BIOSTATISTICS, DOCTOR OF PHILOSOPHY (PH.D.) WITH A CONCENTRATION IN GENOMIC BIOSTATISTICS

Program goal

The mission of the VCU Department of Biostatistics is to improve human health through methodological research, the education of graduate students and health science researchers in biostatistical methods and applications, and collaborative health sciences research. Faculty members conduct methodological research motivated by collaborative alliances, which in turn contributes to and enhances the department's educational mission. By focusing on the integration of methodological and collaborative research, students develop strong biostatistical and communication skills, enabling them to assume leadership positions in academia, government and industry.

Student learning outcomes

This training program is designed to help students achieve the following learning outcomes.

Biostatistics core outcomes

1. Develop new (or extend existing) biostatistical methods through scholarly peer-reviewed publications that contribute to and expand the biostatistical research literature
2. Effectively collaborate with both biostatistical and health science researchers to plan and design research studies and analyze data from a broad spectrum of research questions
3. Apply standard computational and analytic procedures to demonstrate the ability to solve new and complex problems and develop fluency in a minimum of two computational languages
4. Explain biostatistical concepts, methods and results to both biostatistical and non-biostatistical health sciences researchers using exceptional written and oral communication skills

Genomic biostatistics concentration-specific outcomes

1. Contribute to the biostatistical genomics literature by applying the various formats for high-throughput genomic data
2. Use computational tools for analyzing high-throughput genomic data

VCU Graduate Bulletin, VCU Graduate School and general academic policies and regulations for all graduate students in all graduate programs

The VCU Graduate Bulletin website documents the official admission and academic rules and regulations that govern graduate education for all graduate programs at the university. These policies are established by the graduate faculty of the university through their elected representatives to the University Graduate Council.

It is the responsibility of all graduate students, both on- and off-campus, to be familiar with the VCU Graduate Bulletin as well as the **Graduate School website** and academic regulations in individual school and department publications and on program websites. However, in all cases, the official policies and procedures of the University Graduate Council, as published on the VCU Graduate Bulletin and Graduate School websites, take precedence over individual program policies and guidelines.

Visit the academic regulations section for additional information on academic regulations for graduate students.

Degree candidacy requirements

A graduate student admitted to a program or concentration requiring a final research project, work of art, thesis or dissertation, must qualify for continuing master's or doctoral status according to the degree candidacy requirements of the student's graduate program. Admission to degree candidacy, if applicable, is a formal statement by the graduate student's faculty regarding the student's academic achievements and the student's readiness to proceed to the final research phase of the degree program.

Graduate students and program directors should refer to the following degree candidacy policy as published in the VCU Graduate Bulletin for complete information and instructions.

Visit the academic regulations section for additional information on degree candidacy requirements.

Graduation requirements

As graduate students approach the end of their academic programs and the final semester of matriculation, they must make formal application to graduate. No degrees will be conferred until the application to graduate has been finalized.

Graduate students and program directors should refer to the following graduation requirements as published in the Graduate Bulletin for a complete list of instructions and a graduation checklist.

Visit the academic regulations section for additional information on graduation requirements.

Apply online today. (https://www.vcu.edu/admissions/apply/graduate/)

Admission requirements

Degree:	Semester(s) of entry:	Deadline dates:	Test requirements:
Ph.D.	Fall preferred	Applications received prior to Dec 1 given priority consideration	GRE

In addition to the general admission requirements of the VCU Graduate School (http://bulletin.vcu.edu/graduate/study/admission-graduate-study/admission-requirements/), applicants must complete the verbal, quantitative and analytical writing sections of the Graduate Record Exam. The following mathematics courses or their equivalents are required for admission: MATH 307, MATH 310, STAT 309 and STAT 212. MATH 507 and an additional graduate-level math analysis course are recommended for students interested in completing the Ph.D. program.

Degree requirements

In addition to the general VCU Graduate School graduation requirements (http://bulletin.vcu.edu/academic-regs/grad/graduation-info/), Ph.D. students in the genomic biostatistics concentration will complete a minimum of 78 graduate credit hours (59 didactic credit hours plus

eight hours each of consulting and seminar, and at least three credit hours of research). More specifically, required courses include: BIOS 513, BIOS 514, BIOS 524, BIOS 601, BIOS 602, BIOS 606, BIOS 615, BIOS 632, BIOS 647, BIOS 653, BIOS 654, BIOS 658, BIOS 668, BNFO 540 (or BIOL 540) and one of OVPR 601, OVPR 602 or OVPR 603. In addition, students will take one of BIOS 667 or BIOS 691, and at least nine credits of other graduate-level BIOS, STAT, MATH or BNFO courses. Ph.D. students must take eight semesters each of BIOS 603 and BIOS 690. Ph.D. students will also participate in the summer student research program at least twice and present at the Biostatistics Student Research Symposium each fall.

In addition to meeting VCU Graduate School and program requirements for graduation, all students enrolled in the School of Population Health must demonstrate competence in foundational public health learning objectives. This requirement is waived for students who previously completed a CEPH-accredited degree at the bachelor's, master's or doctoral level.

Qualifying exam

Students pursuing the Ph.D. degree must pass a two-part qualifying examination administered after completion of core courses. Part A (the theoretical examination) covers material from the following courses: BIOS 513, BIOS 514, BIOS 653 and BIOS 654. Part B (the applied examination) covers material from the following courses: BIOS 524, BIOS 601, BIOS 602 and BIOS 606.

Each part of the exam is graded as pass or fail. A student must pass both Part A and Part B of the qualifying exam at the Ph.D. level to continue in the Ph.D. program. A student who does not pass either Part A or Part B of the qualifying examination at the Ph.D. level will have one opportunity to retake that part of the qualifying examination.

Dissertation proposal defense

Students pursuing the Ph.D. degree who have passed the qualifying exam must pass a defense of their dissertation proposal that will consist of both written and oral components. For the written component of the dissertation proposal defense the student will produce a detailed report and description of the proposed research plan. For the oral component of the dissertation proposal defense the student will present the dissertation proposal to their dissertation committee and respond to any feedback or questions.

The proposal defense will be scheduled as soon as the student is ready after passing both parts of the qualifying examination. This could be as early as Year 2, with students required to defend before December of their fourth year.

Each part of the exam is graded as pass or fail. A student must pass both Part A and Part B of the dissertation proposal defense to continue toward their final dissertation defense. A student who does not pass both Part A and Part B of the dissertation proposal defense may choose to complete the requirements for an M.S. degree.

Admission to candidacy

A student must pass both parts A and B of their qualifying examination, must identify a dissertation adviser and committee and must pass both the written and oral components of the dissertation proposal defense before they can be admitted to candidacy.

Dissertation

A comprehensive dissertation reporting the results of original research related to genomics topics is required for the Ph.D. with a concentration in genomic biostatistics. It is expected that the dissertation will make use of some high-throughput genomic technology as an application for the methodological development.

Final examination

All Ph.D. candidates must defend their dissertations at a final oral examination. A public presentation will precede a Ph.D. defense closed to all but the student's committee. Questions are restricted to the topic of the dissertation for the Ph.D. candidate.

Course requirements

Course	Title	Hours
Required core courses		
BIOS/STAT 513	Mathematical Statistics I	3
BIOS/STAT 514	Mathematical Statistics II	3
BIOS 524	Biostatistical Computing	3
BIOS 601	Analysis of Biomedical Data I	3
BIOS 602	Analysis of Biomedical Data II	3
BIOS 603	Biostatistical Consulting (1 credit course taken 8 semesters)	8
BIOS 606	Clinical Trials	3
BIOS 615	Advanced Inference	4
BIOS 647	Survival Analysis	3
BIOS 653	Biostatistical Methods I	4
BIOS 654	Biostatistical Methods II	4
BIOS 690	Biostatistical Research Seminar (1-credit course taken 8 semesters)	8
Required additional courses		
BIOL/BNFO 540	Fundamentals of Molecular Genetics (or other relevant course)	3
BIOS 632	Multivariate Analysis	3
BIOS 658	Statistical Methods for High-throughput Genomics Data I	3
BIOS 667	Statistical Learning and Data Mining [1]	3
or BIOS 691	Special Topics in Biostatistics	
BIOS 668	Statistical Methods for High-throughput Genomic Data II	3
OVPR 601	Scientific Integrity	1
or OVPR 602	Responsible Scientific Conduct	
or OVPR 603	Responsible Conduct of Research	
Elective courses		
At least nine credits must come from the courses below (or others with approval of program director).		9
BIOS 535	Behavioral Measurement	
BIOS 549	Spatial Data Analysis	
BIOS 631	Mixed Models and Longitudinal Data Analysis	
BIOS 635	Structural Equation Modeling	
BIOS 649	Advanced Spatial Data Analysis	
BIOS 688	Applied Bayesian Biostatistics	
BIOS 691	Special Topics in Biostatistics	

BNFO/BIOL 601	Integrated Bioinformatics	
BNFO 691	Special Topics in Bioinformatics	
MATH 640	Mathematical Biology I	
STAT 613	Stochastic Processes	
STAT 614	Stochastic Processes	
STAT/OPER 636	Machine Learning Algorithms	
STAT 642	Design and Analysis of Experiments I	
STAT 645	Bayesian Decision Theory	
STAT 675	Time Series Analysis I	
Dissertation research		
BIOS 697	Directed Research in Biostatistics	4
Total Hours		**78**

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Or other course with program approval.

The minimum total of graduate credit hours required for this degree is 78.

Students who complete the requirements for this concentration will receive a Doctor of Philosophy in Biostatistics.

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Program website: biostatistics.vcu.edu (http://www.biostatistics.vcu.edu/)