The University of Iowa
College of Public Health

THE UNIVERSITY OF IOWA
College of Public Health

Department of Biostatistics

2011-2012 Student Handbook

The University of Iowa prohibits discrimination in employment AND in its educational programs and activities on the basis of race, national origin, color, creed, religion, sex, age, disability, veteran status, sexual orientation, gender identity, or associational preference. The University also affirms its commitment to providing equal opportunities and equal access to University facilities. For additional information on nondiscrimination policies, contact the Coordinator of Title IX, Section 504, and the ADA in the Office of Affirmative Action, (319) 335-0705 (voice) or (319)335-0697 (text), 202 Jessup Hall, The University of Iowa, Iowa City, Iowa, 52242-1316.Individuals with disabilities are encouraged to attend all University of Iowa sponsored events. If you are a person with a disability who requires an accommodation in order to participate in this program, please contact Terry Kirk in advance at (319)384-5016.

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 Coordinator. 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 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 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 Head of the Department of Biostatistics is Dr. Kathryn Chaloner, who is responsible for administration of the educational, research, and professional service functions of the Department. Dr. William R. Clarke is Deputy Head of the Department. Dr. Jeffrey Dawson serves as Director of Graduate Studies. The department currently has fifteen primary faculty (see Appendix A—Biostatistics Faculty and Staff Directory for a list), three emeritus faculty, twelve secondary faculty, and three adjunct faculty. Ms. Ann Weber serves as departmental secretary, Ms. Caitlin Crispin is a Project Assistant, and Ms. Terry Kirk is Graduate Program Coordinator.

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. Jane Pendergast.

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 offers student memberships at reduced rates to full-time students. Information and applications are available from the graduate program coordinator or on-line at www.amstat.org. 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, check out the 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 also required. The recommended minimum score on the combined verbal and quantitative portions is 1050; however, the average combined score for new students in recent years has been 1250-1350.

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 highly recommended. Remedial English courses are required for foreign students whose TOEFL score falls below 250 (computer-based), 600 (paper-based), or 100 (internet-based). Scores below 213 (computer-based), 550 (paper-based) or 81 (computer-based) are not considered for admission.

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.

Conditional Student Status

Potentially successful students not meeting all criteria may be admitted on a conditional basis. Specially tailored additional stated conditions (e.g., taking remedial courses or maintaining a specified grade point average for a prescribed length of time) must be met by the student to achieve regular student status. Regular admission must be reached within two semesters.

Failure to achieve this requirement will result in dismissal. When changing to regular student status, a Request for Change of Graduate College Status form must be completed.

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 January 15th 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. One reference letter from a faculty member outside of the department
5. One brief reference letter from a Biostatistics faculty member

The Ph.D. Admissions Committee will consider the above items along with other information already contained in the applicant's file (M.S. Final 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 adviser. The Ph.D. Admissions Committee will attempt to make a decision on the application by the end of 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 adviser, apply during the fall of their second year to be admitted effective in the subsequent Spring Semester. For these early applications, October 31st is the deadline for submitting the materials listed above, and the M.S. Final 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 January 15th deadline, for consideration for regular Fall admission. Students whose applications are denied or deferred are encouraged to consult with their adviser.

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 has two deadlines for making offers of admission and financial aid for the fall semester: January 15 and March 15. Candidates whose applications are complete by January 15 compete for the first set of offers of financial aid. The availability of financial aid is less likely for individuals who miss the January 15 deadline. Many students who are accepted into the program are 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 are 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 adviser, 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.

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.

Training Grant: Statistics in Microbiology, Infectious Diseases & Bioinformatics

The Department of Biostatistics offers an NIH sponsored pre-doctoral training program in Statistical Methods for Microbiology, Infectious Diseases and Bioinformatics. NIH fellowships are available to US citizens and permanent residents. These fellowships support Ph.D. students in Biostatistics and Statistics in integrating biology course work and laboratory experiences into their Ph.D. program. The following courses should be included into the Ph.D. plan of study: General Microbiology (5 s.h.), Microarray Analysis and Statistics in Bioinformatics (3 s.h.) and a Biostatistics topics course in Statistics in Microbiology (1 s.h.). Trainees will also complete a mentored laboratory rotation, spending at least 6 weeks in a Microbiology laboratory (3 s.h.). These courses fulfill the biology/health science requirement for the Biostatistics Ph.D. degree. The grant will also support microbiology Ph.D. students, or Ph.D. students in a related biological science, to spend one year studying biostatistics. Please refer to the Biostatistics web page or contact Terry Kirk, Graduate Program Coordinator, for detailed requirements and application procedures for this fellowship: terry-kirk@uiowa.edu.

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.

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://gervaseprograms.georgetown.edu/honor/system/53377.html

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 adviser by the Director of Graduate Studies and notified by the Department. If a student wishes to change advisers, the student initiates the change by determining which faculty adviser would be preferred and discussing the possibility with the preferred faculty adviser. Upon approval by the new faculty adviser, the student must then notify the prior adviser, 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 adviser 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 Coordinator and/or the Office of International Students and Scholars (OISS) 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.

Computer registration is done at 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 authorization from the student's faculty adviser. The student or the adviser should contact the Graduate Program Coordinator 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. Beginning the first day of classes, computer registration is no longer possible and any change must be done with an add/drop slip and signed by the course instructor and the student's adviser. Students should be aware that failure to drop classes by the established deadline will result in a successively increase 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 adviser approve the registration. Arrangements for S/U grading in these courses are accomplished by filing a form with appropriate signatures in 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/dissertation, 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 adviser, and submitted to the Graduate Program Coordinator for review. The student and his or her adviser 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 also available on the Department of Biostatistics website under *Information for Current Students*, or from the graduate program coordinator. M.P.H. students should consult the *2011-2012 M.P.H. Student Handbook* for the 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 at the Registrar Service Center in Calvin Hall by the posted deadline of a 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 Graduate Program Coordinator will file the necessary Graduate College forms for graduation, in consultation with the student and the adviser.

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

Persons with deficiencies in any one of the above areas may apply for admission and make up these deficiencies during the first year of graduate study. The University of Iowa courses that provide training in prerequisite work at the required level are:

Computer Science
22C:005 Introduction to Computer Science, 3 s.h.
Mathematical Sciences
22M:025 Calculus I, 4 s.h.
22M:026 Calculus II, 4 s.h.
22M:028 Calculus III, 4 s.h.
22M:027 Introduction to Linear Algebra, 4 s.h.

Course Requirements

Required Courses:

171:178	Biostatistical Computing	3 s.h.
171:201	Biostatistical Methods I	4 s.h.
171:202	Biostatistical Methods II	4 s.h.
171:203	Biostatistical Methods in Categorical Data	3 s.h.
171:266	Statistical Methods in Clinical Trials	3 s.h.
171:280	Preceptorship in Biostatistics*	3 s.h.
173:140	Epidemiology I: Principles	3 s.h.
22S:153 & 154	Mathematical Statistics I & II	
OR		6 s.h.
22S:193 & 194	Statistical Inference I & II	
		29 s.h.

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

Required Biology/Public Health Course. Students must select one course from the following list or an approved substitution:

002:169	Introduction to Bioinformatics	4 s.h.
055:122	Computational Genomics	3 s.h.
061:157	General Microbiology	5 s.h.
069:133	Human Pathology	4 s.h.
096:114	Human Pathophysiology I *	3 s.h.
096:115	Human Pathophysiology II *	3 s.h.
127:191	Human Molecular Genetics	3 s.h.
171:185	Microarray Data Analysis	3 s.h.
171:xxx	Statistical Genetics	3 s.h.
172:101	Intro. to Health Promotion and Disease Prevention	3 s.h.
174:102	Introduction to U.S. Health Care System	3 s.h.
175:197	Environmental Health	3 s.h.
		at least 3 s.h.

*A previous course in animal biology is strongly recommended for Pathophysiology.

In addition, students must select at least 6 additional semester hours from the following list (5 s.h. if 171:280 is taken for only 1 s.h.).

171:164	Research Data Management	3 s.h.
171:173	Intermediate Design of Sample Surveys	3 s.h.
171:174	Introductory Longitudinal Data Analysis	3 s.h.
171:185	Microarray Data Analysis	3 s.h.
171:230	Statistical Data Mining in Public Health	3 s.h.
171:242	Applied Survival and Cohort Data Analysis	3 s.h.
171:251	Theory of Biostatistics I	4 s.h.
171:252	Theory of Biostatistics II	4 s.h.
171:261	Survival Data Analysis	3 s.h.
171:262	Analysis of Categorical Data	3 s.h.
171:264	Longitudinal Data Analysis	3 s.h.
171:268	Bayesian Methods and Design	3 s.h.
171:282	Biostatistical Consulting	1 s.h.
22C:104	Introduction to Informatics	3 s.h.
22S:138	Bayesian Statistics	3 s.h.
22S:161	Applied Multivariate Analysis	3 s.h.
22S:248	Computer Intensive Statistics	3 s.h.
22S:255	Linear Models	4 s.h.
		Total of at least 6 s.h.

Electives:

The student may choose other graduate-level courses in consultation with his/her adviser.

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

Preceptorship Guides

The Preceptorship in Biostatistics (171:280) 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 adviser 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 used.
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.

Master's Residence Requirement

Under most circumstances, a minimum of 24 semester hours must be completed under the auspices of The University of Iowa. 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 Final Examination

The master's 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 from the Graduate Program Coordinator. Any student who has a disability that may require some modification of seating or testing must inform the Graduate Program Coordinator when intent is declared to take the examination.

Outline of Topics Covered on the M.S. Final 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, χ^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 Biostatistics

Information about other College of Public Health programs, including the M.P.H. Subtrack in Biostatistics, can be found on the College of Public Health website www.public-health.uiowa.edu/academics/ or by contacting Lexie Just, E172 GH, 384-5470, lexie-just@uiowa.edu.

M.P.H. 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.

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 MS 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, Ph.D. in Biostatistics

M-S Level Background **26 s.h.**

Ph.D. students must take the following 26 s.h. of Required Courses listed in the M.S. Program in Biostatistics: 171:178, 171:201, 171:202, 171:203, 171:280, 173:140, 22S:153/154 (or 22S:193/194), 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 **21 s.h.**

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

171:251	Theory of Biostatistics I	4 s.h.
171:252	Theory of Biostatistics II	4 s.h.
22S:255	Linear Models	4 s.h.
171:261	Survival Data Analysis	3 s.h.
171:262	Analysis of Categorical Data	3 s.h.
171:264	Longitudinal Data Analysis	3 s.h.

Electives and Dissertation **32 s.h.**

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.

Dissertation Requirement

171:300 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

171:173	Design of Sample Surveys	3 s.h.
171:174	Introductory Longitudinal Data Analysis	3 s.h.
171:178	Biostatistical Computing	3 s.h.
171:185	Microarray Data Analysis	3 s.h.
171:230	Statistical Data Mining in Public Health	3 s.h.
171:266	Statistical Methods in Clinical Trials	3 s.h.
171:268	Bayesian Methods and Design	3 s.h.
171:271	Advanced Survival Analysis	3 s.h.
171:290	Advanced Biostatistics Seminar	1-3 s.h.

Statistics

22S:138	Bayesian Statistics	3 s.h.
22S:156	Applied Time Series Analysis	3 s.h.
22S:161	Applied Multivariate Analysis	3 s.h.
22S:195	Probability and Stochastic Processes I	3 s.h.
22S:238	Bayesian Analysis	3 s.h.
22S:248	Computer Intensive Statistics	3 s.h.
22S:256	Multivariate Analysis	3 s.h.

Bioinformatics/Informatics:

002:170	Bioinformatics	3 s.h.
002:128	Fundamental Genetics	3 s.h.
070:110	Medical Genetics	2 s.h.
22C:104	Introduction to Informatics	3 s.h.

Community and Behavioral Health:

172:150	Health Behavior and Health Education	3 s.h.

Environmental Health:

175:197	Environmental Health	3 s.h.
175:209	Rural Health and Agricultural Medicine	3 s.h.
175:230	Occupational Health	3 s.h.
175:252	Theories of Environmental Policy	3 s.h.
175:260	Environmental Toxicology	3 s.h.

Epidemiology:

173:155	Diagnostic Microbiology for Epidemiology	3 s.h.
173:225	Genetics and Epidemiology	4 s.h.
173:235	Nutritional Epidemiology	2 s.h.
173:240	Epidemiology II: Advanced Methods	3 s.h.
173:251	Injury Epidemiology	3 s.h.
173:255	Epidemiology of Infectious Diseases	3 s.h.

173:256	Hospital Epidemiology	2 s.h.
173:260	Epidemiology of Chronic Diseases	3 s.h.
173:261	Epidemiology of Aging	1-2 s.h.
173:262	Neuroepidemiology	1 s.h.
173:263	Epidemiology of Reproductive Diseases	2-3 s.h.
173:265	Cardiovascular Disease Epidemiology	3 s.h.
173:267	Psychiatric Epidemiology	3 s.h.
173:270	Cancer Epidemiology and Control	3 s.h.
173:290	Intervention and Clinical Trials (same as 171:267)	3 s.h.
173:291	Pharmacoepidemiology	3 s.h.

Microbiology:

061:147	Survey of Immunology	4 s.h.
061:157	General Microbiology	5 s.h.
061:159	Pathogenic Bacteriology	5 s.h.
061:264	Directed Study in Microbiology	Arr
061:267	Graduate Introduction to Animal Viruses	3 s.h.

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

Residence Requirement

Following the first 24 semester hours of graduate work, a Ph.D. student must complete either (1) two full-time semesters of graduate work (9 or more semester hours each) *or* (2) three semesters of at least 6 semester hours each during which time the student holds an assistantship of at least one-third time which is certified by the Department as contributing to the student's doctoral program.

Ph.D. Qualifying Examination

The Ph.D. qualifying examination is required for all entering Ph.D. students and should be taken during the first year of Ph.D. studies. This exam is the same as the biostatistics master's exam (see page 14) and is offered twice each year. Copies of past exams are available for review from the Graduate Program Coordinator. Students in our biostatistics program who have passed the M.S. exam may petition the biostatistics faculty for permission to have the M.S. exam count as the Ph.D. qualifying exam. If the Ph.D. qualifying exam is not passed, the student must retake the exam at the next administration to remain in the program. The exam cannot be repeated more than once.

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 Committee. The exam consists of two parts, an in-class component and a take-home component. The in-class component contains a closed-book set of theory problems covering the Ph.D. required courses (171:251, 171:252, 22S:255, 171:261, 171:262, and 171:264). The topic areas for the take-home examination include the topics covered by the in-class exam, as well as the topics covered in the courses 171:201 and 171:202 (Biostatistical Methods I and II). The Ph.D. comprehensive examination is a two-day in-class exam, each day three hours in length. The first day will cover the Theory of Biostatistics sequence and the second will cover Linear Models and two out of the three courses on Survival, Categorical, or Longitudinal Data Analysis. The remaining course out of these three will be covered on the take-home examination. The primary focus of the take-home exam is a data analysis project and report. In addition, problems of a more theoretical nature that are related to the data-analytic problems may be included in the take-home exam.

The Ph.D. Comprehensive Examination Committee consists of five faculty members of the Department of Biostatistics who will meet and discuss the students' performance on the comprehensive examination and will recommend a grade of pass or fail in their report. However, in highly unusual circumstances, this committee may feel that clarification is necessary before rendering a pass/fail outcome and will then give the student an oral examination as a follow-up to the written exam. The Examination Committee will report to the department faculty, who then vote on acceptance of the report. The committee members then sign the required Graduate College examination reporting form.

The Ph.D. comprehensive examination is offered once yearly. Copies of past written exams are available for review from the graduate program coordinator. Students who are unsuccessful in passing the Ph.D. comprehensive exam in their first attempt may repeat the exam only one time. Any student who has a disability that may require some modification of seating or testing must inform the Biostatistics graduate program coordinator when intent is declared to take the examination.

Outline of possible topics covered by Ph.D. comprehensive examination:

171:251 Theory of Biostatistics I

Reading List for 171:251

The first two references are the primary sources. The others are auxiliary.

CN: 171:251 Course Notes

BD: Bickel and Doksum, Mathematical Statistics (2001) Chapters 1-6

CH: Cox and Hinkley, Theoretical Statistics (1974) Chapters 2,3,4,7,8

F: Ferguson, A Course in Large Sample Theory (1996)

S: Serfling, Approximation Theorems for Mathematical Statistics (1980)

R: Rohatgi, An Introduction to Probability Theory and Mathematical Statistics (1976) Chapter 6

1. Probability theory (*CN, BD*)
   a. conditional expectation
   b. distribution theory of transformations
   c. bivariate normal distribution
   d. moment-generating and characteristic functions
   e. order statistics
2. Statistical models (*CN, BD, CH*)
   a. sufficiency
   b. exponential family
   c. Bayesian models
3. Methods of estimation (*CN, BD, CH*)
   a. substitution methods and method of moments
   b. least-squares methods
   c. maximum-likelihood estimation
   d. Bayes' estimators
4. Optimal estimation (*CN, BD, CH*)
   a. criteria of estimation
   b. uniformly minimum variance unbiased estimators
   c. information inequality
5. Hypothesis testing and confidence intervals (*CN, BD, CH*)
   a. Neyman-Pearson tests
   b. confidence intervals and bounds
   c. uniformly most powerful tests and accurate confidence intervals.
6. 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, Lindberg-Feller
   e. Distributions of transformed sequences: Taylor series, approximations to moments, delta method, variance stabilizing transforms
7. Likelihood theory and methods (*CN, S*)
   a. Estimation; asymptotic normality
   b. Testing and confidence intervals: score, Wald and likelihood ratio tests with and without nuisance parameters
   c. Reparametrization

<u>171:252 Theory of Biostatistics II</u>

Reading List for 171:252

The course notes are the primary reference. The others are auxiliary.

CN: 171:252 Course Notes

HS: Hajek and Sidak, Theory of Rank Tests (1967) Chapters 2- 3

L: Lehmann, Testing Statistical Hypotheses (1959) Chapter 4

CH: Theoretical Statistics, (1974) Section 5.2, Chapter 6

MN: McCullagh and Nelder, Generalized Linear Models (1989) Chapters 2,4,7,9

BD: Breslow and Day, Statistical Methods in Cancer Research, Volume I - The analysis of case-control studies (1980) Chapters 6-7

FT: Fahrmeir and Tutz, Multivariate Statistical Modelling Based on Generalized Linear Models (2001) Chapters 2, 7
T: Tanner, Tools for Statistical Inference (1993) Chapters 3- 4
LR: Little and Rubin, Statistical Analysis with Missing Data (1987) Chapters 7, 9

1. Nonparametrics and related topics (*CN, HS, CH, L*)
   a. Hypothesis testing with nuisance parameters (similar tests)
   b. Permutation tests
   c. Randomization model vs population model
   d. Linear rank tests
   e. Locally most powerful rank tests (marginal likelihood)
   f. Estimation based on rank tests—semiparametrics
2. Generalized linear models and related topics (*CN, MN, BD, FT*)
   a. GLM framework
   b. Parameter estimation and aliasing
   c. Unconditional likelihood theory with applications of logistic regression
   d. Conditional likelihood theory with applications of conditional logistic regression
   e. Misspecified models (omitted covariates, robust variance estimation)
   f. Quasi-likelihood & generalized estimating equations (GEE)
   g. Generalized linear mixed models
3. The EM Algorithm (*CN, T, LR*)
   a. The algorithm
   b. Missing data examples
   c. Theory of the EM algorithm; EM for the exponential family
   d. Missing Information Principle
   e. Estimating standard errors in context of EM
   f. Monte-Carlo EM (MCEM)

<u>171:261 Survival Data Analysis</u>
Reading List for 171:261
171:261 Course Notes
Kalbfleisch and Prentice: The Statistical Analysis of Failure Time Data (1980)
Cox and Oakes: Analysis of Survival Data (1984)
Klein and Moeschberger: Survival Analysis, Techniques for Censored and Truncated Data (1997)

1. Functions of survival time
   a. Hazard and survival functions
   b. Continuous time, discrete time
2. Censoring and truncation
   a. Left, right and interval censoring
   b. Left and right truncation
3. Parametric regression analysis
   a. Classical survival distributions
   b. Accelerated failure time model
   c. Proportional hazards model
4. Nonparametric estimation and testing
   a. Product limit estimator
   b. One-sample, two-sample, k-sample tests
   c. Trend tests, stratification

5. Cox regression
    a. Partial likelihood theory
    b. Estimation and testing
    c. Proportional hazards assumption
    d. Time-dependent covariates
    e. Regression diagnostics
6. Competing Risks
    a. Cumulative incidence function
    b. Cox regression
7. Multivariate survival analysis
    a. Marginal models
    b. Frailty models

<u>171:262 Categorical Data Analysis</u>
Reading List for 171:262
171:262 Course notes
A Agresti: Categorical Data Analysis (2nd). Wiley (2002)

1. Distributions and Inference for Categorical Data
    a. Discrete Distributions
    b. Maximum Likelihood
    c. Wald, Score, Likelihood-Ratio Tests
    d. Confidence Intervals Based on Test Inversion
    e. Inference for Binomial and Multinomial Parameters
2. Analysis of Contingency Tables
    a. Sampling and Probability Distribution Models
    b. Odds Ratio and Measures of Association
    c. Conditional and Marginal Associations
    d. Confidence Intervals for Association Measures
    e. Testing Independence in Two-Way Tables
    f. Partitioning Chi-Squared Test Statistics
    g. Two-Way Tables Based on Ordinal Variables
    h. Fisher's Exact Test / Exact Inferential Procedures
3. Generalized Linear Models (GLMs)
    a. Components of the GLM
    b. GLMs for Binary and Count Data
    c. Maximum Likelihood / Newton-Raphson / Fisher Scoring
    d. Inference for GLMs
    e. Deviance
    f. Quasi-Likelihood and Overdispersion
4. Logistic Regression: Logit Models for Binary Responses
    a. Parameter Interpretation and Model Structure
    b. Model Fit and Inference
    c. Categorical Explanatory Variables
    d. Cochran-Armitage Linear Trend Test
    e. Model Selection
    f. Residuals and Diagnostics
    g. Conditional Associations and Cochran-Mantel-Haenszel Methods

h. Using Models to Improve Inferential Power
i. Sample Size Determination and Power
j. Alternate Links
k. Conditional Logistic Regression and Exact Inference

5. Logit Models for Multicategory Responses
   a. Nominal Responses and Baseline Category Models
   b. Ordinal Responses /Proportional Odds Models /Cumulative Link Models
6. Loglinear Models
   a. Loglinear Models for Two-Way and Three-Way Tables
   b. Inference for Loglinear Models
   c. Loglinear-Logit Model Connection

171:264 Longitudinal Data Analysis

Course Outline

1. Univariate methods. Pros and cons of collapsing longitudinal measures into a single summary measure.
2. Normal-theory multivariate methods. Hotelling's T2, multivariate analysis of variance (MANOVA), profile analysis. What they are and how to use them.
3. Review of repeated measures ANOVA, and how it fits into the general multivariate theory.
4. Linear mixed models for normally-distributed responses, hierarchical models. A broader perspective on the linear mixed model than was presented in 171:202, and more detail about estimation and hypothesis testing. Similarities and differences of this approach relative to previous approaches.
5. Reintroduction of the (univariate) generalized linear model (GLM) for the sake of consistent notation. Material assumed to be covered in 171:202 or 171:203.
6. Generalized estimating equations (GEE) used primarily for non-normally-distributed responses. What they are, how they are used to get model parameter estimates, and interpretations of those estimates. Similarities and differences of this approach relative to what has been covered so far.
7. Generalized linear mixed models (GLMM). The theoretical basis for these models, estimation approaches and issues, interpretation of resulting parameters. Similarities and differences of the GLMM relative to methods/approaches previously covered.
8. Approaches to assessing the adequacy of the model and comparing model fits in each of the above models.
9. General topics related to current and future research in this area.

Reading List for 171:264

171:264 Course notes – This is the primary source of material for the course. The rest is supplementary and not required reading.

CS Davis: Statistical Methods for the Analysis of Repeated Measurements: Springer Publishing Co, New York (2002). This is the primary reference for the earlier (Gaussian data) part of the course.

G Verbek and G Molenberghs, (2001) Linear Mixed Models for Longitudinal Data, Springer Series in Statistics, Springer Publishing Co., New York. This is a good source for the linear mixed model (topic 4 above).

G Molenberghs and G Verbeke: Models for Discrete Longitudinal Data. Springer (2005). This is a good source for the non-Gaussian section of the course (topics 6 and 7).

PJ Diggle PJ, Heagery, K-Y Liang , and SL Zeger, (2002). Analysis of Longitudinal Data, Second Edition. Oxford Univ. Press. This is a general text which covers many of the sections of the course, from basically the same perspectives.

D Hedeker and RD Gibbons (2006). Longitudinal Data Analysis. Wiley Series in Probability and Statistics, John Wiley & Sons, Inc. Many of the course topics are included in this book, but from more of a social science perspective and with some differences in the approaches.

CE McCulloch and SR Searle (2001) Generalized, Linear, and Mixed Models. Wiley Series in Probability and Statistics. John Wiley & Sons, Inc. This is more of a regular textbook than some of the others above, and has more detail on the theoretical underpinnings than some of the others. Better discussions of computational issues of estimation than others.

Goldstein, H. (1995) Multilevel Statistical Models, Second Edition. Oxford University Press, New York. This book approaches the topic from the hierarchical modeling perspective.

GM Fitzmaurice, NM Laird, and JH Ware, (2004). Applied Longitudinal Analysis. John Wiley and Sons, This is actually a lower-level text on this general topic. It includes some nice discussions on modeling issues.

<u>22S:225 Theory of Linear Models</u>

Readings List for 22S:255

22S:255 Course notes

F Graybill: Theory and Application of the Linear Model, Duxbury (1986)

SR Searle: Linear Models, John Wiley (1971)

J Schott: Matrix Analysis for Statistics, John Wiley (1996)

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, multi-part problems, 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
8. The general linear mixed models, including best linear unbiased prediction (BLUP)
9. Estimation of variance components, including maximum likelihood and restricted maximum likelihood approaches

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 Graduate College course 000:002 Doctoral Continuous Registration. Tuition and fees for Doctoral Continuous Registration are the equivalent of 2 s.h. of coursework. 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 adviser. The dissertation advisor should have a primary, secondary, or joint faculty appointment in the Department of Biostatistics. The student, in collaboration with the dissertation adviser, 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

The dissertation prospectus describes the rationale for the proposed research and outlines its basic components. The prospectus must be submitted to the committee members prior to initiation of the research. Unanimous, written approval by all committee members is required on the Ph.D. Dissertation Prospectus Approval form. The student is required to arrange a special meeting of their committee to evaluate the prospectus.

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 Coordinator and/or posted deadlines for a particular academic session. See Office of the Registrar for posted deadlines.

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 adviser 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. Certificate in Biostatistics Application

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; hence, at least 9 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.)

171:161 (BIOS:5110) Introduction to Biostatistics (3 s.h.)
171:162 (BIOS:5120) Design and Analysis of Biomedical Studies (3 s.h.)

Elective Courses (9 s.h. chosen from the following):

171:164 (BIOS:5310) Research Data Management (3 s.h.)
171:173 (BIOS:5610) Design of Sample Surveys (3 s.h.)
171:174 (BIOS:6310) Introductory Longitudinal Data Analysis (3 s.h.)
171:185 (BIOS:6410) Microarray Data Analysis (3 s.h.)
171:241 (BIOS:6110) Applied Categorical Data Analysis (3 s.h.)
171:242 (BIOS:6210) Applied Survival and Cohort Data Analysis (3 s.h.)
171:266 (BIOS:6610) Statistical Methods in Clinical Trials (3 s.h.)
171:290 (BIOS:7600) Advanced Biostatistics Seminar (1-3 s.h.)
171:295 (BIOS:7850) Research in Biostatistics: Biostatistics Rotation (1-3 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.

General Information for Students

Computer Labs

The College of Public Health Microsoft Windows computer lab in E176 GH is available for use by Biostatistics students, as is the College's computer classroom in E178 GH when it is not in use for a class. Students are assigned College of Public Health computer accounts at orientation, or they should contact the college receptionist in E107 GH to apply. Only College of Public Health students can use these facilities. Students can apply for evening and weekend access to the labs by contacting the College of Public Health receptionist.

There is a Linux computer lab available for Biostatistics students in 1215 Westlawn. Students should contact Terry Kirk for access.

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.

Confidential Resources

Rape Victim Advocacy Program	www.rvap.org/pages/home/
Office of the Ombudsperson	www.uiowa.edu/~ooombuds/
Women's Resource and Action Center	www.uiowa.edu/~wrac/
Family Services	http://www.uiowa.edu/hr/famserv/
University Counseling Services	http://www.uiowa.edu/ucs/
Student Disabilities Services	www.uiowa.edu/~sds/

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 space is available. Space 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 should apply for a university e-mail account upon enrollment. The student will then be connected to the College of Public Health network individually and as part of the Biostatistics Student Group e-mail list. This e-mail list is the most efficient way 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 Coordinator, has a supply of most forms necessary for the academic programs, or she can direct students to the appropriate university office. Commonly

used forms are also available electronically on the department's website under "Information for Current Students" and in Appendix –E of this handbook.

Job and Internship Announcements

Announcements of job and internship opportunities are communicated to students via e-mail. Recent employment opportunities are posted on the Biostatistics website under "Alumni".

Mailboxes

Every student has a mailbox in the Student Commons (E177 GH). Students should check their mailboxes regularly for important information. Mailboxes are assigned by box number, and each student will retain the same box number throughout the student's academic career.

A current list of all mailbox numbers will be kept posted in the Student Commons. Mail addressed to a student should be addressed as is shown in these examples:

FIRST CLASS MAIL (from home, friends, business, etc.)

Morgan Smith - #49
College of Public Health
University of Iowa
200 Hawkins Drive – E177 GH
Iowa City IA 52242

CAMPUS MAIL ENVELOPES:

Morgan Smith #49 CPH E177 GH

Student Commons

The Student Commons at E177 GH 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 Student Commons (E177 GH). Interested students should check with the College of Public Health receptionist.

If you wish to reserve the Commons for a special event, contact Ms. Lexie Just in E172 GH or at lexie-just@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 being attended, the reason for attending (for instance, making a presentation), and the amount 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://www.public-health.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.

Appendix A—Biostatistics Faculty and Staff Directory

Primary Faculty

Cavanaugh, Joe Professor	C22-G GH	384-5024	joe-cavanaugh@uiowa.edu
Chaloner, Kathryn Professor and Department Head	C22-N-1	384-5029	kathryn-chaloner@uiowa.edu
Clarke, William Professor and Deputy Department Head	2419 UCC	384-2833	william-clarke@uiowa.edu
Coffey, Christopher Professor	2450-UCC	384-4197	Christopher-coffey@uiowa.edu
Dawson, Jeffrey Professor and Director of Graduate Studies, Associate Dean for Faculty Affairs	C22-H GH	384-5023	jeffrey-dawson@uiowa.edu
Huang, Jian Professor	221-SH	353-0823	jian-huang@uiowa.edu
Jones, Michael Professor	C22-J GH	384-5025	michael-p-jones@uiowa.edu
Liu, Dawei Assistant Professor	C22-B GH	384-5027	dawei-liu@uiowa.edu
Oleson, Jacob Assistant Professor	C22-C GH	384-5017	jacob-oleson@uiowa.edu
Pendergast, Jane Professor	C22-K GH	384-5028	jane-pendergast@uiowa.edu
Smith, Brian Associate Professor	C22-L GH	384-5026	brian-j-smith@uiowa.edu
Wang, Kai Associate Professor	C227 GH	384-5175	kai-wang@uiowa.edu
Zamba, Gideon Assistant Professor	C22-M GH	384-8090	gideon-zamba@uiowa.edu
Zhang, Ying Professor	C22-F GH	384-5174	ying-j-zhang@uiowa.edu
Zimmerman, Bridget Professor (Clinical)	C22-E GH	384-5022	bridget-zimmerman@uiowa.edu

Staff

Crispin, Caitlin Project Assistant	C22-C-GH	384-5262	catlin-crispin@uiowa.edu
Kirk, Terry Graduate Program Coordinator	C22-N GH	384-5016	terry-kirk@uiowa.edu
Weber, Ann Department Secretary	C222 GH	384-8085	ann-weber@uiowa.edu

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

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.

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 156:204. Arranged.

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.

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: 171:161 or equivalent. Same as 22S:140. Offered spring semesters.

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: Fortran or C programming capability. Offered fall semesters of odd years.

171:173 Design of Sample Surveys, 3 s.h.
Involves challenges encountered in designing sample surveys, including construction and number strata, unbiased ratio estimators, multi-staged sampling, variance estimation in complex surveys, double sampling, sampling frame construction, panel studies, and problems due to non-response. Prerequisites: 171:202, 22S:154 or 22S:194 or equivalent. Offered fall semesters.

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: 171:203, 171:241, 22S152 or 22S:162, or consent of instructor. Same as 22S:160. Offered fall even years.

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: 171:201. Offered fall semesters.

171:185 Microarray Data Analysis, 3 s.h.
Basic statistical principles and techniques used in bioinformatics, including analyzing microarray gene expression data. Prerequisite: 171:161, 22S:030, 22S:101, or consent of instructor. Cross-listed: 002:176 and 127:176. Offered spring even years.

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.

171:202 Biostatistical Methods II, 4 s.h.
Continuation of 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: 171:201. Offered spring semesters.

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: 171:201, 171:178. Co-requisite: 171:202, 22S:154 or 22S:194. Offered spring semesters.

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: 171:202, 22S:153 or 22S:193 or equivalent. Offered spring semester of even years.

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. Prerequisites: 171:162, 173:140. Offered fall semesters.

171:242 Applied Survival and Cohort Data Analysis, 3 s.h.
Nonparametric and semiparametric methods for survival data; methods of comparing directly standardized rates and standardized mortality ratios; Poisson regression for cohort data. Prerequisites: 171:203 or 171:241. Offered spring semesters of odd years.

171:243 Cohort Data Analysis, 1 s.h.
Methods of comparing directly standardized rates and standardized mortality ratios; Poisson regression for cohort data. Prerequisites: 171:241, consent of instructor. Offered spring semesters of odd years.

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: 22S:154 or 22S:194, 171:202, or equivalent. Offered fall semester of even years.

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 171:251 to classical and new methods in biostatistics. Prerequisites: 171:251. Offered spring semester of odd years.

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: 22S:154 or 22S:194, 171:202, or equivalent. Same as 22S:225. Offered fall semesters.

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: 22S:154 or 22S:194, 22S:164 or 171:202, or equivalent. Same as 22S:220. Offered spring semesters.

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: 22S:154 or 22S:194, 171:202, or equivalent. Offered spring semesters of odd years.

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: 171:202, 22S:154 or 22S:194, or equivalent. Offered spring semesters.

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: 171:178, 171:202, 171:103, 22S:153 and 22S:154. Offered fall semesters of even years.

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: 171:261.

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.

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.

171:282 Problems/Special Topics in Biostatistics, arr.
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.

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. Prerequisite: 22S:154 or 22S:194, 171:202, consent of instructor.

171:295 Research in Biostatistics, arr.
For students engaged in research that may lead to a dissertation. Prerequisite: consent of instructor.

171:300 Thesis/Dissertation, arr.
Work on Biostatistics Ph.D. dissertation with the dissertation adviser. Prerequisite: consent of instructor.

Selected Statistics Courses

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

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: 22S:120 or equivalent. Offered fall semesters. Same as 07P:148.

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: 22S:027 and 22S:028 or equivalents. Offered fall and spring semesters.

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: 22S:153. Offered fall and spring semesters.

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: 22S:131, and either 22S:152 or 22S:164. Offered spring semesters.

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: 22S:152 and 22S:158 or equivalents, and facility with matrix algebra. Same as 07P:245. Offered fall semesters of odd years.

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: 22S:152 and 22S:154, or equivalents.

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: 22M:028 and 22S:131, or equivalents.

22S:194 Statistical Inference II, 3 s.h.
Continuation of 22S:193, which is prerequisite, point estimation theory (MLE, Bayes, UMVU), hypothesis testing, interval estimation, decision theory. Offered spring semesters.

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: 22S:130 or 22S:120 and consent of instructor. Offered fall semesters.

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: 22S:190 and 22S:194.

22S:248 Computer Intensive Statistics, 3 s.h.
Computer arithmetic: random variate generation; numerical optimization; numerical differentiation, integration, and linear algebra; smoothing techniques; bootstrap methods; cross-validation; MCMC; EM and related algorithms; other topics per student/instructor interests. Offered spring semesters. Prerequisites: 22S:164 and proficiency in Fortran or C or C++ or Java.

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: 22S:164, 22S:165, and 22S:194. Offered fall semesters.

22S:256 Multivariate Analysis, 3 s.h.
Multivariate distributions, tests and estimates, multivariate general linear model, MANOVA, discriminant analysis, canonical correlation, factor analysis, principal components. Prerequisite: 22S:255. Offered spring semesters of even years.

Selected Other College of Public Health Courses

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.

22C:104 Introduction to Informatics, 3 s.h.
Computing principles and fundamental aspects of computer science; history of computing, basic computer architecture and operating system concepts, fundamentals of relational databases, algorithmic idioms, computational complexity, introductory programming concepts in Perl. Prerequisites: 22C:005 or graduate standing.

Community and Behavioral Health

172:101 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.

172:150 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

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.

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, ad fungi. Prerequisite: 61:164, 61:112, 61:157, 61:103, or consent of instructor. Offered spring semesters.

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: 173:140. Corequisites: 171:161 and 175:197. Same as 175:220.

173:225 Genetics and Epidemiology, 4 s.h.
Basic human genetic and population genetics principles; methods of integrating genetic principles into epidemiological studies; analytical methods for case control and family data. Prerequisites: 171:161 and 173:140.

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.

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: 173:140, 173:160, and 171:161. Offered spring semesters.

173:241 Statistical Methods in Epidemiology, 3 s.h.
Overview of methods to analyze data from epidemiologic investigations; estimation of relative measures of risk, attributable risk, stratified analysis, model-fitting approaches using logistic and Poisson regression analysis; confounding and effect modification; analysis of epidemiologic data sets. Prerequisites: 171:161 and 171:162.

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: 173:140 or consent of instructor. Offered spring semesters of odd years.

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 173:140 or equivalent. Offered fall semesters.

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: 173:140 or equivalent.

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: 173:140 or consent of instructor. Offered spring semesters.

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: 173:140 or consent of instructor. Offered spring semesters

173:262 Neuroepidemiology, 1 s.h.
Expands basic epidemiologic concepts to neurologic disease. Includes readings from a variety of diseases and methods. Prerequisite: 173:140 or consent of instructor.

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: 173:140 or consent of instructor. Offered fall semesters of odd years.

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 173:140 and 171:161. Offered fall semesters of odd years.

173:267 Psychiatric Epidemiology, 3 s.h.
Series of lectures and reading assignments reviewing population-based studies of psychiatric disorders and associated methodologic tools. Students review diagnostic criteria used in psychiatric research and common structural interviews and rating scales. Recent research relevant to common psychiatric disorders presented by guest lecturers. Midterm project requires students write a research idea using standard NIH PHS format. Prerequisite: 173:140 or consent of instructor. Recommended: 173:240 or 173:260 or two years of resident training in psychiatry. Same as 73:255. Offered spring semesters.

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: 173:140 or 171:161; and a college pathology course. Offered spring semesters of even years.

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.

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: 173:140 or consent of instructor. Offered fall semesters of even years.

Health Management and Policy

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.

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: 050:283, 051:187, 056:186, 074:191, 096:283, 174:226. Fall semesters.

Environmental and Occupational Health

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.

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 173:140 or consent of instructor.

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.

175:252 Theories of Environmental Policy and Assessment, 3 s.h.
Major issues in environmental health and related public policy, focusing on similarities/differences between U.S. and international regulatory efforts. The role of government, industry, academia, and advocacy groups is discussed. Prerequisite: 175:197 or consent of instructor. Same as 53:158. Offered fall semesters of odd years.

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

002:128 Fundamental Genetics, 3 s.h.
This is one of the required courses for biology majors. All major topics of genetics, except population genetics, are covered. Prerequisites 002:010, 002:011, and 004:012.

002:170 Bioinformatics, 3 s.h.
Overview of bioinformatics and genomics. Equivalent to 2:169 but 3 s.h. rather than 4. There are two lecture hours plus two workshop hours weekly beginning the 5th week of classes. This class is suitable for upper level undergraduates and graduate students with a strong background in genetics, biochemistry and/or molecular biology.

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.

051:121 Introduction to Bioinformatics, 4 s.h.
Overview of bioinformatics and genome science including genome projects, functional genomics, phylogenetics, proteomics, microarrays, DNA polymorphisms and data-mining algorithms. Basics of genetics and molecular biology are presented at the outset. Experimental methods and analytical approaches are discussed side-by-side. Same as: 051:121 and 005:121. Fall semesters.

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.

051:122 Computational Genomics, 3 s.h.
Contemporary computational methods in genomics and molecular biology; DNA and RNA sequence analysis, sequence/gene/disease mapping, gene expression, disease gene linkage; principal genome science challenges, recent solutions. Same as: 002:174, 055:122, 127:173. Fall semesters.

061:147 Survey of Immunology, 4 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 Spring semester only.

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 and 002:011. Corequisite: 004:121. Offered Spring semester only.

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: 061:157 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.

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.

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.

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.

Appendix C - Competencies

MS in Biostatistics

Graduates of the MS in Biostatistics will be able to:	Primarily Gained through These Required Courses	Secondarily Gained through These Elective or Other Required Courses
Demonstrate a broad knowledge and understanding of current statistical theory, methods, and practices in the health sciences.	171:173 Design of Sample Surveys 171:201 Biostatistical Methods I 171:202 Biostatistical Methods II 171:203 Biostatistical Methods in Categorical Data 171:266 Statistical Methods in Clinical Trials 22S:153 Mathematical Statistics I 22S:154 Mathematical Statistics II 22S:193 Statistical Inference I 22S:194 Statistical Inference II 173:140 Epidemiology I: Principles	171:185 Microarray Analysis and Statistics in Bioinformatics 171:230 Statistical Data Mining in PH 171:242 Applied Survival and Cohort Data Analysis 171:251 Theory of Biostatistics I 171:252 Theory of Biostatistics II 171:261 Survival Data Analysis 171:262 Analysis of Categorical Data 171:264 Longitudinal Data Analysis 22S:138 Bayesian Statistics 22S:161 Applied Multivariate Analysis 22S:248 Computer Intensive Statistics 22S:255 Linear Models
Effectively collaborate on a research team.	171:280 Preceptorship in Biostatistics	171:282 Biostatistical Consulting
Develop statistical designs and implement analyses for health science investigations.	171:280 Preceptorship in Biostatistics	171:173 Design of Sample Surveys 171:201 Biostatistical Methods I 171:202 Biostatistical Methods II 171:203 Biostatistical Methods in Categorical Data 171:266 Statistical Methods in Clinical Trials
Develop computer programs for the management and analysis of data sets.	171:178 Biostatistical Computing 171:201 Biostatistical Methods I 171:202 Biostatistical Methods II 171:203 Biostatistical Methods in Categorical Data	171:164 Research Data Management
Prepare reports and publications resulting from health science studies.	171:280 Preceptorship in Biostatistics	171:201 Biostatistical Methods I 171:202 Biostatistical Methods II 171:203 Biostatistical Methods in Categorical Data
Effectively communicate key statistical principles to a non-statistical audience.	171:280 Preceptorship in Biostatistics	171:201 Biostatistical Methods I 171:202 Biostatistical Methods II 171:203 Biostatistical Methods in Categorical Data

PhD in Biostatistics

Graduates of the PhD in Biostatistics will be able to:	Primarily Gained through These Required Courses	Secondarily Gained through These Elective or Other Required Courses
Master MS competencies	See previous page	
Demonstrate an increased level of knowledge and understanding of current statistical theory, methods, and practices in the health sciences.	171:251 Theory of Biostatistics I 171:252 Theory of Biostatistics II 171:261 Survival Data Analysis 171:262 Analysis of Categorical Data 171:264 Longitudinal Data Analysis 22S:255 Linear Models	171:185 Microarray Analysis and Statistics in Bioinformatics 171:230 Statistical Data Mining in Public Health 22S:138 Bayesian Statistics 22S:161 Applied Multivariate Analysis 22S:248 Computer Intensive Statistics
Develop new statistical methods.	171:300 Dissertation	171:290 Advance Biostatistics Seminar
Design, manage data, analyze and interpret data from a variety of experimental and observational studies.	171:280 Preceptorship in Biostatistics 171:261 Survival Data Analysis 171:262 Analysis of Categorical Data 171:264 Longitudinal Data Analysis	171:185 Microarray Analysis and Statistics in Bioinformatics 171:230 Statistical Data Mining in Public Health 22S:138 Bayesian Statistics 22S:161 Applied Multivariate Analysis 22S:248 Computer Intensive Statistics
Communicate research findings, including new statistical methods developed, effectively to various audiences in writing and through oral presentation.	171:300 Dissertation 171:280 Preceptorship in Biostatistics	171:261 Survival Data Analysis 171:262 Analysis of Categorical Data 171:264 Longitudinal Data Analysis

MPH-Biostatistics Subtrack

In addition to mastering the core competencies, graduates of the MPH subtrack in Biostatistics will be able to:	Primarily Gained through These Required Courses	Secondarily Gained through These Elective or Other Required Courses
Demonstrate a broad knowledge and understanding of statistical techniques used in public health studies and investigations.	171:173 Intermediate Design of Sample Surveys 171:201 Biostatistical Methods I 171:202 Biostatistical Methods II 171:241 Applied Categorical Data Analysis 171:242 Applied Survival Analysis and Data Cohort Analysis 22S:153 Mathematical Statistics I 22S:154 Mathematical Statistics II	171:164 Research Data Management 171:261 Survival Data Analysis 171:262 Categorical Data 171:264 Longitudinal Data Analysis 171:266 Statistical Meth in Clinical Trials
Collaborate on public health projects, often taking a leadership role in the design and implementation of projects.	170:299 The MPH Practicum Experience	
Analyze and interpret the data from public health investigations.	170:299 The MPH Practicum Experience 171:173 Intermediate Design of Sample Surveys 171:201 Biostatistical Methods I 171:202 Biostatistical Methods II 171:241 Applied Categorical Data Analysis 171:242 Applied Survival Analysis and Data Cohort Analysis	
Manage, analyze and interpret the data for projects such as large community surveys, laboratory investigations, and multi-center clinical trials.	171:178 Biostatistical Computing	171:164 Research Data Management

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. Plan of Study
2. Change in Plan of Study
3. Change of Registration
   Add Form
   Drop Form
4. Grading Option (Satisfactory/Unsatisfactory)
   Available from Graduate Program Coordinator
5. Student Preceptorship Evaluation
6. Dissertation Prospectus Approval
7. Application for Graduate College Degree
8. Short Hours Form (International Students)
   Available from Graduate Program Coordinator
9. Request for Change of Graduate College Status

Additional forms may be found on the Registrar's website, Forms for Students.

Significant Dates 2011–12

Fall Semester 2011

August 22	First day of classes
August 26	Last day to drop or add courses without charge
September 2	Last day to register late Last day to add or change S-U status
September 5	Labor Day Holiday
October 11	Last day to submit degree application to Registrar for Dec. graduation
November 3	First deposit of thesis due in Graduate College for Dec. graduation
November 8	Last day to drop classes or withdraw registration
Nov. 14- Dec. 6	Early registration for Spring 2011 Semester
Nov. 19-27	Thanksgiving Holiday Recess
Nov. 30	Final exam reports due in Graduate College for Dec. graduation
December 7	Final deposit of thesis due in Graduate College for Dec. graduation
Dec. 12-16	Final Exam week
December 16	University Commencement: Graduate College (see www.registrar.uiowa.edu)
December 21	Deadline for reports to remove "Incomplete", grades due to Registrar

Spring Semester 2012

January 12-13	Biostatistics Spring M.S. Final Examination (Tentative Dates)
January 16	University Holiday, MLK, Jr., Convocation
January 17	First day of Spring classes
January 23	Last day to drop or add courses without charge
January 30	Last day to register late Last day to add or change S-U status
February 24	Last day to submit degree application to Registrar for May graduation
March 11-18	Spring Break
March 22	First deposit of thesis due in Graduate College for May graduation
April 10	Last day to drop classes or withdraw registration
April 16-27	Early registration for Summer 2012 Session and Fall 2012 Semester
April 25	Final exam reports due in Graduate College for May graduation
May 2	Final deposit of thesis due in Graduate College for May graduation
May 7-11	Final Exam week
May 12	Commencement: Graduate College (see www.registrar.uiowa.edu)
May 16	Deadline for reports to remove "Incomplete", grades due to Registrar

Fall Semester 2012

August TBA	PhD Comprehensive Examination MS Final Examination
August 20	First day of classes 2012-2013