

HANDBOOK FOR BIostatISTICS GRADUATE STUDENTS

GRADUATE GROUP IN BIostatISTICS

University of California, Davis

July 2006

Welcome to the **Biostatistics Graduate Group at UC Davis!** This Handbook helps you to navigate through your studies at Davis. It summarizes the most important guidelines and issues.

I. General Information

A. Resources

1. Computing

There are two computer labs in the Department of Statistics, which serves as administrative home for the Graduate Group in Biostatistics. These labs are located in the Mathematical Sciences Building and have many Windows-based computers with statistical software packages. Additional computing is available through workstations operating on a version of Unix. Access to common statistical software such as R is available through these computers.

2. Support

a. Teaching Assistantships

Students are encouraged to seek a TA-ship which will enhance their professional experience and teaching competence. TA-ships are provided by departments, and students in Biostatistics can apply to various departments across campus, including the Department of Statistics, Department of Mathematics, Department of Economics, and the Department of Public Health Sciences. TA-ships will usually cover part of the tuition costs. Teaching Assistants are required to have taken or be concurrently taking a TA training course. All Biostatistics students are required to take STA390 – Methods of Teaching Statistics during their first quarter of residence.

b. Graduate Student Researcher (GSR)

Usually GSR positions are not provided by departments but by individual faculty who would typically hire a GSR to perform research that is supported by research grants. Students who are interested in working as a GSR are therefore encouraged to approach individual faculty and ask about the availability of a GSR position. Faculty who might hire Biostatistics students as GSRs have traditionally included the Biostatistics Program faculty, faculty in the Departments of Statistics and Public Health Sciences, faculty in the School of Medicine or School of Veterinary Medicine, and faculty of other departments across campus.

c. University Fellowships

There are several campus based fellowship programs administered by the Office of Graduate Studies. These fellowships provide financial support for non-resident tuition, fees, stipends, research, and travel. The application deadline for competitive, merit-based awards is January 15. See the Office of Graduate Studies internal funding website (<http://gradstudies.ucdavis.edu/ssupport/internal.html>) for more information.

3. Graduate Student Handbook, Teaching Assistant Handbook and Forms

An important resource for all regulations that apply to graduate students is the Graduate Student Handbook published by Graduate Studies, and available at

<http://gradstudies.ucdavis.edu/students/handbook/index.html>.

The Teaching Assistant Handbook can be downloaded from

<http://gradstudies.ucdavis.edu/publications/>.

Forms needed for exams etc. can be downloaded from

<http://gradstudies.ucdavis.edu/forms/>.

Further important information for graduate students is available at

<http://gradstudies.ucdavis.edu/students/>.

B. Graduate Student Community

1. Office of Graduate Studies

The Office of Graduate Studies (<http://gradstudies.ucdavis.edu>) handles all of the academic and administrative policies affecting graduate students. There is a lot of information available on the website, including necessary forms for exams and advancement to candidacy, financial support, and general information for graduate students.

2. Graduate Student Association (GSA)

According to the GSA website (<http://gsa.ucdavis.edu>), the GSA was established “to provide a forum where matters of concern to graduate and professional students may be discussed, where opinions on actions of the Administration, departments and graduate groups may be initiated, and to conduct programs and services of special interest to graduate studies.” The GSA is located at 253 South Silo. There are typically representatives from each graduate program, graduate group, etc. that meet throughout the year and discuss issues of importance to graduate and professional students. Check the website for other offerings by the GSA.

C. Biostatistics website, contacts and student organization

More information about the current program faculty, committees, and student representatives may be found on the Graduate Group in Biostatistics website (<http://biostat.ucdavis.edu/>). Students are encouraged to bring any problems or concerns to the attention of the Graduate Master Advisor, their mentor, any of the other graduate advisors, the program chair, or Pete Scully, the graduate staff administrator. The Biostatistics graduate students maintain their own organization, selecting representatives, a web master and a President who leads the organization. Active participation of Biostatistics students in their student organization is highly encouraged.

II. Undergraduate Preparation

An undergraduate major in Mathematics, Statistics, Biostatistics or Biological Sciences with a quantitative orientation is typical for Biostatistics graduate students but is not required. However, because of the mathematical nature of some of the graduate coursework, students should be able to demonstrate good mathematical ability and should have taken coursework in mathematics. Students would preferably have had some exposure to courses in the life sciences (biological, environmental, medical, and agricultural sciences). Students without sufficient coursework in mathematics or life sciences may be admitted on the condition that deficiencies will be corrected during the first year of study. The minimal background for entrance into the program is: a bachelor's degree with 3.0 overall grade-point average; one year of calculus; a course in linear algebra or one year of biological course work; facility with a programming language; and upper-division work in at least one of the following: Mathematics, Statistics, Biology or Biostatistics. All students whose native language is not English should demonstrate proficiency in English language by taking tests such as Test of English as a Foreign Language (TOEFL) and satisfying the minimum score requirements as set out by the Office of Graduate Studies. The Graduate Record

Examination (GRE) General Test is required for all applicants. GRE scores should be greater than 1000 (combined verbal and quantitative) and dated not more than 3 years prior to the quarter of admission.

III. MS Program Information and Requirements

The Graduate Program in Biostatistics offers the M.S. degree under Plan II (the Comprehensive Examination option). A Master's degree is awarded to recognize a student's command of a wide range of knowledge in a specific area or field. A Master's degree may be awarded upon completion of all required coursework, passing the pre-qualifying Basic Examination and the MS Comprehensive Examination.

A. **Biostatistics Master Graduate Advisor**

Student advising in the Graduate Group in Biostatistics is primarily the responsibility of the Master Graduate Advisor. All students need to meet with the Master Graduate Advisor early in Fall quarter and all coursework taken must be approved by this advisor, who has signature authority for forms etc. Quarterly meetings with the Master Graduate Advisor are encouraged.

B. **Faculty Mentor**

For the first two years each student is assigned a faculty mentor, who is often a member of the committee of Biostatistics Graduate Advisors. This mentor is available to guide students on a regular and as-needed basis, but will not approve coursework or sign forms.

C. **Courses**

1. **Unit Load**

Graduate students are expected to enroll for a minimum of 12 units each quarter, according to the Office of Graduate Studies policy. These 12 units can be made up of a combination of required coursework as described below, additional elective coursework, if any, and BST 299 or BST299D (Individual Study courses). In particular, units of 299 should be assigned for students doing supervised preparation for qualifying examinations. If a student has special circumstances which prevent the student from maintaining the minimum unit requirement, the Graduate Advisor should be notified as soon as possible so that Graduate Studies can be informed and negative consequences avoided to the degree possible. For budgetary purposes, *Graduate Studies wants students to enroll in course work (12 units) each quarter* before the last day of the third week of classes. There is no part-time study allowed in the program.

2. **Required Courses**

Required courses cannot be waived and must be completed prior to a student's Comprehensive (M.S.) Examination. There are no unit requirements other than the Office of Graduate Studies policy that every full-time graduate student must register for a minimum of 12 units per quarter. Note that all courses used to fulfill program requirements that are offered on a letter graded basis must be taken for a letter grade, not for S/U.

The program of study will be adjusted to individual needs by the Biostatistics Graduate Advisor. The program will consist of at least 46 units of coursework, at least 18 of which must be at the graduate level. This will include the core courses listed below, covering basic material in Biostatistics and Statistics. Besides the courses required to pass the pre-qualifying Basic Exam (except for those students who are sufficiently well prepared for their studies in Biostatistics so that their Basic

Exam requirement is waived), the following courses are required for the MS degree. For all courses listed, prerequisites must be satisfied.

a. Biostatistics Core Courses (8 units)

Two courses from the following list are required.

- *BST 222: Survival Analysis (4 units)*
- *BST 223: Generalized Linear Models (4 units)*
- *BST 224: Longitudinal Data Analysis (4 units)*
- *BST 225: Clinical Trials (4 units)*
- *BST 226: Statistical Methods in Bioinformatics (4 units)*

b. Statistics Core Courses (8 units)

The linear models sequence (STA 232 AB, 4 units each)

c. Methods Core Courses (8 units)

- *STA 135: Applied Multivariate Analysis (4 units)*
- *STA 141: Statistical Computing (4 units)*

Note that STA 232C may replace STA 135.

d. Biostatistics and Methods Electives (8 units)

Two courses with a substantial biostatistical data analysis component, at least at the upper division level, at least one of them at the graduate level.

e. Life Sciences Elective (4 units)

One course selected from any upper division or graduate offering in biology, epidemiology, environmental, agricultural, or medical sciences.

f. Seminars and Professional Courses

- *BST 290: Graduate Group in Biostatistics Seminar (1 unit)* – required every quarter during residence (5 quarters maximum)
- *STA 401: Methods in Statistical Consulting (3 units)* – required once
- *STA 390: Methods of Teaching Statistics (2 units)* – required once during 1st year of residence

D. Requirements for M.S. Degree

1. Residency

Candidates for the M.S. degree must be in residence for at least six academic quarters.

2. Scholarship

Only courses in the 100, 200, 300 or 400 series in which the student receives grades of A, B, C and S may be counted in satisfaction of the requirements for the Master's degree. A course in which a student receives a D+ or lower cannot be used to satisfy the unit requirement for the Master's degree but will count in determining the grade point average. Courses in the 300 or 400 series may be accepted as 200 series courses if they have been approved by Graduate Council as graduate-level courses. Students must maintain a G.P.A. of 3.0 or better in all upper division and graduate courses elected during their residence as graduate students.

3. Unit Requirements

Students are required to take a minimum of 46 units of coursework, at least 18 of which must be at the graduate level (see Required Courses for M.S. above).

4. Advancement to Candidacy

Master's degree students may file an official application for Advancement to Candidacy after completion of at least one-half of the course requirements for the

degree and at least one quarter before completion of all degree requirements. The forms can be obtained from Graduate Studies, Room 252 Mrak Hall, or online (<http://gradstudies.ucdavis.edu/forms>).

5. Basic Examination (pre-qualifying exam)

Students must pass the written pre-qualifying *Basic Examination* on preparatory methodology which covers the courses STA 131ABC, STA 106, and STA 108. The examination must be taken and passed at the end of the first year. Each student will receive an evaluation of his/her performance on the entire examination, which will be discussed with the Biostatistics Graduate Adviser. This exam will be given the week after the end of the Spring Quarter finals. It can be repeated once. Failure to pass this exam at the second attempt results in the recommendation to the Dean of Graduate Studies that the student be disqualified from the Biostatistics M.S. program.

6. Research

Although no Master's thesis is required, research experience can be gained by electing STA 299 under the guidance of a Biostatistics program member. This course may be related to the project presented at the Comprehensive Examination.

7. Comprehensive Examination

The purpose of the Comprehensive Examination for M.S. Students in Biostatistics is to assess whether the student has acquired basic statistical knowledge at the Master's level and is capable of analyzing, reporting and presenting the results of real-life data in medicine, biological sciences, agriculture, environmental sciences or related fields. The comprehensive examination must be attempted before the beginning of the sixth quarter of graduate work and may be repeated once.

The examination consists of two parts:

1. A twenty-minute presentation by the student, with a detailed analysis of the assigned data; this part of the examination is open to the public. Students who plan to take the exam during the same academic year are encouraged to attend the public part of the examinations.
2. A thirty-minute examination by the exam committee covering topics related to the methods used in the analysis of the assigned data, the background of the problem analyzed, and general questions relating to the material of biostatistics and statistics courses that the candidate has taken.

The examination committee consists of two permanent members (one of them serving as committee chair), who, for each academic year, are appointed by the Chair of the Graduate Group in Biostatistics (GGB), in conjunction with the Executive Committee, and a third member recommended by the student and approved by the Chair of the Biostatistics Graduate Advisors Committee. One member of the examination committee will provide a data set from medicine, biological sciences, agriculture, environmental sciences or related fields to the student for the purpose of this examination two weeks prior to the exam date. The student is expected to provide a written report on the analysis of the assigned data to the members of the examination committee at least two days prior to the date of the exam. An abstract and title should be given to the graduate administrator for dissemination at least six days prior to the date of the exam. The report should be professionally prepared and include all components of a scientific report with detailed explanation of the data, methods of analysis, final models, results and conclusions. It should be concise yet comprehensive and written in the format of a journal article, following the style of a journal such as *Statistics in Medicine*.

Evaluating the quality of the data analysis, oral presentation of the results, quality of the written report, and responsiveness of the student to the technical questions asked during the exam, the committee will assign a PASS or FAIL by unanimous vote. The committee may decide that the exam needs to be continued at a later date before a decision on PASS or FAIL is made, for example if the report is not satisfactory and needs to be revised or if further evaluation of student performance is needed. If a FAIL is given, the student has only one more chance to retake the exam. In this case, another exam will be scheduled within six weeks. If a student receives a second FAIL, this will result in the recommendation to the Dean of Graduate Studies that the student be disqualified from the Biostatistics M.S. program.

The chair of the exam committee will communicate the result of the examination to the student and provide feedback as appropriate. At the discretion of the chair, students who plan to take the MS oral examination in a given academic year may be required to participate in seminar sessions to prepare for the exam.

IV. PhD Program Information and Requirements

The Graduate Group in Biostatistics offers the Ph.D. degree under Plan C. According to this plan, the Dissertation Committee consists of three faculty members who guide the student in his or her research and pass upon the merits of the dissertation and conduct the final oral examination.

A. Biostatistics Master Graduate Advisor

Student advising in the Graduate Group in Biostatistics is primarily the responsibility of the Master Graduate Advisor. All students need to meet with the Master Graduate Advisor early in Fall quarter and all coursework taken must be approved by this advisor, who has signature authority for forms etc. Quarterly meetings with the Master Graduate Advisor are encouraged.

B. Faculty Mentor

For the first two years each student is assigned a faculty mentor, who is often a member of the committee of Biostatistics Graduate Advisors. This mentor is available to guide students on a regular and as-needed basis, but will not approve coursework or sign forms.

C. Dissertation Advisor

The term "dissertation advisor" is used by the Group to indicate the faculty member who is or who will be guiding the student in his/her research. The dissertation advisor must be a member of the Graduate Group in Biostatistics. The dissertation advisor is also referred to as major professor and will prepare the student for the qualifying exam. Students will select a dissertation advisor during the first two years of coursework. The dissertation advisor will serve as the chair of the dissertation committee. The dissertation advisor should be considered to be the principal faculty contact for a student who has advanced to candidacy and will advise the student about additional coursework to take.

D. Dissertation Committee

A topic in Biostatistics will be selected by the student, under the advice and guidance of a Dissertation Committee, which consists of three program members (Plan C according to Academic Senate Regulations). This committee is nominated by the graduate program Master Advisor after consultation with the student and in accordance with Graduate Council and Graduate Studies policies. The committee is chaired by the dissertation advisor.

E. Courses

1. Unit Load

Graduate students are expected to enroll for a minimum of 12 units each quarter, according to the Office of Graduate Studies policy. These 12 units can be made up of a combination of required coursework as described below, additional elective coursework, if any, and BST 299 or BST299D (Individual Study courses). In particular, units of 299 should be assigned for students doing supervised preparation for qualifying examinations. If a student has special circumstances which prevent the student from maintaining the minimum unit requirement, the Graduate Advisor should be notified as soon as possible so that Graduate Studies can be informed and negative consequences avoided to the degree possible. For budgetary purposes, *Graduate Studies wants students to enroll in course work (12 units) each quarter* before the last day of the third week of classes. There is no part-time study allowed in the program.

2. Prerequisites

The Basic Exam covers methodology prerequisites covered in the courses STA 131ABC, STA 106, STA 108 and an additional elective. The material of these courses (excluding the elective) is prerequisite for the core courses of the Biostatistics program. Therefore, students who do not have such a background must take these courses. Additionally, students who have not taken advanced real analysis or advanced calculus (at the level equivalent to an upper division course in calculus or real analysis for mathematics majors) should take Mathematics 127AB or an equivalent upper division course in analysis directed at mathematics majors; and those without previous exposure to upper division linear algebra should take Mathematics 167 or an equivalent course. Furthermore, basic biological preparation, if missing, should be attained before the Life Sciences elective courses can be taken, as most of these courses have biological prerequisites. Careful attention needs to be paid to these prerequisites of the Life Sciences elective courses and students should work closely with the Biostatistics Graduate Advisor to create their study plan. Consultation with the Master Graduate Advisor and an approved plan of study is a requirement. Those students who are sufficiently well prepared for their studies in Biostatistics may petition to the Biostatistics Educational Policy Committee to have their Basic Exam requirement waived.

3. Required Courses

Course requirements cannot be waived and must be met prior to a student's PhD Qualifying Examination. There are no unit requirements other than the Office of Graduate Studies policy that every full-time graduate student must register for a minimum of 12 units per quarter.

Note that all courses used to fulfill program requirements that are offered on a letter graded basis must be taken for a letter grade, not for S/U.

The program of study will be adjusted to individual needs by the Biostatistics Graduate Advisor. Besides the courses required to pass the pre-qualifying Basic Exam (except for those students who are sufficiently well prepared for their studies in Biostatistics so that their Basic Exam requirement is waived), the following courses are required for the PhD degree. For all courses listed, prerequisites must be satisfied.

a. Biostatistics Core Courses

We note that all of these courses carry a data analysis component and include a computing laboratory. Students will be exposed to projects involving advanced data analyses to address complex life science problems.

- *BST 222: Survival Analysis (4 units)*
- *BST 223: Generalized Linear Models (4 units)*

- *BST 224: Analysis of Longitudinal Data (4 units)*

b. Methodology Core Courses

- *STA 231 ABC: Mathematical Statistics I-III (4 units each)*
- *STA 232ABC: Linear Statistical Models (4 units each)*
- *STA 141: Statistical Computing (4 units)*

c. Life Sciences Core Requirements

Eight units of upper-division or graduate level course work in Biology and Life Sciences are required (see Appendix A for list of approved courses). The intention is to provide a base of knowledge in molecular, cellular, organismal, and population biology, epidemiology or environmental sciences. In general, courses that use those on the list in Appendix A as prerequisites may serve as substitutions for students entering with more background in biology. To ensure that each student graduating with a degree in Biostatistics will obtain an appropriate depth of training in the life sciences, it is recommended that a "core" topic be chosen from the list and a second course be an advanced treatment of materials in the chosen core topic. At least one course must be taken from the biological/environmental sciences. The combination of courses chosen and any substitutions desired are subject to approval by the Master Biostatistics Graduate Adviser. Most of the courses listed have lower-division prerequisites, and students are expected to be prepared to meet these prerequisites, which may require additional coursework. Careful planning of the Life Sciences course requirements is recommended to ensure timely completion of coursework.

d. Required Methodological Electives

Three courses selected from the following list are required. If Time Series Analysis or Probability Theory is selected, the full sequence must be taken to fulfill one of the electives (so both STA 237AB or STA 235AB). Credit can be accrued for taking STA 250, 251, or BST 252 repeatedly with permission of the master Graduate Adviser, as long as these courses are offered under different topics.

Biostatistical Electives:

- *BST 225 Clinical Trials (4 units)*
- *BST 226 Statistical Methods for Bioinformatics (4 units)*
- *BST 252 Advanced Topics in Biostatistics (4 units)*

Methodological Electives:

- *STA 250 Advanced Data Analysis (4 units)*
- *STA 251 Advanced Statistical Theory (4 units)*
- *STA 237AB Time Series Analysis (4 units each)*
- *STA 235AB Probability Theory (4 units each)*

e. Seminars and Professional Courses

- *BST 290: Graduate Group in Biostatistics Seminar (1 unit)* – required every quarter during residence, for five quarters
- *STA 390: Methods of Teaching Statistics (2 units)* – required once, during first quarter of residence
- *STA 401: Methods in Statistical Consulting (3 units)* – required twice

f. Internship

Students are strongly encouraged to do a Summer internship at an appropriate medical or biological facility to broaden their professional experience.

F. Biostatistical Practicum

Students will complete a practicum in the form of an interdisciplinary applied data analysis project. They will work in close collaboration with a UC Davis faculty researcher who conducts studies or experiments which generate or analyze data in the medical, biological, veterinary medical, epidemiological, agricultural or environmental sciences, and who will

serve as a mentor. The practicum will involve the analysis of original data and the student will prepare or substantially contribute to a project report. The practicum may be conducted as part of employment as a Graduate Student Researcher or as part of the dissertation research.

A report based on an internship of a duration of at least six weeks at a facility, government health office, institute or company outside of UC Davis, focusing on biological or medical research can also be used to satisfy this requirement. In this case the mentor will reside at the institution where the internship is carried out.

The practicum (including the internship option) will be conducted under the additional supervision of a Biostatistics faculty member. The student chooses the mentor and the supervising Biostatistics faculty member, who may or may not be identical with the student's dissertation adviser, and notifies the master graduate adviser and graduate administrator of this choice before starting the project or internship. The student will usually enroll in a BST 299 or BST 299D class with the Biostatistics mentor as instructor.

Successful completion of the practicum requires submission of both the report and of an accompanying letter signed by both mentor and supervising Biostatistics faculty member (who might be identical), in which the successful completion of the project is reported. Criteria for successful completion are that (1) the report requirement has been met; (2) the student has gained an understanding of the underlying biological problem or question, the study or experiment and the nature of the data; (3) the data analysis and methodology is adequate to the problem and data.

The report should have the form of a paper which includes the student as a co-author. Not more than one biostatistics student can be among the co-authors. The report should follow the general format of a manuscript to be submitted to a scientific journal. In the case of an internship-based report, it may alternatively consist of a description of the work completed during the internship. In this case, the report should include an outline of the scientific background and the problem addressed by the student during the internship.

G. Requirements for Ph.D. Degree

1. Residency

Students working toward a doctorate must be registered and in University (Graduate Studies) residence for a minimum of six quarters.

2. Scholarship

Students must have completed all required course work and have achieved a G.P.A. of 3.0 or better in all graduate work.

3. Basic Examination (pre-qualifying)

All Graduate students, except for well-prepared students who receive a waiver, must pass the written *Basic Examination* on preparatory statistics material covered in the courses STA 131A-131B-131C, STA 106 and STA 108. The examination must be taken and passed at the end of the first year. Each student will receive an evaluation of performance on the entire examination, which will be discussed with the Biostatistics Graduate Adviser. This exam will be given the week after the end of Spring Quarter finals. It can be repeated once. Failure to pass this exam at the second attempt results in the recommendation to the Dean of Graduate Studies that the student be disqualified from the Biostatistics Ph.D. program.

Students with sufficient preparation are encouraged to apply to the Biostatistics Educational Policy Committee for a waiver of the requirement to take the Basic Examination in June at the end of the first year. This will allow the student to take the Biostatistics Ph.D. Written Examination after the first year and to finish all course work within the second year and thus put the student on a fast track.

A student applying for such a waiver must agree to take the Ph.D. Written Exam in September following the first year. This is then counted as the first attempt at the Basic Exam and also as the first attempt at the Ph.D. Written Exam. Passing the Ph.D. Written Exam then satisfies the requirement of passing the Basic Exam. In case a student fails to pass the Ph.D. Written Exam in the situation where the Basic Exam was not yet passed, s/he will be required to take the Basic Exam the following June. This will then count as the second attempt at the Basic Exam.

4. Pre-Qualifying Ph.D. Written Examination

A Ph.D. student must pass the *Pre-Qualifying Biostatistics Ph.D. Written Examination* given in September. This exam must be attempted in September following the second year, at the latest. It is an exam on the material covered in the following courses: STA 231ABC (Session 1) and BST 222, BST 223, BST 224 (Session 2). The Biostatistics part (Session 2) may include questions on the theory of Biostatistics as well as a data analysis exam at the discretion of the exam committee. The exam committees in charge may be different for each part of the exam. Pass or Fail is determined separately by the exam committees for BST 222, 223, 224 and for STA 231ABC. If one or both parts of the exam are failed, they must be attempted again at the next offering of the exam. A second failure in any part of the exam results in the recommendation to the Dean of Graduate Studies that the student be disqualified from the Biostatistics Ph.D. program.

5. Ph.D. Qualifying Examination

Students in a PhD program at the University of California are required by the University to pass the Qualifying Examination (QE) before being advanced to candidacy for the degree. The Qualifying Examination Committee evaluation will consider relevant portions of the student's academic record and performance on the examination in making an overall evaluation of the student's performance and potential for scholarly research.

This is an oral exam and must be attempted as soon as the required coursework is completed, and the pre-qualifying Biostatistics Ph.D. Written Examination has been passed, normally one or two quarters after passing the pre-qualifying Biostatistics Ph.D. Written Examination. The student must be registered in the quarter in which the exam will be taken. The "Application for Qualifying Examination" form (available from Graduate Studies in Mrak Hall) must be submitted to the Graduate Adviser or program chair **at least six weeks prior** to the examination date, as it takes Graduate Studies two to three weeks to process the application.

In preparation for this exam, the student selects a major professor who commonly is selected by the student as the dissertation advisor after passing the exam and who is a regular member of the Biostatistics Graduate Group. The Exam Committee consists of five faculty members, at least three of whom are members of the Biostatistics Graduate Group. The chair is not the major professor and must be a member of the Biostatistics Graduate Group. One member of the Exam Committee is not a member of the Biostatistics Graduate Group.

The examination consists of three parts:

1. Presentation of an advanced research topic in Biostatistics, or, alternatively, advanced biostatistical data analysis leading into biostatistical research;
2. A period of questions relating to the presented material;
3. Questions relating to biostatistical theory and methodology. The regulations regarding Ph.D. Qualifying Exams as determined by the Graduate Council apply. The Committee will be nominated by the graduate program master adviser, after consultation with the student, and will be appointed in accordance with Graduate Council and Graduate Studies policies.

6. Advancement to Candidacy

Upon successful completion of the qualifying examination, the student is sent an application for advancement to candidacy by Graduate Studies. After the application is filled out and signed by the Graduate Adviser and major professor, the student pays the advancement to candidacy fee at the Cashier's office and returns the form to Graduate Studies. Upon successful completion of the qualifying examination, it is the student's responsibility to immediately and without delay fill out an application for advancement to candidacy, obtain the needed signatures, and to forward the form to Graduate Studies. All of this should be done on the day the exam is passed or the next day at the latest. Any delay in this filing may lead to substantially increased tuition fees for non-resident students, since only the filing of this form initiates the process of reducing the non-resident tuition fees for candidates. The reduced fees will be in effect for three years. In order to qualify for reduced fees during a particular quarter, the form must be filed before the start of the quarter. If a person required to sign a form is unavailable (i.e. out of the country), other faculty may be able to sign in their absence (Graduate Studies can advise you about who is eligible to sign the forms).

7. Selection of the Dissertation Committee

a. The chair of the committee is the dissertation advisor, also referred to as major professor, and is chosen by the student from among the Biostatistics Program faculty. The dissertation advisor bears the major responsibility in guiding the research of the student.

b. The Graduate Program Master Adviser nominates to Graduate Studies three members of the Dissertation Committee after consultation with the student. These three faculty members guide the candidate in the research phase and approve the dissertation.

c. Qualifications for membership on the Dissertation Committee are the same as for members of the Qualifying Examination Committee. The student should consult with his/her major professor about membership before meeting with the Graduate Program Master Adviser.

8. Dissertation

A topic in Biostatistics will be selected by the student, under the advice and guidance of a Dissertation Committee, which consists of three or more members (Plan C). This committee is nominated by the graduate program master adviser after consultation with the student and in accordance with Graduate Council and Graduate Studies policies and is appointed by the Dean of Graduate Studies. The committee is chaired by the dissertation adviser, and shall guide the candidate in his or her research and shall pass upon the merits of the dissertation.

The entire committee shall conduct a final oral examination, which shall deal primarily with questions arising out of the relationship of the dissertation to the field of Biostatistics. To elucidate this relationship, the final examination will be conducted in two parts. The first part consists of a one hour presentation by the candidate followed by a brief period of questions pertaining to the presentation. This part of the examination is open to the public. The second part of the examination will immediately follow the first part and will consist of a period of questioning by the committee members. Attendance in the second part is restricted to members of the committee, members of the Academic Senate, and guests of equivalent rank at other institutions.

9. Filing the Dissertation

The candidate must file with the Dean of Graduate Studies one copy of the dissertation approved by the Dissertation Committee, not later than three weeks before the close of the quarter in which the degree is to be conferred. An abstract of the dissertation must be filed by the same date.

At the time of filing the dissertation, the student is encouraged to sign an agreement with University Microfilms, Inc. to microfilm the dissertation and print the abstract in Dissertation.

Arrangements for copyrighting the dissertation and for obtaining reprints of the abstract, if desired, must also be made at this time. Dissertations will be withheld from microfilming only at the request of the student and then for a period not in excess of three years from the date the dissertation is filed. Complete information is available from Graduate Studies.

10. Filing Fee

The Filing Fee was established expressly to assist those students who had completed all requirements for degrees except filing theses or dissertations and/or taking formal final examinations (master's comprehensive examinations or doctoral dissertation defenses).

Eligibility for Filing Fee

To prevent abuses of the Filing Fee procedures, definite limitations on eligibility for the Fee have been established. In general, these limitations are based upon the principle that students using University facilities or making demands upon faculty time - other than the time involved in the final reading of dissertations or theses or in holding final examinations - are not eligible to employ the Filing Fee procedure. Students paying only the Filing Fee are not registered students eligible for the privileges accorded regularly enrolled students. In particular, students using the Filing Fee:

1. may not make use of University educational facilities, such as the Library (unless the student has purchased a Library use card) or laboratories;
2. is not eligible for the services of the University Health Center or for University housing;
3. may not take course work of any kind;
4. may not make use of faculty time except as noted above;
5. may not hold any academic student appointment titles (e.g., Research Assistant, Teaching Assistant, Post Graduate Researcher, Associate In, Graduate Reader);
6. may not receive a fellowship or financial aid.

Students who plan to make use of Library or other facilities or to take courses must register as regular students. Students who plan to be away from the campus but to be in an instructional relationship with faculty members must register as regular students (a student outside the State of California may be eligible to register for reduced fees). Students planning to take Qualifying Examinations for the Ph.D. must register as regular students. Completion of formal course work or residency requirements does not entitle a student to apply for the Filing Fee unless she or he will use no University facilities or faculty time except as noted above.

Students wishing to make use of the Filing Fee procedure should secure a Filing Fee application from the Graduate Division, obtain the signatures of the Graduate Adviser and major professor, and return the form to the Graduate Division before she or he stops registering. The Filing Fee (one half the Registration Fee) is payable at the time the thesis or dissertation is filed or the comprehensive examination is completed. The fee may also be paid at the time the application is

submitted to the Graduate Division. The Filing Fee is assessed only once and may be deferred to a later quarter if the student does not finish at the anticipated time.

H. Annual Evaluation of Progress

The normative time for the Ph.D. in the Biostatistics program is 5 years. Incentives for timely progress toward completion for Ph.D. students will be instituted by offering support primarily for those students who are making good progress, by encouraging the recruitment of “fast track” Plan 2 students (described in Sample Plans in the Appendix), by efficient advising and mentoring of students, and by annual offerings of required courses.

Graduate Council policy requires the Graduate Adviser to file an annual, written evaluation of the academic progress of each graduate student. On the basis of this evaluation as well as GPA, each student who is rated as making unsatisfactory progress receives a warning letter from Graduate Studies indicating specific conditions that must be met in order to continue in graduate status. If the conditions that lead to an unsatisfactory progress report or GPA below 3.0 are not corrected within a specified time, this may lead to termination of the graduate student status in the program. A satisfactory progress report does not necessarily imply that a student will ultimately succeed in completing a graduate program. Ph.D. students must maintain the level as stipulated by Graduate Studies in all graduate and upper division course work to maintain satisfactory progress. For PhD students in the GGB, satisfactory progress consists of:

- GPA of 3.0 or better;
- advancement to candidacy filed within 2 quarters of becoming eligible to take the examination, within 2 years of entering the program for students with significant Statistics and Biostatistics background and within 3 years of entering the program for students with lesser background;
- taking all pre-qualifying exams as soon as eligibility is established, i.e., at the first offering after the coursework that is examined has been completed.
- passing the pre-qualifying exams.
- completion of all degree requirements, including successful defense of the dissertation and filing of the dissertation, within 3 years of advancing to candidacy and within 5 years of entering the PhD program.

I. Double Majors

The minimum G.P.A. normally required for admission to a double major is 3.3. Applicants for admission to two graduate programs administered by Graduate Studies must file the Petition for Double Major along with the regular graduate studies application, application fee and transcripts. Admission as a double-major to Biostatistics requires endorsement by the Biostatistics Admissions and Awards Committee and is subject to approval by Graduate Studies.

Under a ruling by the Graduate Council, a student who is in a double major program (either a professional degree/academic degree program or two academic degree programs) may transfer a total of 12 units overall between academic programs with the approval of the Graduate Adviser and the Dean of Graduate Studies. The student must spend a minimum of two quarters in regular graduate standing in the master’s program to fulfill the residency requirements of Graduate Studies.

Progress Outline M.S.

This is a Sample Curriculum for MS students who are planning on taking the Basic Examination at the end of the first year. Two life sciences courses are included in the sample plan to indicate that a prerequisite may have to be fulfilled for students without prior exposure to coursework in the life sciences.

	Fall	Winter	Spring
Year 1	STA 131A (4) STA 106 (4) STA 138 (4) STA 390 (2) STA 290 (1)	STA 131B (4) STA 108 (4) MAT 167 (4) STA 290 (1)	STA 131C (4) STA 135 (4) Life Science Course STA 290 (1) <i>Basic Exam</i>
Year 2	BST 222 (4) STA 232A (4) BST 226 (4) STA 401 (3) STA 290 (1)	BST 225 (4) STA 232B (4) STA 141 (4) STA 290 (1)	EPI 223 (3) Life Science Course <i>Comprehensive Exam</i>

Progress Outline Ph.D. (Sample Plan 1)

Sample Plan 1: This is a Sample Curriculum for Ph.D. students who need to train in prerequisites and are preparing to take the Basic Examination after the first year.

	Fall	Winter	Spring
Year 1	STA 131A (4) STA 106 (4) MAT 167 (4) STA 390 (2) STA 290 (1)	STA 141 (4) STA 131B (4) MAT 127A (4) STA 290 (1)	STA 131C (4) STA 108 (4) MAT 127B (4) STA 290 (1) <i>Basic Exam</i>
Year 2	BST 222 (4) STA 231A (4) STA 232A (4) STA 290 (1)	BST 223 (4) STA 231B (4) STA 232B (4) STA 290 (1)	BST 224 (4) STA 231C (4) STA 232C (4) STA 401 (3)
Year 3	STA 250 (4) BST 226 (4) STA 401 (3) <i>Written Ph.D. Exam (pre-qualifying)</i>	Life Sciences Course BST 252 (4) BST 225 (4) <i>Ph.D. Qualifying Exam</i>	BST 299D: Dissertation Research

Years 4, 5: Research, BST 299D (Dissertation Research), Elective Coursework, Summer Internships, Biostatistical Practicum, Dissertation Presentation or Defense. Note that even after passing the qualifying examination, all full-time students must register for 12 units per quarter as per the Office of Graduate Studies regulations. These 12 units can be made up of elective coursework and BST 299 (Independent Study) courses.

Progress Outline Ph.D. (Sample Plan 2)

Sample Plan 2: This plan applies for a student who already qualifies for the prerequisites of the program and who will therefore not take the pre-qualifying Basic Exam. This fast track plan allows a student to graduate with the Ph.D. degree approximately one year earlier a compared to Sample Plan 1.

	Fall	Winter	Spring
Year 1	BST 222 (4) STA 231A (4) STA 232A (4) STA 390 (2) STA 290 (1)	BST 223 (4) STA 231B (4) STA 232B (4) STA 290 (1)	BST 224 (4) STA 231C (4) STA 232C (4) STA 290 (1)
Year 2	BST 226 (4) BST 252 (4) Life Sciences Course STA 401 (3) <i>Written Ph.D. Exam (pre-qualifying)</i>	Life Sciences Course BST 225 (4) STA 141 (4) STA 401 (3)	BST 299D: Dissertation Research

Years 3, 4: Research, BST 299D (Dissertation Research), Elective Coursework, Summer Internships, Biostatistical Practicum, Dissertation Presentation or Defense. Note that even after passing the qualifying examination, all full-time students must register for 12 units per quarter as per the Office of Graduate Studies regulations. These 12 units can be made up of elective coursework and BST 299 (Independent Study) courses.

Faculty Profiles

RAHMAN AZARI, Department of Statistics, Categorical Data Analysis, Time Series Analysis, Spatial Analysis, and Applications of Statistics in the Medical and Biological Sciences. E-mail: azari@wald.ucdavis.edu

LAUREL BECKETT, Department of Public Health Sciences, Statistical methods for longitudinal data, population-based studies, and translational research between basic science and clinical medicine. Collaborative research using these methods for studies of chronic disease. E-mail: labeckett@ucdavis.edu

RUDOLPH BERAN, Department of Statistics, ASP algorithms, bootstrap, directional data, experimental statistics. E-mail: beran@wald.ucdavis.edu

PRABIR BURMAN, Department of Statistics, Categorical data analysis; Nonparametric curve estimation, Model selection techniques. E-mail: burman@wald.ucdavis.edu

ANDREW J. CLIFFORD, Department of Nutrition, Human nutrient requirements, Behavior of human folate, in vivo dynamic and kinetic modeling of folate metabolism, folate in relation to birth defects, cardiovascular disease and cancer, Mathematical Modeling. E-mail: ajclifford@ucdavis.edu

NELLO CRISTIANINI, Department of Statistics, Design and Analysis of Machine Learning Algorithms, Kernel-Based Learning methods, Support Vector Machines. E-mail: nello@wald.ucdavis.edu

CHRISTIANA DRAKE, Department of Statistics, Causal inference in observational studies, imputation of missing responses under informative drop out, cancer epidemiology, generalized linear models with random effects. E-mail: drake@wald.ucdavis.edu

THOMAS R. FAMULA, Department of Animal Science, Statistical aspects of genetics and animal improvement, particularly in the area of inheritance of disease in dogs such as epilepsy in Belgian tervuren, deafness in Dalmatians, and Addison's disease in Bearded collies. E-mail: tfamula@ucdavis.edu

THOMAS B. FARVER, Department of Population Health and Reproduction, School of Veterinary Medicine, Biostatistics, sampling, multivariate analysis, analytical epidemiology. E-mail: tbfarver@ucdavis.edu

IAN GARDNER, Department of Medicine and Epidemiology, School of Veterinary Medicine, Risk analysis related to livestock health and food safety; diagnostic test evaluation – practical and theoretical issues; epidemiology of infectious diseases in livestock production systems; epidemiology of protozoal myeloencephalitis in marine mammals and equids; epidemiology of catastrophic musculoskeletal injuries in racehorses. E-mail: iagardner@ucdavis.edu

DANIELLE HARVEY, Department of Public Health Sciences, computational methods, analysis of high dimensional neuroimaging data, survival analysis, correlated event times. Collaborative research in Alzheimer's disease, cancer, end-of-life care, dosing errors and health services research. E-mail: djharvey@ucdavis.edu

FUSHING HSIEH, Department of Statistics, Survival analysis, joint modeling in biomedical dynamic system; modeling animal behavior, evolutionary ecology and aging; analysis of cognitive processing and neural spikes train data. E-mail: fushing@wald.ucdavis.edu

JIMING JIANG, Department of Statistics, Mixed effects models, small area estimation, longitudinal data, pharmacokinetics. E-mail: jjiang@wald.ucdavis.edu

PHILLIP H. KASS, Department of Population Health and Reproduction, School of Veterinary Medicine, epidemiologic methods; nonexperimental inference, companion animal epidemiology; chronic disease epidemiology; environmental epidemiology. E-mail: phkass@ucdavis.edu

KYOUNGMI KIM, Department of Public Health Sciences, Statistical methodologies for gene mapping for complex traits and diseases and for analyzing gene expression microarray data. Email: kmkim@ucdavis.edu

HAO LIU, Department of Public Health Sciences, Recurrent events, multivariate survival data, correlated longitudinal data, frailty models, semiparametric regression models, application of empirical processes, statistical methods for epidemiological studies. Collaborative research includes design and conduct of epidemiological studies as well as clinical trials. Email: ucldiu@ucdavis.edu

Y.P. MACK, Department of Statistics, Ecological and environmental statistics. E-mail: mack@wald.ucdavis.edu

HANS-GEORG MÜLLER, Department of Statistics, Aging and longevity, nonparametric curve estimation and smoothing methods, functional and longitudinal data analysis, generalized linear models, semiparametric models in biostatistics. E-mail: mueller@wald.ucdavis.edu

JIE PENG, Department of Statistics, Statistical genetics/genomics, linkage analysis, variance-component models, admixture models, boundary crossing problems, population genetics. E-mail: jie@wald.ucdavis.edu

KATHERINE POLLARD, Department of Statistics, Microarrays, population genetics, genome sequences. Email: kpollard@wald.ucdavis.edu

LIHONG QI, Department of Public Health Sciences, Design and analysis of genetic association studies, survival analysis, modeling missing data and measurement error problems. Email: lhqi@ucdavis.edu

DAVID M. ROCKE, Department of Public Health Sciences, Statistical analysis of gene expression data; statistical analysis of high-throughput biological assay data; analysis of massive data sets; robust statistical methods; chemometrics. E-mail: dmrocke@ucdavis.edu

GEORGE G. ROUSSAS, Department of Statistics, asymptotic inference in stochastic processes. E-mail: roussas@wald.ucdavis.edu

FRANCISCO J. SAMANIEGO, Department of Statistics, Mathematical statistics, reliability, survival analysis, sampling, Bayesian methods, applications to engineering and public health. E-mail: fjsamaniego@ucdavis.edu

ROBERT H. SHUMWAY, Department of Statistics, longitudinal data, time series, functional data analysis, biological and biomedical applications. E-mail: shumway@wald.ucdavis.edu

CHIH-LING TSAI, Graduate School of Medicine, Regression analysis, model selection, time series, biostatistics, business statistics. E-mail: cltsai@ucdavis.edu

ALEX TSODIKOV, Department of Public Health Sciences, Survival analysis, cure models, computational methods in statistics, semiparametric models, frailty models, screening, modeling and analysis in cancer. E-mail: atsodikov@ucdavis.edu

JESSICA UTTS, Department of Statistics, Applied Statistics, statistics education, meta-analysis, statistics and parapsychology. E-mail: utts@wald.ucdavis.edu

JANE-LING WANG, Department of Statistics, Dimension reduction methods, functional data analysis, longitudinal data analysis, research in aging, survival analysis.

XIAOWEI YANG, Department of Public Health Sciences, Bayesian model selection strategies for generalized linear models, especially those with missing covariates; longitudinal data analysis, functional regression modeling of data with large dimensionality; statistical computation and software development focusing on MCMC methods. Clinical trials and epidemiological studies on drug dependence, mental disorder, and general public health problems. Email: xdyang@ucdavis.edu

Appendix A Life Science Courses

Agricultural Sciences

ANG 107	Genetics and Animal Breeding (4)
ASE 105	Concepts in Pest Management (3)
ASE 107	Small Fruit Production (2)
ASE 110ABC	Crop Production and Management (3,3,4)
ASE 112	Forage Crop Ecology (3)
ASE 150	Cropping Systems of the World (4)
AVS 100	Avian Biology (3)
ENH 102	Physiological Principles in Environmental Horticulture (4)

Biological and Environmental Sciences

BIS 101	Genes and Gene Expression (4)
BIS 102	Structure and Function of Biomolecules (3)
BIS 103	Bioenergetics and Metabolism (3)
ECS 124	Theory and Practice of Bioinformatics (4)
ENT 100	General Entomology (3)
ENT 102	Insect Physiology (4)
EST 100	General Ecology (4)
EST 110	Principles of Environmental Science (4)
EST 121	Population Ecology (4)
EVE 100	Introduction to Evolution (4)
EVE 101	Introduction to Ecology (4)
EVE 102	Population and Quantitative Genetics (4)
EVE 103	Phylogeny and Macroevolution (3)
EVE 117	Plant Ecology (4)
MCB 150	Embryology (4)
FST 104	Food Microbiology (3)
NPB 100	Neurobiology (4)
NPB 101	Systemic Physiology (5)
NPB 102	Animal Behavior (3)
NPB 112	Neuroscience (3)
NPB 113	Cardiovascular, Respiratory, and Renal Physiology (4)
NPB 114	Gastrointestinal Physiology (3)
NPB 117	Avian Physiology (3)
NPB 121	Physiology of Reproduction (3)
NPB 125	Comparative Physiology: Neurointegrative Mechanisms (3)
NPB 126	Comparative Physiology: Sensory Systems (3)
NPB 127	Comparative Physiology: Circulation (3)
NPB 128	Comparative Physiology: Endocrinology (3)
NPB 129	Comparative Physiology: Respiration (3)
NPB 130	Physiology of the Endocrine Glands (4)
NPB 140	Principles of Environmental Physiology (3)
NUT 110	Principles of Nutrition (5)
NUT 116AB	Clinical Nutrition (3,3)
NUT 118	Community Nutrition (4)
PLB 105	Developmental Plant Anatomy (5)

PLB 111 Plant Physiology (3)
PLB 112 Plant Growth and Development (3)
PLB 116 Plant Morphology and Evolution (5)
PLB 143 Evolution of Crop Plants (4)
PLB 152 Plant Genetics (4)
PLB 154 Plant Breeding (4)
PLB 175 Applied Plant Biology (4)

Epidemiology and Veterinary Medicine

EPI 222 Epidemiological Modeling (3)
EPI 223 Spatial Epidemiology (3)
EPI 206 Epidemiologic Study Design (3)
EPI 208 Analysis and Interpretation of Epidemiologic Data (3)
EPI 220 Problems in Epidemiologic Study Designs (4)
EPI 207 Advanced Study Design (3)
EPI 210AB Analytic Epidemiology (3,3)
EPI 270 Research Methods in Occupational Epidemiology (3)
EST 126 Environmental and Occupational Epidemiology (4)
VME 217 Evaluation and Diagnostic Tests (3)