

BIOSTATISTICS, PHD

Program Overview

The PhD program at the Johns Hopkins Department of Biostatistics offers comprehensive training in biostatistical methodology and practice, grounded in both probability and statistics theory and advanced data science. This program is unique in its broad emphasis, spanning the foundations of statistical reasoning and data science. It provides rigorous training in real analysis-based probability and statistics, comparable to that of most mathematical statistics departments, as well as in data science principles and practice.

The Department of Biostatistics PhD program prepares individuals who have demonstrated excellence in mathematics, engineering, and the natural or social sciences to become research biostatisticians in academia, industry, or government. PhD graduates:

- Conduct and publish original research on the theory, methodology and practice of biostatistics and data science;
- Translate methodological advances into software and other tools to facilitate their practical application;
- Apply innovative theories and methods to solve public health problems;
- Serve as expert biostatisticians and data scientists on collaborative teams of investigators addressing key public health questions;
- Teach biostatistics and data science effectively to health professionals, scientists, and graduate students in biostatistics.

Program Requirements

Course location and modality is found on the BSPH website (<https://publichealth.jhu.edu/courses/>).

The core curriculum consists of the following components:

| Code | Title | Credits |
|---|---|---------|
| Biostatistical Methodology (Methods) | | |
| <i>A one-year sequence of Advanced Methods in Biostatistics (advanced-level)</i> | | |
| PH.140.751 | Advanced Methods in Biostatistics I | 3 |
| PH.140.752 | Advanced Methods in Biostatistics II | 4 |
| PH.140.753 | Advanced Methods in Biostatistics III | 4 |
| PH.140.754 | Advanced Methods in Biostatistics IV | 4 |
| Probability and Statistical Theory (Theory) | | |
| <i>A one-year sequence of introductory-level probability and statistical theory</i> | | |
| PH.140.646 | Essentials of Probability and Statistical Inference I: Probability | 4 |
| PH.140.647 | Essentials of Probability and Statistical Inference II: Statistical Inference | 4 |
| PH.140.648 | Essentials of Probability and Statistical Inference III: Theory of Modern Statistical Methods | 4 |
| PH.140.649 | Essentials of Probability and Statistical Inference IV | 4 |
| <i>A one-year sequence of probability theory (advanced-level)</i> | | |
| PH.140.721 | Probability Theory I | 3 |
| PH.140.722 | Probability Theory II | 3 |
| PH.140.723 | Probability Theory III | 3 |

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| PH.140.724 | Probability Theory IV | 3 |
| <i>A one-year sequence of statistical theory (advanced-level)</i> | | |
| PH.140.731 | Statistical Theory I | 4 |
| PH.140.732 | Statistical Theory II | 4 |
| PH.140.733 | Statistical Theory III | 4 |
| PH.140.734 | Statistical Theory IV | 4 |
| Data Science | | |
| <i>A one-year sequence of introductory-level data science</i> | | |
| PH.140.776 | Statistical Computing | 3 |
| PH.140.777 | Statistical Programming Paradigms and Workflows | 3 |
| PH.140.628 | Data Science for Public Health I | 4 |
| PH.140.629 | Data Science for Public Health II | 4 |
| <i>A one-year sequence of data science and computing (advanced-level)</i> | | |
| PH.140.644 | Statistical Machine Learning: Methods, Theory, and Applications | 4 |
| PH.140.777 | Statistical Programming Paradigms and Workflows | 3 |
| PH.140.778 | Statistical Computing, Algorithm, and Software Development | 3 |
| PH.140.779 | Advanced Statistical Computing | 3 |
| <i>A half-year sequence of advanced data science (advanced-level)</i> | | |
| PH.140.711 | Advanced Data Science I | 3 |
| PH.140.712 | Advanced Data Science II | 3 |

All PhD students are required to:

1. Take at least 14 courses from the core course list above. The 14 courses should contain at least a one-year sequence of Methods (140.751-754), a one-year sequence of Theory (140.646-649 or 140.721-724 or 140.731-734), and a one-year sequence of Data Science (140.776/777/628/629 or 140.644/777/778/779). The 14 courses should contain no more than 4 introductory-level courses (140.646-649, 140.776/628/629).
2. In addition to the 14 core courses, take 16 credits of advanced PhD elective courses.
3. Take at least 18 credit units of formal coursework in courses outside the Department of Biostatistics. At least nine of these credits must be taken in the School of Public Health.
4. Take Current Topics in Biostatistics Research (140.860), Academic & Research Ethics at BSPH (550.860), Responsible Conduct of Research (550.600), and Epidemiologic Inference in Public Health I (340.721).

Students who use the one-year sequence of introductory-level probability and statistical theory (140.646-649) to fulfill requirement (1) must also take the half-year sequence of advanced data science (140.711-712).

Students who use the one-year sequence of introductory-level data science (140.776/777/628/629) courses to fulfill requirement (1) must take at least two advanced-level probability (140.721-724) and two advanced-level statistical theory (140.731-734) courses.

Student Evaluations

The Department is committed to providing every opportunity for its students to successfully complete the academic program of their choice. To support students in progressing toward the degree and to further their educational experience, the Department offers a comprehensive written examination at the end of the first year. For more details about the

first-year PhD comprehensive exam, please visit the PhD in Biostatistics (<https://publichealth.jhu.edu/academics/phd-dept-of-biostatistics/>) page where students can find a link to our PhD handbook.

The University requires students to successfully complete a preliminary oral examination, typically taken at the beginning of the third year. The main purpose of this examination is to evaluate students' foundational knowledge and ability to communicate statistical ideas and concepts. Students should prepare a paper/proposal related to their potential thesis topic and present it in the preliminary oral exam. The University also requires students to successfully complete an oral thesis defense before graduation, where the completed thesis is defended in a public forum.

Research and Teaching Assistantships

The Department of Biostatistics offers teaching and research assistantships to its PhD students on a competitive basis. All PhD applicants (US and international) are ranked based on their merits; top candidates are offered admission. All students who matriculate are provided with assistantships that last five years and include full tuition, health insurance, and a living stipend. Students find the teaching and research assistantships to be the most valuable part of their PhD experience. Please visit the PhD in Biostatistics (<https://publichealth.jhu.edu/academics/phd-dept-of-biostatistics/>) page where students can find a link to our PhD handbook and the PhD union collective bargaining agreement (<https://provost.jhu.edu/education/graduate-and-professional-education/phd-union/collective-bargaining-agreement/>) for more details on funding and benefits.

Seminars

The Department offers a weekly seminar program (<https://publichealth.jhu.edu/departments/biostatistics/news-and-events/current-seminars/>) featuring recent work by outstanding statistical scientists from around the world. Attendance is required for all graduate students. One seminar per month may be designated to be part of the Biostatistics "Grand Rounds" series, which features statistical analyses addressing important public health questions.

In addition, first-year graduate students are required to complete the Current Topics in Biostatistics Research course (140.860 (<https://www.jhsph.edu/courses/course/34636/2022/140.860.01/current-topics-in-biostatistics-research/>)), where faculty, postdoctoral fellows, and senior students from the Department present their research, with a focus on the public health and scientific questions driving the work, why the research makes a difference for the subject area and how to translate the research into practice.

Recommended Curriculum

First-Year PhD Students

In addition to the core courses described in the program requirements, the following curriculum is recommended:

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PH.260.600 Introduction to the Biomedical Sciences

First Term

"Cells to Society" modules, if applicable*

PH.550.860 Academic & Research Ethics at BSPH

PH.140.840 Special Studies and Research Biostatistics (credits as needed in order to get to at least 16 credits total)

PH.140.860 Current Topics in Biostatistics Research

Second Term

"Cells to Society" modules, if applicable*

PH.140.840 Special Studies and Research Biostatistics (credits as needed in order to get to at least 16 credits total)

PH.140.860 Current Topics in Biostatistics Research

Third Term

"Cells to Society" modules, if applicable*

PH.140.840 Special Studies and Research Biostatistics (credits as needed in order to get to at least 16 credits total)

PH.140.860 Current Topics in Biostatistics Research

Fourth Term

"Cells to Society" modules, if applicable*

PH.140.840 Special Studies and Research Biostatistics (credits as needed in order to get to at least 16 credits total)

PH.140.860 Current Topics in Biostatistics Research

Second-Year PhD Students

In addition to the core courses described in the program requirements, the following curriculum is recommended:

First Term

"Cells to Society" modules, if applicable*

PH.340.721 Epidemiologic Inference in Public Health I (if not taken the first year)

PH.550.600 Living Science Ethics - Responsible Conduct of Research

PH.550.860 Academic & Research Ethics at BSPH (if not taken in a previous term)

PH.140.840 Special Studies and Research Biostatistics (credits as needed in order to get to at least 16 credits total)

Second Term

"Cells to Society" modules, if applicable*

PH.140.840 Special Studies and Research Biostatistics (Credits as needed in order to get to at least 16 credits total)

Third Term

"Cell to Society" modules, if applicable*

Select one or both of the following:

PH.140.820 Thesis Research Biostatistics (credits as needed in order to get to at least 16 credits total)

PH.140.840 Special Studies and Research Biostatistics (Credits as needed in order to get to at least 16 credits total)

Fourth Term

"Cells to Society" modules, if applicable*

Select one or both of the following:

PH.140.820 Thesis Research Biostatistics (credits as needed in order to get to at least 16 credits total)

PH.140.840 Special Studies and Research Biostatistics (Credits as needed in order to get to at least 16 credits total)

Third-Year PhD Students

Coursework in scientific/statistical electives/special studies for a minimum of 16 credits per term

Fourth-Year PhD Students

Coursework in scientific/statistical electives/special studies for a minimum of 16 credits per term

* Students are required to take eight 552.xxx "Cells to Society" courses (552.601.81, 552.603.81, 552.607.81, 552.608.81, 552.609.81, 552.610.81, 552.611.81, 552.612.81) by the end of Year Two.

Doctoral Student Policies

Below covers policies regarding academic performance of doctoral students that are specific to the Department of Biostatistics. Students also must satisfy the academic standing requirements of the Johns Hopkins University and Bloomberg School of Public Health.

For a full list of program policies, please visit the PhD in Biostatistics (<https://publichealth.jhu.edu/academics/phd-dept-of-biostatistics/>) page where students can find a link to our PhD handbook.

Academic Standing and Exams

Doctoral students are expected to stay in good academic standing throughout their PhD studies.

Students are expected to maintain grades of B or higher in core classes. Any core class with a grade lower than a B will need to be retaken.

First year students maintaining B grades in core classes can sit for the first year Departmental exam. Students with any grades lower than a B in core classes must receive approval from the graduate committee to sit for the exams. In the event that students are denied, possible resolutions include postponing the exam for one year, switching to a master's program or being required to leave the doctoral program based on a consideration by the faculty of overall academic performance.

In the event of a failure of the exam, students are allowed one retake. Student retakes typically occur in the following year, with exceptions occurring when mitigating circumstances are present, such as a leave of absence. In the event of a failure in the retake, the student will be asked to leave the doctoral program, typically with the option to join the master's program. The exams, either a first take or retake, are only given once per year at the start of the summer break (typically in early June).

The grading of the Departmental exam is as follows. Passing scores are determined by exam writers after grading with examiners blinded from student names. Students who pass all sections of the exam pass the exam. Students failing one or more sections will be discussed by the faculty as a whole. This discussion will include exam and course performance. Possible resolutions include: declaring the student as passing the exam, declaring the student as having failed the exam, take-home remediation of sections of the exam or a full retake (only available if it is the student's first attempt at the exam).

To maintain good academic standing, students must complete their school-wide preliminary oral exam by the end of their third academic year

before the start of the first term of their fourth year (typically late August or early September depending on that year's academic calendar).

Full funding for tuition and stipend is provided to PhD students for five years. Students are expected to finish their doctoral programs within this time. Students who do not finish within five years may continue in the program for up to two additional years. In these cases, a 75% departmental tuition scholarship is provided, but students are responsible for the remaining tuition, their own health insurance, and living expenses. Personal office space cannot be guaranteed for students beyond the five-year point. Common areas (Biostatistics Library, Genome Cafe) remain available for use by these students.

Program Changes from PhD to ScM or MHS

In the event that a doctoral student switches to the ScM or MHS programs, the following should be noted.

Funded doctoral students forfeit their funding in the event of a program switch.

Students have the option of switching to part-time status after switching programs. However, visa residency requirements for maintaining full-time student status typically prevent foreign students from being able to switch to part-time.

MHS and ScM students receive a 75% tuition reduction in their second year provided that they have taken 12 credits of courses outside of the Department (of which at least 6 credit hours must come from the School of Public Health courses) and have passed their Departmental exams. Doctoral students considering a program switch should appropriately plan their first year coursework to ensure eligibility for the tuition reduction in their second year. The 75% tuition remission is contingent on passing the first year exams at the master's level. PhD students who take the doctoral exam and then elect or are asked to switch to a master's program will be informed whether their performance on the doctoral exam constitutes a pass at the master's level. Students who are deemed to have not passed at the master's level will be asked to take the master's Departmental exam in the subsequent year to fulfill the requirements of the master's program and will not be eligible for the tuition reduction until the exam requirements have been met. Students will be allowed this one administration of the master's exam in these circumstances.

Upon successful completion of the Doctor of Philosophy in Biostatistics, students will have mastered the following competencies:

- Apply quantitative methods to public health and scientific problems;
- Examine and apply foundational concepts of probability theory and statistical inference;
- Construct, fit and interpret different types of linear model (LM), generalized linear model (GLM), linear mixed model (LMM) and generalized linear mixed model (GLMM) in the context of scientific and public health applications, and conduct statistical inference in these models;
- Develop foundational insights for applying biostatistical theory and methodology to solve public health and scientific problems;
- Produce a complete data analysis to answer a targeted scientific or public health question.

According to the requirements of the Council on Education for Public Health (CEPH), all BSPH degree students must be grounded in foundational public health knowledge. Please view the list of specific

CEPH requirements by degree type (<https://e-catalogue.jhu.edu/public-health/ceph-requirements/>).