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1 INTRODUCTION

This handbook describes the academic programs offered by the Department of Biostatistics at Harvard University. The Department offers courses of study leading to the Doctor of Philosophy and Master of Science degrees. Both the Ph.D. and SM programs provide rigorous training in theory and practical experience in statistical and bioinformatics methods used in the biomedical sciences. The Department’s programs are designed to prepare students for careers in the theory and practice of biostatistics and bioinformatics, especially as applied to the biomedical and health sciences. The programs include training in the application and development of methodology, consulting, teaching, and collaboration on a broad spectrum of health-related problems. All students work with faculty on ongoing projects in methodological research and scientific collaboration. About sixty faculty participate in these programs.

The sections of this handbook include information and Departmental regulations concerning entrance requirements, program descriptions, degree requirements, and other Departmental policies. The Ph.D. Program is overseen by the Graduate School of Arts and Sciences, whereas the SM degree is governed by the School of Public Health. Policies and official requirements of the Graduate School of Arts and Sciences are set forth in the **Graduate School of Arts and Sciences Handbook** (http://handbook.gsas.harvard.edu/). Policies and official requirements of the School of Public Health are set forth in the **Harvard T. H. Chan School of Public Health Student Handbook** (https://www.hsph.harvard.edu/student-handbook/). Each graduate student is responsible for general knowledge of, and adherence to, the policies and requirements of the degree program in which the student is enrolled. Additional departmental information is available at [https://www.hsph.harvard.edu/biostatistics/](https://www.hsph.harvard.edu/biostatistics/). Vitally important for our community is that all members demonstrate respect for each other and our discipline. For all members of the community, respect is demonstrated by attending all scheduled classes or meetings, and arriving on time, fully prepared, and ready to participate.

This handbook was prepared by the Director of Graduate Studies for the PhD program and the Director of Master of Science Programs and approved by the Faculty of the Department of Biostatistics. The Directors are responsible for reviewing the student’s program of study, and have the authority to consider exceptions to the rules and regulations established by the Department. Recommendations of the Directors are forwarded to the Chair of the Degree Program Committee for final approval. Both the Directors and the Department Chair welcome suggestions and comments.
2 THE DOCTOR OF PHILOSOPHY PROGRAM

The Ph.D. program in Biostatistics trains students in the areas of probabilistic and statistical theory, biostatistical and bioinformatics methods, statistical computation and algorithm development, the ability to collaborate and communicate effectively with scientists in related disciplines, and the ability to teach biostatistics and bioinformatics effectively to general or specialized audiences. The Ph.D. program includes training in the development of methodology, consulting, teaching, and collaboration on a broad spectrum of health-related problems.

All Ph.D. students work with faculty on ongoing projects in methodological research and scientific collaboration. Faculty and students conduct methodologic research in Bayesian inference, bioinformatics, causal inference, clinical trials, computational biology, data analysis, decision sciences, experimental design, health policy, multivariate and longitudinal studies, quantitative genomics, sequential methods, spatial statistics, statistical computing, statistical genetics, stochastic processes, and survival analysis, among other areas. Areas of application include big data, biology, cancer, clinical research, computational biology, the environment, epidemiology, genetics, health disparities, HIV/AIDS, infectious diseases, neurology, and psychiatry, among other areas. Collaborative activities include coordination of national and international clinical trials, participation in studies of potential environmental hazards, collaboration on novel genetic and genomic studies, design of health surveys, evaluation of health interventions and medical technologies, and consultation with federal, state, and local agencies.

The Department of Biostatistics offers the Ph.D. in Biostatistics with two areas of interest: Biostatistics and Bioinformatics. Students select the area of interest most appropriate to their background and interests, and satisfy the degree program requirements listed below for their area of interest. Some Ph.D. requirements are common to both areas of interest, while others are specific to the area of interest selected.

The Ph.D. program in Biostatistics prepares students in the following five specific competencies:

1. Applying innovative probabilistic and statistical theory and computing methods to the development of new biostatistical or bioinformatics methodology, publishing of original methodological research, and the solution of public health problems.

2. Providing scientific and biostatistical or bioinformatics leadership in the design, conduct, and analysis of collaborative research studies in medicine and public health.

3. Applying modern statistical and computational methods to effectively analyze complex medical and public health data, including the development of new software for non-standard problems and simulation methods.

4. Collaborating and communicating effectively with research scientists in related disciplines.

5. Teaching biostatistics or bioinformatics effectively to health professionals, research scientists, and graduate students.

2.1 Admissions Procedures and Requirements

2.1.1 Graduate School of Arts and Sciences Requirements

For information on general requirements for admission, see the Graduate School of Arts and Sciences website (https://gsas.harvard.edu/admissions) or contact the Admissions Office by phone (617/496-6100).

2.1.2 Departmental Requirements

All candidates for admission to the Ph.D. program should have successfully completed calculus through multivariable integration and one semester of linear algebra. Knowledge of a programming language is also required. Evidence that these requirements have been fulfilled should form part of the application. In
addition, all applicants are strongly encouraged to have completed two semesters of calculus-based probability and statistics, two semesters of advanced calculus or real analysis, and a course in numerical analysis. Students with interests in bioinformatics are also encouraged to have completed courses in biology, computational biology, and genetics. Practical knowledge of a statistical computing package such as SAS, Splus, R, Stata, or SPSS is also desirable. Students with interests in bioinformatics should also have knowledge of a scripting language such as Python or Perl and some familiarity with relational databases. In addition, the Department Summer Program, which is held in August for admitted students, is designed to review basic concepts of probability, statistics, advanced mathematics, and statistical computing prior to the first semester in the Ph.D. program.

2.2 Advising and Degree Program Approval

2.2.1 Academic Advisor

The Department has a Student Advising Committee which provides guidance and assistance to students. In addition, all entering students are assigned an academic advisor to help plan course loads and explain Departmental requirements. At the earliest possible date, the student and the academic advisor will develop a program of study. Should a student wish to change his/her academic advisor, he or she is encouraged to discuss this with the Director of Graduate Studies. In addition, the Department and GSAS/SPH provide services for all students with clinically documented learning and/or physical disabilities.

2.2.2 Dissertation Advisor

After the written qualifying examination has been successfully completed, and usually in the fourth semester of study, the doctoral candidate will identify an area of research and a prospective dissertation advisor from the Department. The dissertation advisor assumes the responsibilities of the academic advisor and directs the student’s doctoral research.

2.2.3 Dissertation Committee

By October 15 after choosing a dissertation advisor, the student, in consultation with the dissertation advisor, nominates a Dissertation Committee to oversee the student’s progress. The Dissertation Committee ordinarily consists of the dissertation advisor, who serves as the chairperson, and two other faculty members. At least two of the Dissertation Committee members must be either members of the Faculty of Arts and Sciences, or of the Department of Biostatistics. The chair should be a member of the Department of Biostatistics. In some cases, a student could have two co-chairs of the Dissertation Committee. The student is responsible for arranging periodic meetings with the Dissertation Committee, and for submitting Dissertation Progress Report forms (Appendix B) at six month intervals (November 15 and May 15). Students must meet with their dissertation committee at least once every six months; students in their final year of the program are encouraged to meet even more frequently to support completion of their dissertation.

2.2.4 Departmental Approval of Program

The final doctoral program plan must be submitted to the Department for approval, on the doctoral Degree Program form provided by the Department (Appendix B). This program must be approved by the student’s faculty advisor and the Director of Graduate Studies. This plan should be submitted by May 1 of the second year. At this time the student may not have completed all required courses; any subsequent changes to the final program plan must be submitted and approved by the Director of Graduate Studies.

2.3 Degree Requirements

The Ph.D. Program in Biostatistics trains students in probabilistic and statistical theory; the use of biostatistical and bioinformatics methods in formulating problems, planning studies, conducting analyses, and
writing reports; conducting independent methodologic research; providing scientific leadership in collaboration with scientists in related disciplines; and the ability to teach and consult effectively through oral and written communications.

Ph.D. students are expected to take progressively more advanced courses, to prepare for the qualifying exams, and to choose a dissertation advisor and research topic. The student is also expected to participate in the Working Group seminars offered by the Department. These seminars provide background for choosing a dissertation topic, as well as general knowledge of contemporary biostatistical and bioinformatics research.

A detailed presentation of the GSAS’s regulations for doctoral students is found at https://gsas.harvard.edu/. All doctoral students and their advisors should make sure that GSAS and Departmental requirements are met according to schedule.

Full-time students must register for the equivalent of at least (16 credits), or the equivalent in TIME, each semester.

2.3.1 Residency
The Graduate School of Arts and Sciences requires that each student have a minimum of two years of full-time study in residence.

2.3.2 Course Requirements
The requirements listed below are minimal requirements for the Ph.D. program in Biostatistics. Each student should, in consultation with his/her advisor, select an area of interest and develop a program of study to best meet his/her individual needs and goals. Each student’s program is reviewed individually, and the final doctoral program must be approved by the Director of Graduate Studies.

The Ph.D. Program in Biostatistics builds on a ordinarily graded core curriculum consisting of:

- BIST 230 Probability Theory and Applications I
- BIST 231 Statistical Inference I
- BIST 232 Methods I
- BIST 233 Methods II

In addition, the equivalent of 7 full semester courses (generally 28 credits) of ordinarily graded Biostatistics courses (http://www.hsph.harvard.edu/biostats/courses/course.html) must be taken from the advanced doctoral core. Students with an area of interest in Biostatistics must select a minimum of 4 of these 7 courses (16 credits) from among BIST 235, 240, 241, 244, 245, and 249. Students with an area of interest in Bioinformatics must select a minimum of 4 of these 7 courses (16 credits) from among BIST 234, 235, 240, 241, 245, 249, 282 (required), 290, and EPI 511.

The advanced doctoral core includes:

- BIST 234 Introduction to Data Structures and Algorithms
- BIST 235 Advanced Regression and Statistical Learning
- BIST 238 Advanced Topics in Clinical Trials
- BIST 240 Probability Theory and Applications II
- BIST 241 Statistical Inference II
- BIST 244 Analysis of Failure Time Data
- BIST 245 Analysis of Multivariate and Longitudinal Data or STAT 230 Multivariate Statistical Analysis
- BIST 249 Bayesian Methods in Biostatistics or STAT 220 Bayesian Data Analysis
- BIST 254 Sec 1 Theory & Methods for Causality
- BIST 254 Sec 2 Design and Monitoring of Adaptive Clinical Trials
- BIST 254 Sec 3 Measurement Error and Misclassification
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIST 282</td>
<td>Introduction to Computational Biology and Bioinformatics</td>
</tr>
<tr>
<td>BIST 290</td>
<td>Advanced Computational Biology and Bioinformatics</td>
</tr>
<tr>
<td>CS 281</td>
<td>Advanced Machine Learning</td>
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<tr>
<td>EPI 511</td>
<td>Advanced Population and Medical Genetics</td>
</tr>
<tr>
<td>ID 542</td>
<td>Methods for Mediation and Interaction</td>
</tr>
<tr>
<td>STAT 240</td>
<td>Matched Sampling and Study Design</td>
</tr>
<tr>
<td>STAT 260</td>
<td>Design and Analysis of Sample Surveys</td>
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</tbody>
</table>

Other advanced courses in Biostatistics, including many of the special topics courses, and courses at MIT and the Faculty of Arts and Sciences (FAS) that are offered at an advanced level, may also be acceptable. Students are advised to consult with the Director of Graduate Studies to check prior to enrolling in the courses in question.

All advanced doctoral core courses contributing to the final program should be completed with a grade of B or better. Ordinarily, students will complete all course requirements by the end of the sixth semester. By May 15 after passing the written qualifying exam the final doctoral program should be filed with the Department.

In addition, the Department requires that students take EPI 201. A student may choose to take EPI 202 and include this course as part of his/her cognate field, if appropriate (see 2.3.3).

### 2.3.3 Cognate Requirement

The Department requires students to explore in some depth a selected cognate field, a non-quantitative field outside of biostatistics or statistics. Examples of cognate fields include the biology of AIDS or cancer; biophysics; environmental health; epidemiology (e.g., chronic disease epidemiology, environmental and occupational epidemiology, infectious disease epidemiology, molecular epidemiology, psychiatric epidemiology, psychosocial epidemiology); genetics; health policy and management; human development; molecular biology; society and health; or other non-quantitative fields. The cognate field should be complementary to the student’s area of interest in biostatistics or bioinformatics. The courses used to satisfy the cognate requirement should form a coherent set of courses related to the cognate field selected, and should primarily be substantive, rather than quantitative, in nature.

Students must complete 8-10 credits of ordinally graded courses in the cognate field. Provided that the inclusion of such courses contributes to the selection of a coherent cognate field, a maximum of 5 credits among BST 227, BIST 267, RDS 280, RDS 282, RDS 285, EPI 202, EPI 203, EPI 204, EPI 207, EPI 288, EPI 289, or other semi-quantitative courses in epidemiology or other fields will be allowed to count towards the fulfillment of this requirement. Students are advised to consult with the Director of Graduate Studies to check whether certain combinations of courses are appropriate for cognate consideration prior to enrolling in the courses in question.

All cognate field courses contributing to the final program should be completed with a grade of B or better. The selection of courses for the cognate field must be approved by the Director of Graduate Studies. Ordinarily, students will complete the cognate requirement by their sixth semester.

### 2.3.4 Consulting Requirement

Students must acquire experience in the planning of experiments and establishing a collaborative interaction with an investigator. To meet this requirement students must take the consulting seminar (BIST 312). A project outside the consulting seminar may be substituted only if approval is obtained from the Director of Graduate Studies. Ordinarily, students will complete the consulting requirement in their sixth semester, unless they pass their written qualifying exams in their first year.
2.3.5 Teaching Requirement

Students must acquire extensive experience in teaching biostatistics or bioinformatics. To meet this requirement, students ordinarily serve as a teaching assistant (TA) for an average of one 4-credit course in the Department per year in the program. Because doctoral students do not ordinarily serve as a TA in their first year of the program, they may be required to TA more than once per year during a later year in the program.

2.3.6 Employment Outside of the Training/Research Program

It is the policy of both GSAS and the Department to limit outside employment, as the doctoral program requires a full-time commitment to your training and research. The Department Chair, your advisor, training grant director, and the Director of Graduate Studies must review and approve in advance, and in writing, any requests to take on any additional employment, including extra paid TAing at SPH or elsewhere, summer TAing, and tutoring. In order to be considered, the proposed employment must be of limited duration and scope.

2.3.7 Summer Internships

In view of the full-time commitment to training and research in the doctoral program noted above, students are generally discouraged from applying to or participating in summer internships outside the department. However, in rare cases when the internship will directly relate to the students' doctoral training, those in the second or third year may be allowed to participate with the same approvals required as for any outside employment as noted in Section 2.3.6. To request permission to apply for a summer internship, students must submit a Summer Internship Proposal form. Students beyond the third year in the program are strongly recommended against summer internships.

2.3.8 Research Ethics Requirement

Students must satisfy a research ethics requirement by completing a course in responsible conduct of research (currently HPM 548) during the first semester in the program. This requirement may require periodic renewal.

2.3.9 TIME and Research Credits

In addition to regular coursework, Ph.D. students may register for TIME as a means of indicating that appropriate independent work is replacing numbered courses. TIME is undertaken with a faculty advisor who must sign the study card. One unit of TIME is a maximum of 4 credits. Units of TIME are ungraded. TIME-C is used for course-related work; TIME-R for research-related work; and TIME-T, for teaching-related work. Students may register for TIME-C when independent work is being undertaken that is not specifically indicated in a numbered course. TIME-R may be used to indicate that research work is being undertaken that is not directly related to the student’s dissertation work, or that a student has received a research assistant appointment. TIME-T may be used to indicate that a student has received a teaching assistant appointment.

BIST 350 should be used by Ph.D. candidates who have passed their written qualifying examination and who are working on their dissertation research. Students may register for a maximum of 4 units of BIST 350 per semester, as needed, to maintain full-time status.

2.3.10 Transfer of Coursework

The Department of Biostatistics does not allow courses taken elsewhere to count towards the residency requirement. However, students may occasionally be permitted to use graduate level courses in Biostatistics or related areas taken at other universities to satisfy some Departmental requirements for the Ph.D. degree (e.g., core courses, epidemiology requirement, cognate requirement, consulting requirement). Generally, when core courses are waived, it is not necessary to make up the credit in other biostatistics courses.
To request a waiver of Departmental requirements on the basis of prior coursework, the student must petition the Director of Graduate Studies for approval. The petition should contain a course description and syllabus. An official transcript indicating the grade received must be on file, or submitted with the petition. Each request is considered on an individual basis. All waivers of departmental requirements must be approved by the Director of Graduate Studies.

### 2.3.11 Examination Requirements

Students must take and pass two qualifying examinations: a written examination and an oral examination.

**The Written Examination** The written examination is given annually following the fall semester. Students will take the exam for the first time during or before their second year in the doctoral program. Students may be allowed to retake the examination at most once, with Departmental approval.

The exam consists of two parts which are administered in two sessions on different days. Material relevant to the exam is covered in the doctoral core courses of the Biostatistics program (see Section 2.3.2). The exam tests the student’s understanding of probability, statistical inference, and statistical methods. Copies of past examinations are available on request from the Manager of Academic Services.

The written qualifying examination is evaluated by the Qualifying Exam and Academic Standing Committees, who establish the passing score. Students whose scores fall below the passing score are further evaluated based on their performance in coursework, summer projects, and performance as research/teaching assistants. On the basis of this further evaluation, a student whose qualifying exam score is below the passing score may nonetheless be determined to pass the qualifying exam. Students who are taking the qualifying exam for the first time but who do not pass the exam may, on the basis of this further evaluation, be permitted to retake the exam.

**The Oral Examination** The oral examination assesses the student’s potential to perform research in a chosen field, and examines the student’s knowledge of biostatistics or bioinformatics. Successful completion of the written examination is a prerequisite for taking the oral examination. The oral examination should be scheduled by May 15 in the year after passing the written examination or by November 15 in the seventh semester, whichever comes first. In preparation for the oral examination, the student must decide on a specialized topic on which he/she wishes to be examined. In most cases, this specialized topic will be related to the student’s chosen dissertation research area. The student will prepare a written report summarizing the topic and reviewing the relevant literature. This written report must be given to the Dissertation Committee at least two weeks prior to the examination, and the oral scheduling form must also be submitted to the department at least 2 weeks in advance (see B). The Dissertation Committee ordinarily consists of the dissertation advisor, who serves as the chairperson, and two other faculty members (see 2.2.3). At least two of the Dissertation Committee members must be either members of the Faculty of Arts and Sciences, or of the Department of Biostatistics. The chair should be a member of the Department of Biostatistics. In some cases, a student could have two co-chairs of the Dissertation Committee. At the oral examination, students will be required to make a short presentation of the chosen topic, and will be examined on the topic by the Committee.

### 2.3.12 Doctoral Dissertation

The dissertation should be an original contribution to scientific knowledge. It can contribute to a subject matter field through innovative application of existing methodology, can make an original methodologic contribution, or be a combination of the two. Most dissertations consist of material sufficient for three publications. The dissertation topic should be complementary to the student’s area of interest in biostatistics or bioinformatics.

Acceptance of the dissertation is the responsibility of the student’s Dissertation Committee, the Department, and GSAS. When the dissertation is complete, the student defends it to the Dissertation Committee at a public presentation. The defense must be openly publicized and scheduled at least three weeks in advance.
A Dissertation Defense Scheduling Form must also be submitted three weeks in advance (see B). Copies of the dissertation should be given to the members of the Dissertation Committee and the Department Chair at least two weeks before the defense.

2.4 Satisfactory Progress Requirements

A doctoral student’s academic standing will be assessed by the Department on a regular basis to ensure that he/she is progressing at an appropriate rate. The Department adheres to the general satisfactory progress requirements as established by the Graduate School of Arts and Sciences and described in Section VI of the GSAS Handbook. Our Department will use the following additional criteria in establishing satisfactory progress.

1. Students in the first year of the Biostatistics doctoral program are expected to complete four core courses (BIST 230, BIST 231, BIST 232, and BIST 233) with a minimum average of B+ and no grade below B.

2. No more than one grade below B in any academic year; satisfactory performance on summer projects and as teaching assistants, research assistants, and/or computing assistants; maintain full time status of 4 full semester courses (16 credits) minimum per semester. According to the GSAS handbook, in each of the first two years a student must have achieved the minimum grade-point average required by this faculty, a B average (3.0).

3. Students will complete their written qualifying examination by the beginning of the fourth semester. The written exam must be passed by the beginning of the sixth semester.

4. Students will complete their oral examination by May 15 in the year after passing the written examination or by November 15 in the seventh semester, whichever comes first.

5. Ordinarily, students will complete all course, cognate, and consulting requirements by the end of the sixth semester.


Ordinarily, a student will complete their degree within 3 to 5 years after entering the program.

2.5 Master of Arts

No one is admitted as a candidate for the Master of Arts (AM), only for the Ph.D. Nevertheless, the requirements for the Master of Arts degree must be satisfied by all students as they move toward the Ph.D. and are ordinarily expected to be completed by the end of the fourth semester. The AM degree may be granted when these requirements are fulfilled. In addition, the Department may confer a terminal AM degree on students who will not be completing the requirements for the Ph.D. In order to satisfy the AM requirements, at least 10 full semester or 20 half semester (equivalent to 50 SPH credits) ordinarily graded courses are required from the doctoral core, the advanced doctoral core, or the two-year Master of Science in Biostatistics degree core (described in Section 3.4). Upon fulfilling these requirements, students should submit an application for the AM degree to GSAS.

2.6 Joint SD Program

In certain cases, the Department may entertain applications for a joint SD program in Biostatistics from students already enrolled in another SPH SD program. The student would be required to fulfill the Ph.D. requirements described above, but would follow SPH doctoral student guidelines. Joint doctoral degrees are not recognized or possible for students in Harvard PhD programs. Further information is available from the Director of Graduate Studies.
3 THE MASTER OF SCIENCE PROGRAMS

The Master of Science programs in Biostatistics train students in the basics of statistical theory, biostatistical and bioinformatics methods in planning studies, conducting analyses, and writing reports, the interpretation of numeric data for scientific inference in studies in medicine and public health, and the ability to collaborate and communicate effectively with scientists in related disciplines. Application areas include observational studies, clinical trials, computational biology and quantitative genomics, statistical genetics, and medical and public health research, among other areas.

The Department of Biostatistics offers several Master of Science programs, with the appropriate program dependent on the student’s background and interests. The two-year Master of Science (SM2) degree provides training in statistical theory and a variety of statistical, computational, and bioinformatics methods for application in medicine and public health. The SM2 program is appropriate for students considering doctoral level work or Master’s level medical research positions upon completion. The one-year Master of Science (SM1) degree is designed for students with a mathematical and statistical background sufficient to achieve a level of proficiency after one year of study comparable to that obtained in the SM2 program. The 60-credit Master of Science (SM60) degree has an applied emphasis and is designed for students seeking medical research positions in biostatistics upon completion.

All Master of Science programs in Biostatistics prepare students in four specific competencies:

1. Designing research studies in medicine and public health, including study design and population selection, sample size justification, data analysis plans, methods of data acquisition and organization, data management methods, data analysis plans, and protocol development.

2. Analyzing and interpreting quantitative data for scientific inference, including graphical and tabular displays, descriptive statistics, statistical inference, and choice of appropriate statistical software for the data analysis.

3. Using modern computational methods to effectively analyze complex medical and public health data, including regression methods, survival data analysis, bioinformatics, and statistical genetics.

4. Collaborating and communicating effectively with research scientists in related disciplines.

The SM1 and SM2 programs in Biostatistics have a fifth specific competency:

5. Using probabilistic and statistical reasoning and theory to effectively analyze non-standard problems arising in medicine and public health and assisting biostatistical researchers in the conduct of methodologic research.

The SM60 program in Biostatistics also has a fifth specific competency:

5. Disseminating new knowledge in a research discipline through the preparation of written reports of biostatistical analyses, comparison of different statistical methodologies, and oral presentation of results.

Specific program requirements are described below. Some requirements are common to all Master of Science programs, while others are specific to the degree program.

3.1 Admissions Procedures and Requirements

3.1.1 Harvard T. H. Chan School of Public Health Requirements

Application for admission to the SM program is available online on the Admissions Office website (https://www.hsph.harvard.edu/admissions/admissions/how-to-apply/application-requirements/). For information
on general requirements for admission, contact the Admissions Office by phone (617/432-1031) or through their website (https://www.hsph.harvard.edu/admissions/).

3.1.2 Departmental Requirements

All candidates for admission to the SM programs should have successfully completed calculus through multivariable integration and one semester of linear algebra. Knowledge of a programming language is also required. Evidence that these requirements have been fulfilled should form part of the application. In addition, applicants are encouraged to have completed courses in probability, statistics, advanced calculus, and numerical analysis. Practical knowledge of a statistical computing package such as SAS, Splus, R, Stata, or SPSS is also desirable. Students with interests in bioinformatics are also encouraged to have completed courses in biology, computational biology, and genetics, and would benefit by having knowledge of a scripting language such as Python or Perl and some familiarity with relational databases.

Students who have a Master’s degree in one of the mathematical sciences or a doctorate in a quantitative field may be qualified for a one-year SM program. To be admitted, applicants must have a mathematical and statistical background sufficient to achieve a level of proficiency after one year of study comparable to that achieved by the two-year program.

3.2 Advising and Degree Program Approval

3.2.1 Academic Advisor

The Department has a Student Advising Committee which provides guidance and assistance to students. In addition, all entering students are assigned an academic advisor to help plan course loads and explain Departmental requirements. At the earliest possible date, the student and the academic advisor will develop a program of study. Should a student wish to change his/her academic advisor, he or she is encouraged to discuss this with the Director of Master of Science Programs. In addition, the Department and SPH provide services for all students with clinically documented learning and/or physical disabilities.

3.2.2 Departmental Approval of Program

The Master’s program plan must be submitted to the Department for approval, using the Master’s Degree Program form provided by the Department. The program must be approved by the student’s faculty advisor and the Director of Master of Science Programs. This plan should be submitted at least one semester prior to the expected graduation date for Master’s students.

3.2.3 Epidemiology Requirement

The School of Public Health requires that Master’s students must successfully pass one Epidemiology course. The Department requires that EPI 201 be taken to satisfy this requirement.

3.2.4 Research Ethics Requirement

Students must satisfy a research ethics requirement by completing a course in responsible conduct of research or by completing an online training course during the first year in the program. Students who feel they have already completed an equivalent training program must submit adequate documentation to, and receive approval from, the Director of Master of Science Programs during the first semester in residence.

3.3 Satisfactory Progress Requirements

For students in the SM2 program, a minimum of 60 ordinal credits is required. For students in the SM60 program, a minimum of 45 ordinal credits is required. For students in the SM1 program, a minimum of 30 ordinal credits is required. In addition, SPH students must remain in good academic standing, must complete program requirements within the designated time to degree, and must maintain a cumulative average of 2.70 or above. All ordinal grades for courses used to satisfy Departmental requirements specified in Sections
3.4.1, 3.5.1, 3.6.1 (depending on your program) must be at the level of B- or higher. Courses taken on a pass/fail basis cannot be used to satisfy ordinally graded Departmental requirements.

A detailed presentation of SPH’s regulations for Master’s students is found at https://www.hsph.harvard.edu/student-handbook/. All Master’s students and their advisors should make sure that SPH and Departmental requirements are met according to schedule.

3.4  Degree Requirements for the Two-Year SM (SM2) in Biostatistics

A total of 80 credits are required for the SM2 program. The SM2 program is aimed at students who are considering doctoral level work in biostatistics, statistics, bioinformatics, or allied fields such as epidemiology, environmental health, or medicine. The SM2 program is also appropriate for students seeking to take more varied and advanced courses but who are considering Master’s level medical research positions upon completion.

3.4.1 Course Requirements for the SM2 in Biostatistics

SM2 students can develop a flexible program in statistical methods, statistical theory, statistical computing, bioinformatics, and health decision sciences, depending on the student’s background and interests. Fifty credits of ordinally graded courses must be taken from the two-year Biostatistics Master’s core (at least 35 credits must come from courses with a BST prefix), including:

- BST 210 Applied Regression Analysis
- BST 212 Survey Research Methods in Community Health
- BST 214 Principles of Clinical Trials
- BST 216 Introduction to Quantitative Methods for Monitoring and Evaluation
- BST 217 Statistical and Quantitative Methods for Pharmaceutical Regulatory Services
- BST 222 Basics of Statistical Inference
- BST 223 Applied Survival Analysis
- BST 226 Applied Longitudinal Analysis
- BST 227 Introduction to Statistical Genetics
- BST 228 Applied Bayesian Analysis
- BST 230 Probability I
- BST 231 Statistical Inference I
- BST 232 Methods I
- BST 233 Methods II
- BST 234 Introduction to Data Structures and Algorithms
- BST 235 Advanced Regression and Statistical Learning
- BST 238 Advanced Topics in Clinical Trials
- BST 246 Statistical Methods for Incomplete Data
- BST 249 Bayesian Methods in Biostatistics or STAT 220 Bayesian Data Analysis
- BST 254 Sec 2 Design and Monitoring of Adaptive Clinical Trials
- BST 254 Sec 3 Measurement Error and Misclassification
- BST 261 Data Science II
- BST 267 Introduction to Social and Biological Networks
- BST 280 Introductory Genomics & Bioinformatics for Health Research
- BST 281 Genomic Data Manipulation
- BST 282 Introduction to Computational Biology and Bioinformatics
- BST 283 Cancer Genome Analysis
- BST 290 Advanced Computational Biology and Bioinformatics
- EPI 511 Advanced Population and Medical Genetics
- GHP 261 Models of Complex Systems in Biology and Public Health
- ID 271 Advanced Regression for Environmental Epidemiology
- ID 542 Methods for Mediation and Interaction
Other advanced courses in Biostatistics, including many of the special topics or Wintersession courses, and courses at MIT and the Faculty of Arts and Sciences (FAS) that are offered at an advanced level, may also be acceptable. Students are advised to consult with the Director of Master of Science Programs prior to enrolling in the courses in question.

Students can then choose electives depending on their background and interests. Students are strongly encouraged to take appropriate training in areas of application such as the biological sciences, biophysics, cancer, computational biology, environmental health, epidemiology, health policy, infectious diseases, international health, nutrition, psychiatry, social health, or other allied fields to prepare them for interdisciplinary collaborative research.

### 3.5 Degree Requirements for the 60-credit SM (SM60) in Biostatistics

The SM60 program has an applied emphasis and is geared toward students with an undergraduate degree in one of the mathematical sciences or an allied field (e.g., biology, psychology, or economics). At least 40 credits of course work are required, including 20 credits of required courses and a minimum of 15 credits of elective Biostatistics courses. The program culminates with a Master’s thesis and oral defense, summarizing work accomplished during a collaborative research practicum. The SM60 program is aimed at students seeking a terminal Master’s degree. Typically of 17 months duration (though dependent on how long the student takes to finish and defend their Master’s thesis), the focus of the SM60 program is on training graduates for applied biostatistics positions involving medical or epidemiologic research in teaching hospitals, universities, research organizations, and the pharmaceutical and biotechnology industries.

#### 3.5.1 Course Requirements for the SM60 in Biostatistics

A total of 60 credits are required for the SM60 degree. SM60 students follow a structured program of required courses, and then choose electives depending on the student’s background and interests. Specific requirements of this program include the following 20 credits of required ordinally graded courses:

- **BST 210** Applied Regression Analysis
- **BST 222** Basics of Statistical Inference
- **BST 223** Applied Survival Analysis
- **BST 226** Applied Longitudinal Analysis

In addition, students select a minimum of 15 credits of ordinally graded courses in Biostatistics to round out their program. At most 5 credits can come from relevant courses in computer science, risk and decision sciences, statistics, or quantitative epidemiology, with the approval of the Director of Master of Science Programs, and students are advised to consult with him prior to enrolling in the courses in question.

#### 3.5.2 Thesis Requirements for the SM60 in Biostatistics

An SM60 student must complete a 10–20 credit ordinally graded Master’s Thesis and Collaborative Research Practicum (BST 325), usually taken after the required course work has been completed. This will typically involve data analysis for a research project under the direction of one or more mentors. The project could be supervised primarily by a faculty member in Biostatistics, or co-supervised by a doctoral-level investigator (at Harvard or elsewhere) and a faculty member in Biostatistics.

In this Collaborative Research Practicum, a student will perform activities related to the design, conduct, and analysis of research studies with a focus on data analysis and scientific presentation. The student will carry out an extensive data analysis, often including data summaries and graphical displays, regression
methods, data interpretation, and comparison of alternative methods. Usually these projects will involve interacting with a group of people with varied disciplinary backgrounds. The student will then write a Master’s thesis of approximately 20-25 double-spaced pages excluding tables, figures, and references that describes the medical or public health problem of interest, summarizes the appropriate data analyses, and provides a scientific interpretation of the data, in a standard scientific writing style. The student will also orally present this work in a seminar of approximately 30 minutes in length. The Master’s thesis and oral presentation will primarily be the work of the student, with only advisory input from the mentor(s). The Master’s thesis and oral presentation will be evaluated by a review committee consisting of three members. The members will include the student’s Practicum mentor(s), the Director of Master of Science Programs, and other Biostatistics faculty members or surrogates as needed. The Master’s thesis must be submitted to the review committee at least two weeks prior to the oral presentation. A written evaluation will be provided to the student.

3.6 Degree Requirements for the One-Year SM (SM1) in Biostatistics

Students who have a Master’s degree in one of the mathematical sciences or a doctorate in a quantitative field may be qualified for the one-year Master’s program. To be admitted, applicants must have a mathematical and statistical background sufficient to achieve a level of proficiency after one year of study comparable to that achieved by the two-year program.

3.6.1 Course Requirements for the SM1 in Biostatistics

A total of 42.5 credits are required for the one-year Master’s program. A minimum of 25 credits of ordinally graded courses must be taken from the one-year Biostatistics Master’s core, including:

- **BST 214** Principles of Clinical Trials
- **BST 216** Introduction to Quantitative Methods for Monitoring and Evaluation
- **BST 217** Statistical and Quantitative Methods for Pharmaceutical Regulatory Services
- **BST 222** Basics of Statistical Inference
- **BST 223** Applied Survival Analysis
- **BST 226** Applied Longitudinal Analysis
- **BST 227** Introduction to Statistical Genetics
- **BST 228** Applied Bayesian Analysis
- **BST 230** Probability Theory and Applications I
- **BST 231** Statistical Inference I
- **BST 232** Methods I
- **BST 233** Methods II
- **BST 234** Introduction to Data Structures and Algorithms
- **BST 235** Advanced Regression and Statistical Learning
- **BST 238** Advanced Topics in Clinical Trials
- **BST 246** Statistical Methods for Incomplete Data
- **BST 249** Bayesian Methods in Biostatistics or **STAT 220** Bayesian Data Analysis
- **BST 254 Sec 2** Design and Monitoring of Adaptive Clinical Trials
- **BST 254 Sec 3** Measurement Error and Misclassification
- **BST 261** Data Science II
- **BST 267** Introduction to Social and Biological Networks
- **BST 280** Introductory Genomics & Bioinformatics for Health Research
- **BST 281** Genomic Data Manipulation
- **BST 282** Introduction to Computational Biology and Bioinformatics
- **BST 283** Cancer Genome Analysis
- **BST 290** Advanced Computational Biology and Bioinformatics

Other advanced courses in Biostatistics, including many of the special topics or Wintersession courses, and courses at MIT and the Faculty of Arts and Sciences (FAS) that are offered at an advanced level, may
also be acceptable, provided that least 20 credits come from courses with a BST prefix. Students are advised to consult with the Director of Master of Science Programs prior to enrolling in the courses in question.

3.7 Biostatistics SM Program for Students in Another SPH SD Program

In certain cases, the Department may entertain applications for an SM1 or SM2 program in Biostatistics from students already enrolled in another SPH SD program. The student would need to meet the eligibility requirements for the SM1 or SM2 program and would be required to fulfill the SM degree requirements described above, following all SPH student guidelines. Further information is available from the Director of Master of Science Programs.
A ADMINISTRATIVE REQUIREMENTS FOR DOCTORAL PROGRAM

Detailed requirements and deadlines are given at the Graduate School of Arts and Sciences webpage. All forms linked below are also located on last page of this Graduate Student Handbook.

- **Year One**
  - **First Semester**
    - Complete Research Ethics requirement (HPM 548).
    - Ask for waivers of fall core courses (BIST 230 and BIST 232) that you intend to waive by emailing the Manager of Academic Studies with details about the course(s) taken or experience that you have that may qualify you for a waiver.
    - May begin taking courses to count toward completion of cognate.
    - Turn in Wintersession plan by December 15.
  - **Second Semester**
    - Complete or waive spring core courses (BIST 231 and BIST 233).
    - Start to take advanced core courses if applicable.
    - Continue completion of cognate-related courses.
    - Search for summer project. Turn in proposal form about summer project to the Manager of Academic Services by May 1.
  - **Summer**
    - Complete ten-week summer project.
    - Present summer project in orientation week (late August).
    - Attend TA training sessions in orientation week (late August).

- **Year Two**
  - **Third Semester**
    - Take advanced core courses.
    - Continue completion of cognate-related courses.
    - Study for qualifying exam to be taken in mid-January.
  - **Fourth Semester**
    - Take written qualifying exam in mid-January.
    - Take advanced core courses.
    - Continue completion of cognate-related courses.
    - If written qualifying exam passed, choose dissertation advisor. Notify Manager of Academic Studies of your choice by April 15.
    - Turn in your final program form by May 1.
    - AM degree “along the way” should be completed, and all paperwork filed for degree application by GSAS deadlines.
Year Three

- Fifth Semester
  - Take advanced core courses.
  - Continue completion of cognate-related courses.
  - If written qualifying exam passed, turn in the Dissertation Committee nomination form by October 15.
  - If written qualifying exam passed, turn in your first Dissertation Progress Report (due twice a year) by November 15.

- Sixth Semester
  - Complete advanced core courses.
  - Complete cognate-related courses.
  - Complete (or waive) the consulting course, BIST 312.
  - Turn in Dissertation Progress Report by May 15.
  - Schedule and complete Oral Qualifying Exam by May 15 (if written qualifying exam was passed on 1st attempt).
    - Circulate the written report for the Oral Qualifying Exam to the Dissertation Committee two weeks before the exam takes place.
  - If qualifying exam passed on 2nd attempt, choose dissertation advisor. Notify Manager of Academic Studies of your choice by February 15.

Year Four

- Seventh Semester
  - Turn in the Dissertation Committee nomination form within three months of choosing a dissertation advisor (by May 15 if written qualifying exam was passed on 2nd attempt).
  - Turn in Dissertation Progress Report by November 15.
  - Schedule and complete Oral Qualifying Exam by November 15 (if written qualifying exam was passed on 2nd attempt).
    - Circulate the written report for the Oral Qualifying Exam to the Dissertation Committee two weeks before the exam takes place.

- Eighth Semester
  - Turn in Dissertation Progress Report by May 15.
  - Apply for degree by deadline (http://www.registrar.fas.harvard.edu/registration-enrollment-degrees/graduation-diplomas –make sure to click on GSAS Graduation tab). GSAS requires that Ph.D. applicants file an Application for Degree by the dates listed on their academic calendar. (NOTE: The application deadlines are several months before graduation.) Turn in all paperwork associated with degree (http://www.registrar.fas.harvard.edu/registration-enrollment-degrees/graduation-diplomas/phd-dissertation-submission).
  - Schedule your dissertation defense. Submit a Dissertation Defense Scheduling Form to the Department at least three weeks prior to the dissertation defense. Copies of the dissertation should be provided to the Dissertation Committee and to the Manager of Academic Services at least two weeks prior to the defense. A Dissertation Acceptance Certificate will be completed by the Department before the dissertation defense and signed by the Dissertation Committee after the student’s defense.
B  DEPARTMENTAL FORMS

Doctoral Degree Forms

- Biostatistics PhD Degree Program Form
  http://www.hsph.harvard.edu/biostats/publications/handbook/PHD_Degree_Form.pdf

- Oral Examination Scheduling Form
  http://www.hsph.harvard.edu/biostats/publications/handbook/Orals_Exam_Scheduling_Form.pdf

- Summer Internship Proposal Form

- Dissertation Committee Nomination Form

- Dissertation Committee Nomination Change Form

- Dissertation Progress Report Form

- Dissertation Defense Scheduling Form

Masters Degree Forms

- Biostatistics SM2 Degree Program Form
  http://www.hsph.harvard.edu/biostats/publications/handbook/SM2_Degree_Form_BIO.pdf

- Biostatistics SM60 Degree Program Form
  http://www.hsph.harvard.edu/biostats/publications/handbook/SM60_Degree_Form.pdf

- Biostatistics SM1 Degree Program Form
  http://www.hsph.harvard.edu/biostats/publications/handbook/SM1_Degree_Form.pdf

- Thesis Committee Nomination Form

- Thesis Defense Scheduling Form