methods II  
BIOS:5730 Biostatistical Methods in Categorical Data  
BIOS:7270 Scholarly Integrity in Biostatistics |
| Effectively communicate key statistical principles to a non-statistical audience. | BIOS:7500 Preceptorship in Biostatistics | BIOS:5710 Biostatistical Methods I  
BIOS:5720 Biostatistical Methods II  
BIOS:5730 Biostatistical Methods in Categorical Data |
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<th>Graduates of the Ph.D in Biostatistics will be able to:</th>
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<tr>
<td>Master MS competencies</td>
<td>See previous page</td>
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<td>Demonstrate an increased level of knowledge and</td>
<td>BIOS:7110 Theory of Biostatistics I</td>
<td>BIOS:6710 Statistical Data Mining in Public Health</td>
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<td>understanding of current statistical theory, methods,</td>
<td>BIOS:7120 Theory of Biostatistics II</td>
<td>BIOS:6810 Bayesian Methods and Design</td>
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<td>and practices in the health sciences.</td>
<td>BIOS:7210 Survival Data Analysis</td>
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<td>BIOS:7310 Longitudinal Data Analysis</td>
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<td>BIOS:7410 Analysis of Categorical Data</td>
<td>STAT:7400 Computer Intensive Statistics</td>
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<td>STAT:7200 Linear Models</td>
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<tr>
<td>Develop new statistical methods.</td>
<td>BIOS:7900 Dissertation</td>
<td>BIOS:7600 Advance Biostatistics Seminar</td>
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<td>Design, manage data, analyze and interpret data from a</td>
<td>BIOS:7210 Survival Data Analysis</td>
<td>BIOS:6650 Comparative Effectiveness Research Methods in</td>
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<td>variety of experimental and observational studies.</td>
<td>BIOS:7310 Longitudinal Data Analysis</td>
<td>Observational Data</td>
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<td>BIOS:7410 Analysis of Categorical Data</td>
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<td>Communicate research findings, including new statistical</td>
<td>BIOS:7500 Preceptorship in Biostatistics</td>
<td>BIOS:7210 Survival Data Analysis</td>
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<td>methods developed, effectively to various audiences in</td>
<td>BIOS:7900 Dissertation</td>
<td>BIOS:7270 Scholarly Integrity in Biostatistics</td>
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<td>writing and through oral presentation.</td>
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<td>BIOS:7310 Longitudinal Data Analysis</td>
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<td>BIOS:7410 Analysis of Categorical Data</td>
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### MPH-Quantitative Methods Subtrack

In addition to mastering the core competencies, graduates of the MPH in Quantitative Methods will be able to:

<table>
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<th>Competency</th>
<th>Primarily Gained through These Required Courses</th>
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</table>
| Demonstrate a broad knowledge and understanding of statistical techniques used in public health studies and investigations. | BIOS:4120 Introduction to Biostatistics  
BIOS:5120 Design & Analysis of Biomedical Experiments  
BIOS:5710 Biostatistical Methods I  
BIOS:5720 Biostatistical Methods II  
BIOS:6110 Applied Categorical Data Analysis  
BIOS:6210 Applied Survival Analysis | BIOS:5310 Research Data Management  
BIOS:6650 Comparative Effectiveness Research Methods in Observational Data  
BIOS:6610 Statistical Meth in Clinical Trials  
BIOS:7210 Survival Data Analysis  
BIOS:7310 Longitudinal Data Analysis  
BIOS:7410: Categorical Data Analysis  
BIOS:7270 Scholarly Integrity in Biostatistics  
STAT:3100 Intro to Mathematical Statistics I  
STAT:3101 Intro to Mathematical Statistics II  
STAT:4100 Mathematical Statistics I  
STAT:4101 Mathematical Statistics II |
| Serve as an advocate for good statistical design in public health investigations |                                                                                                                      |                                                                                                                                 |
| Interpret the results of statistical analyses in public health related publications for public health professionals and educated lay audiences. |                                                                                                                      |                                                                                                                                 |
| Promote the use of sound statistical methods to answer open questions in public health practice. |                                                                                                                      |                                                                                                                                 |
| Function as a collaborator on public health projects, taking a leadership role in the design and implementation of projects. | MPH:7000 The MPH Practicum Experience | (Graduate Research Assistantship) |
| Assume responsibility for the design and implementation of analyses in investigations of public health questions. | BIOS:5710 Biostatistical Methods I  
BIOS:5720 Biostatistical Methods II  
BIOS:6110 Applied Categorical Data Analysis  
MPH:7000 The MPH Practicum Experience | BIOS:6210 Applied Survival Analysis  
BIOS:6220 Cohort Data Analysis  
STAT:4200 Statistical Methods and Computing  
STAT:3210 Experimental Design & Analysis |
| Manage, analyze and interpret the data for projects such as large community surveys, laboratory investigations, and multi-center clinical trials. | BIOS:5510 Biostatistical Computing | BIOS:5310 Research Data Management  
STAT:3210 Experimental Design & Analysis  
STAT:4200 Statistical Methods and Computing |
| Demonstrate effective written and oral communication skills when communicating quantitative information and statistical inferences to different audiences of public health professionals | MPH:7000 The MPH Practicum Experience | (Graduate Research Assistantship) |
Appendix D - Toward Best Practices for Graduate Students and their Research Advisors

(UI Graduate College, August 2010. Adapted from “Compact Between Biomedical Graduate Students and Their Research Advisors,” Association of American Medical Colleges)

The progress, development and success of a graduate student hinges on the commitment of both the student and the research advisor. Basic principles of best practices in mentoring and graduate student life appear in the two lists that follow. Graduate students should be aware of what is necessary for their success and their advisors likewise should be aware of practices that promote their students’ best interests.

Although the concepts of commitment and responsiveness underlying the lists of expectations apply to all disciplines, the specifics of these principles vary considerably among the biological sciences, physical sciences, social sciences, and humanities. Thus, these guidelines are intended to be modified, appended or reduced to fit specific departments, programs and disciplines.

The Graduate College feels that graduate programs and their students can benefit from a concerted effort to incorporate these best practices, but we do not intend to mandate, monitor, or enforce them in any particular way. Some potential uses of these lists of expectations could include:

1. Presenting these expectations in orientation sessions for new graduate students.
2. Introducing expectations at orientations of new faculty members.
3. Incorporating the expectations into a program’s graduate student handbook.
4. Discussing the expectations during graduate seminars and faculty meetings.
5. Creating a formal agreement that is signed by both the student and the advisor when the mentoring relationship commences.
6. As guidelines for the regular evaluation of graduate student progress.
Expectations of Graduate Students

1. A graduate student has the **primary responsibility for successful completion of his or her degree.** A graduate student should be committed to his or her graduate education and should demonstrate this by efforts in the classroom and in research. A graduate student is expected to maintain a high level of professionalism, self-motivation, engagement, excellence, scholarly curiosity, and ethical standards.

2. A graduate student should **meet regularly with the research advisor** and provide updates on the progress and results of ongoing research.

3. A **graduate student should be knowledgeable of the policies and requirements of the graduate program, the graduate college, and the institution.** The student should strive to meet these requirements, including teaching responsibilities.

4. A **graduate student should work with the research advisor to develop a thesis/dissertation project.** This will include establishing a timeline for each phase of the work. The student should strive to meet the established deadlines.

5. A **graduate student should work with the research advisor to select a thesis/dissertation committee.** The student should meet with this committee at least annually (or more frequently, according to program guidelines) and be responsive to the advice of and constructive criticism from the committee.

6. A **graduate student should discuss policies on authorship and attendance at professional meetings with the research advisor.** The student should work with the advisor to submit all relevant research results that are ready for publication in a timely manner prior to graduation.

7. A **graduate student should attend and participate in meetings, seminars and journal clubs that are part of the educational program.**

8. A graduate student should **contribute to maintaining a research environment that is intellectually stimulating, emotionally supportive, safe, and free of harassment.**

9. A graduate student should **participate in the institution’s Responsible Conduct of Research Training Program and practice those guidelines** in conducting thesis/dissertation research.

10. A graduate student should **discuss policies on work hours, sick leave and vacation with the research advisor or graduate director.** The student should consult with the advisor in advance of any planned absences.

11. A graduate student should **acknowledge primary responsibility to develop a career following the completion of the doctoral degree.** The student should seek guidance from available resources, including the research advisor, career counseling services, thesis/dissertation committee, and any other mentors.

12. A graduate student should **comply with all institutional policies, including academic program milestones.** The student should comply with both the letter and spirit of all best practices and policies of the institution.
Expectations of Research Advisors

1. The research advisor should be committed to the education and training of the graduate student as a future member of the research community.

2. The research advisor should meet one-on-one with the student on a regular basis. The advisor should provide timely feedback on the student’s written work to facilitate ongoing progress on the thesis/dissertation.

3. The research advisor should be knowledgeable of the requirements and deadlines of his/her graduate program as well as those of the institution, including teaching requirements and human resources guidelines. The research advisor should guide the student in these areas to ensure academic and professional success.

4. The research advisor should help to plan and direct the graduate student’s project, set reasonable and attainable goals, and establish a timeline for completion of the project. The research advisor should anticipate conflicts between the interests of externally funded research programs and those of the graduate student, and should help keep these interests from interfering with the student’s thesis/dissertation research.

5. The research advisor should help a graduate student select a thesis/dissertation committee. The advisor should assure that the committee meets at least annually (or more frequently, according to program guidelines) to review the graduate student’s progress.

6. The research advisor should discuss authorship policies regarding papers with the graduate student. The advisor should acknowledge the graduate student’s contributions and work with the graduate student to present and publish his/her work.

7. The research advisor should encourage the graduate student to attend scientific/professional meetings and make an effort to secure and facilitate funding for such activities.

8. The research advisor should provide an environment for his/her graduate students that is intellectually stimulating, emotionally supportive, safe, and free of harassment.

9. The research advisor should discuss intellectual policy issues with the student regarding disclosure, patent rights and publishing research discoveries.

10. The research advisor should not require the graduate student to perform tasks unrelated to his/her academic and professional development.

11. The research advisor should provide career advice and assist in finding a position for the graduate student following his/her graduation. The advisor should provide honest letters of recommendation and be accessible for advice and feedback on career goals.
12. The research advisor should **lead by example and facilitate the training of the graduate student in complementary skills needed to be a successful researcher**, such as oral and written communication, grant writing, lab management, animal and human research policies, the ethical conduct of research, and scholarly professionalism. The advisor should encourage the student to seek opportunities in teaching, if not required by the student’s program.

13. In disciplines where it is customary, the research advisor should **provide financial resources for the graduate student to facilitate the student’s thesis/dissertation research**.
Appendix E—Forms

1. **Dissertation Prospectus Approval**
2. **Certificate in Biostatistics Application**
3. **Change of Registration**
4. Degree Application—located on ISIS under Student Records tab
5. Grading Option (Satisfactory/Unsatisfactory)
   Available from Graduate Program Coordinator
6. **Plan of Study**
   Change in Plan of Study
7. Student Progress Report  [MS Degree]  [Ph.D. Degree]
8. **Student Preceptorship Evaluation**
9. Short Hours Form (Post Comp Students)
   Available from Graduate Program Administrator (Rm 334-CPHB)
10. **Request for Change of Graduate College Status**

Additional forms may be found on the Registrar’s [website](#).
## Significant Dates 2015-16

### Fall Semester 2015

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 24</td>
<td>First day of classes</td>
</tr>
<tr>
<td>September 7</td>
<td>Labor Day Holiday</td>
</tr>
<tr>
<td>August 28</td>
<td>Last day to drop or add courses without charge</td>
</tr>
<tr>
<td>September 4</td>
<td>Last day to register late</td>
</tr>
<tr>
<td></td>
<td>Last day to add or change S-U status</td>
</tr>
<tr>
<td>October 2</td>
<td>Last day to submit degree application to Registrar for Dec. graduation</td>
</tr>
<tr>
<td>November 5</td>
<td>First deposit of thesis due in Graduate College for Dec. graduation</td>
</tr>
<tr>
<td>November 10</td>
<td>Last day to drop classes or withdraw registration</td>
</tr>
<tr>
<td>Nov. 9-20</td>
<td>Early registration for Spring 2016 Semester</td>
</tr>
<tr>
<td>Nov. 223-29</td>
<td>Thanksgiving Holiday Recess</td>
</tr>
<tr>
<td>December 2</td>
<td>Final exam reports due in Graduate College for Dec. graduation</td>
</tr>
<tr>
<td>December 9</td>
<td>Final deposit of thesis due in Graduate College for Dec. graduation</td>
</tr>
<tr>
<td>Dec. 14-18</td>
<td>Final Exam week</td>
</tr>
<tr>
<td>December 19</td>
<td>University Commencement: Graduate College (see <a href="http://www.registrar.uiowa.edu">www.registrar.uiowa.edu</a>)</td>
</tr>
<tr>
<td>December 23</td>
<td>Deadline for reports to remove “Incomplete”, grades due to Registrar</td>
</tr>
</tbody>
</table>

### Spring Semester 2016

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 14-15</td>
<td>Biostatistics Spring M.S. Core Examination (Tentative)</td>
</tr>
<tr>
<td>January 18</td>
<td>University Holiday, MLK, Jr., Convocation</td>
</tr>
<tr>
<td>January 19</td>
<td>First day of Spring classes</td>
</tr>
<tr>
<td>January 25</td>
<td>Last day to drop or add courses without charge</td>
</tr>
<tr>
<td>February 1</td>
<td>Last day to register late</td>
</tr>
<tr>
<td></td>
<td>Last day to add or change S-U status</td>
</tr>
<tr>
<td>February 26</td>
<td>Last day to submit degree application to Registrar for May graduation</td>
</tr>
<tr>
<td>March 13-20</td>
<td>Spring Break</td>
</tr>
<tr>
<td>March 24</td>
<td>First deposit of thesis due in Graduate College for May graduation</td>
</tr>
<tr>
<td>April 12</td>
<td>Last day to drop classes or withdraw registration</td>
</tr>
<tr>
<td>April 11-22</td>
<td>Early registration for Summer 2016 Session and Fall 2016 Semester</td>
</tr>
<tr>
<td>April 27</td>
<td>Final exam reports due in Graduate College for May graduation</td>
</tr>
<tr>
<td>May 4</td>
<td>Final deposit of thesis due in Graduate College for May graduation</td>
</tr>
<tr>
<td>May 9-13</td>
<td>Final Exam week</td>
</tr>
<tr>
<td>May 13</td>
<td>Commencement: Graduate College (see <a href="http://www.registrar.uiowa.edu">www.registrar.uiowa.edu</a>)</td>
</tr>
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</tr>
</tbody>
</table>
Summer 2016

July 25-26    PhD Comprehensive In-Class Examination
(tentative)    MS Core Examination

Fall Semester 2016

August 22    First day of classes 2016-2017