**BIOSTATISTICS, MASTER OF SCIENCE (M.S.) 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 be completed in 18 months (four semesters: fall, spring, summer, fall) and will help students achieve the following learning outcomes:

1. The successful candidate will understand the modern and advanced literature of biostatistical and genomics concepts, ideas and methods.
2. The successful candidate will demonstrate the ability to effectively collaborate with both biostatistical, genomics and health science researchers, specifically with respect to planning and designing research studies, and also in analyzing data from a broad spectrum of research questions.
3. The successful candidate will develop fluency in several computational languages, will exhibit proficiency in standard computational and analytic procedures, and will demonstrate the ability to computationally solve new and complex problems.
4. The successful candidate will display exceptional written and oral communication skills in terms of explaining biostatistical and genomics concepts, methods and results to both biostatistical and non-biostatistical health sciences researchers.

**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.

**Other information**

**School of Medicine graduate program policies**
The School of Medicine provides policies applicable to all programs administratively housed in the school. Information on master’s programs is available elsewhere in this chapter of the Graduate Bulletin.

Apply online at graduate.admissions.vcu.edu (http://www.graduate.admissions.vcu.edu).

**Admission requirements**

<table>
<thead>
<tr>
<th>Degree:</th>
<th>Semester(s) of entry:</th>
<th>Deadline dates:</th>
<th>Test requirements:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D.</td>
<td>Fall preferred</td>
<td>Applications received prior to Jan 15</td>
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<tr>
<td></td>
<td></td>
<td>given priority consideration</td>
<td>GRE</td>
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</table>

In addition to the general admission requirements of the VCU Graduate School (http://bulletin.vcu.edu/graduate/study/admission-graduate-study/admission-requirements), applicants for the M.S. in Biostatistics must complete the verbal, quantitative and analytical writing sections of the Graduate Record Exam.

Additionally, the following mathematics courses or their equivalents are required for admission:
There is no thesis requirement in the M.S. program.

### Degree requirements

In addition to the general VCU Graduate School graduation requirements (http://bulletin.vcu.edu/academic-regs/grad/graduation-info), M.S. students will complete a minimum total of 42 credit hours of course work. Required courses include BIOS 512 or BIOS 513, BIOS 524, BIOS 553, BIOS 554, BIOS 567, BIOS 571, BIOS 572, BIOS 573, BIOL 540 or BNFO 540, at least one of BIOS 632, BIOS 667, BIOS 668, and BIOS 691 (the latter when the topic is systems biology or statistical genetics/genetic epidemiology), and one other 500- or 600-level BIOS, STAT, MATH or BNFO course. M.S. students must take four credit hours of BIOS 516 and three credit hours of BIOS 690. M.S. students interested in applying to the Ph.D. program in biostatistics (with no concentration or with a concentration in genomic biostatistics) are strongly encouraged to take both BIOS 513 and BIOS 514, participate in the Summer Student Training Program, and present at the Biostatistics Student Research Symposium.

### Qualifying exam

Students pursuing the M.S. degree must pass a qualifying examination administered after completion of their first-year courses. This applied examination covers material from the following first-year courses: BIOS 524, BIOS 571, BIOS 572 and BIOS 573. This examination is graded as pass or fail. A student must pass the qualifying examination at the M.S. level to continue in the M.S. program. A student who does not pass the qualifying examination at the M.S. level will have one opportunity to retake the examination. Students interested in applying to the Ph.D. program in biostatistics (with no concentration or with a concentration in genomic biostatistics) are strongly encouraged to also take the theoretical component of the qualifying examination covering material from the following first-year courses: BIOS 513, BIOS 514, BIOS 553 and BIOS 554. These students must pass both the applied and theoretical qualifying examinations at the Ph.D. level in order to be considered in the Ph.D. program.

### Thesis

There is no thesis requirement in the M.S. program.

### Curriculum requirements

#### Core courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>BIOL/BNFO 540</td>
<td>Fundamentals of Molecular Genetics (or other relevant course)</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 512</td>
<td>Basic Mathematical Statistics</td>
<td>3</td>
</tr>
<tr>
<td>or BIOS 513</td>
<td>Mathematical Statistics I</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 524</td>
<td>Biostatistical Computing</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 553</td>
<td>Biostatistical Methods I</td>
<td>4</td>
</tr>
<tr>
<td>BIOS 554</td>
<td>Biostatistical Methods II</td>
<td>4</td>
</tr>
<tr>
<td>BIOS 567</td>
<td>Statistical Methods for High-throughput Genomics Data I</td>
<td>3</td>
</tr>
</tbody>
</table>

Although not required, prior course work in additional mathematics, statistics or computer science is helpful.

### Additional courses

Select one of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS 632</td>
<td>Multivariate Analysis</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 667</td>
<td>Statistical Learning and Data Mining</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 668</td>
<td>Statistical Methods for High-throughput Genomic Data II</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 691</td>
<td>Special Topics in Biostatistics (systems biology or genetic epidemiology)</td>
<td>3</td>
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</table>

Select at least one 500- or 600-level course (minimum three credits), which may be selected from the following list or with program director approval:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS 549</td>
<td>Spatial Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 615</td>
<td>Advanced Inference</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 631</td>
<td>Mixed Models and Longitudinal Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 635</td>
<td>Structural Equation Modeling</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 638</td>
<td>Statistical Design and Analysis in Toxicology</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 639</td>
<td>Statistical Design and Analysis in Toxicology</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 647</td>
<td>Survival Analysis</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 649</td>
<td>Advanced Spatial Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 650</td>
<td>Design and Analysis of Response Surface Experiments</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 688</td>
<td>Applied Bayesian Biostatistics</td>
<td>3</td>
</tr>
<tr>
<td>STAT 613</td>
<td>Stochastic Processes</td>
<td>3</td>
</tr>
<tr>
<td>STAT 614</td>
<td>Stochastic Processes</td>
<td>3</td>
</tr>
<tr>
<td>STAT 625</td>
<td>Applied Multivariate Analysis</td>
<td>3</td>
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### Consulting and seminar

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>BIOS 516</td>
<td>Biostatistical Consulting (one-credit course taken four semesters)</td>
<td>4</td>
</tr>
<tr>
<td>BIOS 690</td>
<td>Biostatistical Research Seminar (one-credit course taken three semesters)</td>
<td>3</td>
</tr>
</tbody>
</table>

### Total graduate credit hours required (minimum) 42

### Typical plan of study

Many students often end up taking more than the minimum number of hours required for a degree program. The total number of hours may vary depending upon the program, nature of research being conducted by a study or in the enrollment or funding status of the student. Students should refer to their program websites and talk with their graduate program directors or advisers for information about typical plans of study and registration requirements.

### Graduate program director

Roy T. Sabo, Ph.D.
Associate professor, Department of Biostatistics
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(804) 828-3047

Additional contact (admissions and prospective students)
Russell M. Boyle
Assistant professor, Department of Biostatistics, and associate program director
russell.boyle@vcuhealth.org
(804) 827-2049

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