BIOSTATISTICS (MS)

Master of Science in Biostatistics (BDSCMS)
Unit: School of Public Health and Information Sciences (https://louisville.edu/sphis) (GH) (https://louisville.edu/sphis)
Department: Bioinformatics and Biostatistics (http://louisville.edu/sphis/departments/bioinformatics-biostatistics)
Program Webpage (http://louisville.edu/sphis/departments/bioinformatics-biostatistics/academics/ms)
Academic Plan Codes: BDSCMS, BDSCMS_O, BDSCMS_INF

Program Information
This program can be completed in a traditional classroom format or entirely online (http://louisville.edu/online/program-finder).

Biostatistics involves the development and application of statistical techniques to scientific research in health-related fields including medicine, nursing, and public health. Students in the Master of Science in Biostatistics program receive state-of-the-art training in the latest statistical methodologies with focus on the design of research studies, modern statistical data analysis in health sciences research, and research in Biostatistical methodology. In addition, students are provided with tools with which to develop evidence-based clinical and healthcare policies and guidelines.

Competency
Evaluate the biostatistics content of scientific and biomedical literature. C6
Analyze moderately complex research data using statistical methods involving common linear statistical models. C4
Manage data using spreadsheet and database software. C3
Demonstrate use of standard statistical and graphics computer packages such as SAS, R, Microsoft Excel, and SPSS. C3
Evaluate statistical methods presented in the literature. C6
Investigate theoretic underpinnings and apply principles and theorems of biostatistics. C4
Design research studies using appropriate statistical methods. C3
Superscript codes represent cognitive domain levels from Bloom’s Taxonomy

Demonstration of the competencies is accomplished by successful completion of all MS curriculum activities.

Faculty Advisor
Upon admission to the MS program, the program director serves as the student’s faculty advisor until a mentor for the student’s independent study, practicum or thesis (as applicable) is identified. At this milestone, the mentor becomes the student’s faculty advisor.

Program of Study
Upon admission to the MS program, the program director, working with the student as faculty advisor, develops a program of study for the student, which requires agreement by the student and the academic dean. Changes to a student’s program of study, including coursework, milestones, and their anticipated timings, are made by the student’s faculty advisor, working with the student, and formally signed by the student, the faculty advisor, the program director, and, for selected changes, the academic dean. This flexibility allows adapting programs of study to differing student capabilities and interests.

Admission Requirements
The MS program is available to students who have completed an undergraduate degree in biostatistics, statistics, mathematics, or a related discipline and possess competency in college-level calculus, up to and including multivariable calculus (partial differentiation and multiple integration) and statistics as evidenced by transcripts from postsecondary institutions attended.

The following are required for admission:

• Graduate application (http://louisville.edu/graduate/apply) submitted to the Graduate School.
• Non-refundable application fee.
• At least two letters of recommendation written within past twelve months, submitted as part of the graduate application (http://louisville.edu/graduate/apply)
• GRE Scores are required and are considered in the context of other required components of the application. Students who have been successful in our programs in the past had a median [Q1, Q3] GRE Quantitative score at the 80th percentile.
• All post-secondary transcripts. Transcripts from institutions outside of the United States require a foreign credential evaluation.
  • The minimum undergraduate grade point average that will be considered for unconditional acceptance and admission is 3.0 on a 4.0 scale. Applicants with a GPA of 2.75 or above may be considered for conditional admission based on the overall quality of the application. Contingencies placed on admission for such cases may vary by the student.
  • Students lacking the necessary background in calculus (up to and including multivariable calculus with coverage of partial differentiation and multiple integration) may be conditionally admitted to the MS program and required to complete remedial coursework in calculus courses offered by the Department in the University of Louisville’s summer term. A minimum grade of B-minus in each course assigned to the student must be achieved (in addition to satisfaction of any other admission conditions) in order for the student to be fully admitted to the MS program. Students have one opportunity to satisfactorily complete all remedial courses assigned to them and all remedial courses must be completed prior to the student’s first Fall semester in the program. Students admitted under this condition will be dismissed from the MS program if they fail to achieve this required calculus competency. The details of these and all conditional admissions are specified in the admission letter students receive from the Department.
    • A statement of purpose submitted to the department office, which must include desired degree program.
    • International students for whom English is not their primary language must show English language proficiency by one of the following:
      • TOEFL examination score at or above 550 (paper based test and a 5.0 on the TWE test), 213 (computer based test), 79 (internet based test)
      • IELTS test score of 6.5 or higher
• Successfully passing the exit examination for the advanced level of an Intensive English as a Second Language Program
• Demonstration of a degree awarded from an institution with instruction primarily in English, as formally documented by an appropriate institutional official

Program Requirements

The MS program in biostatistics can be completed on one of three options. The descriptions below are for students who have completed all prerequisite courses for required and elective courses included in each degree program. Additional credit hours may be needed for remediation of missing or lacking student capabilities encountered following matriculation or for capabilities outside the standard coursework required for an identified project or thesis.

• The Standard Program is a 30 credit hour, non-thesis curriculum that emphasizes a broad understanding of biostatistics and can be completed in three semesters by full-time students. The standard program can be completed in a traditional classroom format or entirely online (http://louisville.edu/online/programs).
• The Thesis Option involves continuing beyond the required coursework for the standard program to pursue the preparation and defense of a master's thesis in an additional semester, during which the student enrolls for a thesis research course for no fewer than six (6) credit hours. The thesis option is recommended for students intending to pursue a PhD degree or wanting to pursue a research project that interests them. However, a master's thesis is a requirement for the thesis option only. A student who elects to pursue the thesis option and subsequently does not successfully complete the thesis remains eligible for the award of degree under the standard program.
• The Bioinformatics Concentration is a 30 credit hour, non-thesis curriculum that is based on coursework in bioinformatics and biostatistics and can also be completed in three semesters by full-time students. The Bioinformatics concentration is currently available in a traditional classroom format only.

Coursework Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Coursework</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Concentration Coursework</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Thesis (optional)</td>
<td></td>
<td>[6]</td>
</tr>
<tr>
<td>Minimum Total Hours</td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>

For a detailed description of the degree requirements and course listing for each option, click on the "Concentration Requirements" tab.

Students will declare their intended degree option upon entrance to the program. Students may choose to move onto a different program path upon discussion with the Program Director. However, switching between the standard program and the Bioinformatics concentration will typically lead to a delay in degree fulfillment due to the differences in the required coursework. Students intending to graduate with the thesis option will begin with the standard program. At the completion of the spring semester of the first year for full-time students (the completion of at least 19 credit hours for part time students), students that have not yet declared for the thesis option may make this declaration, if desired.

Award of degree from an accredited school of public health requires successful completion of the equivalent of three (3) credit hours of instruction that provides students a broad introduction to public health. This requirement may be determined to have been met prior to matriculation by approval of the academic dean via a variance request submitted by the program director. The request for a variance in the requirement must be justified by 1) previous degrees received, such as an MPH or DrPH, 2) previous coursework successfully completed, or 3) extensive experience in the public health workforce. In the absence of a variance for this requirement, the student’s program of study must include successfully completed coursework that satisfies the requirement.

Program Core

The following courses are required for all three tracks:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHST 661</td>
<td>Probability</td>
<td>3</td>
</tr>
<tr>
<td>PHST 680</td>
<td>Biostatistical Methods I</td>
<td>3</td>
</tr>
<tr>
<td>PHPH 523</td>
<td>Public Health in the United States</td>
<td>(2)</td>
</tr>
</tbody>
</table>

Spring

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHST 662</td>
<td>Mathematical Statistics</td>
<td>3</td>
</tr>
<tr>
<td>PHST 681</td>
<td>Biostatistical Methods II</td>
<td>3</td>
</tr>
</tbody>
</table>

Minimum Total Hours 12

1 PHPH 523 fulfills the accreditation requirement that all graduates from the School of Public Health and Information Science receive foundational instruction in public health. The two (2) credit hours for PHPH 523 do not accrue toward the 30 credit hours required for MS degree completion. Students with a prior degree and/or coursework in a public health field or substantial experience in the public health workforce may be relieved of this requirement, per approval of the Associate Dean for Academic Affairs.

Concentration Coursework

The course tables below list all required courses for each track, including the Program Core courses listed under the Degree Requirements tab.

Standard Program Curriculum

<table>
<thead>
<tr>
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<tr>
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<tr>
<td>PHST 680</td>
<td>Biostatistical Methods I</td>
<td>3</td>
</tr>
<tr>
<td>PHST 624</td>
<td>Clinical Trials I: Planning and Design</td>
<td>2</td>
</tr>
<tr>
<td>PHPH 523</td>
<td>Public Health in the United States</td>
<td>(2)</td>
</tr>
</tbody>
</table>

Spring

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<tr>
<td>PHST 681</td>
<td>Biostatistical Methods II</td>
<td>3</td>
</tr>
<tr>
<td>PHST 684</td>
<td>Categorical Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>PHST 625</td>
<td>Clinical Trials II</td>
<td>2</td>
</tr>
</tbody>
</table>

Year 2

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHST 683</td>
<td>Survival Analysis</td>
<td>3</td>
</tr>
<tr>
<td>PHST 620</td>
<td>Introduction to Statistical Computing</td>
<td>3</td>
</tr>
</tbody>
</table>


1. PHPH 523 fulfills the accreditation requirement that all graduates from the School of Public Health and Information Science receive foundational instruction in public health. The two (2) credit hours for PHPH 523 do not accrue toward the 30 credit hours required for MS degree completion. Students with a prior degree and/or coursework in a public health field or substantial experience in the public health workforce may be relieved of this requirement, per approval of the Associate Dean for Academic Affairs.

2. Electives are chosen with the approval of a faculty advisor. Students are typically encouraged to select electives from among the following courses offered by the Department of Bioinformatics and Biostatistics:

### Standard Program Electives

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHST 603</td>
<td>Biostatistics Public Health Practicum I</td>
<td>1-2</td>
</tr>
<tr>
<td>PHST 640</td>
<td>Statistical Methods for Research Design in Health Sciences</td>
<td>3</td>
</tr>
<tr>
<td>PHMS 641</td>
<td>Data Mining I</td>
<td>3</td>
</tr>
<tr>
<td>PHST 675</td>
<td>Independent Study in Biostatistics</td>
<td>1-3</td>
</tr>
<tr>
<td>PHST 682</td>
<td>Multivariate Statistical Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

Subject to the approval of a faculty advisor, students are also welcome to choose elective courses outside of the department in fields related to biostatistics, such as Mathematics, Epidemiology, and Computer Science. Students seeking to pursue elective coursework outside the department are responsible for ensuring they have met the prerequisites for these courses.

### Bioinformatics Concentration Electives

<table>
<thead>
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<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHST 603</td>
<td>Biostatistics Public Health Practicum I</td>
<td>1-2</td>
</tr>
<tr>
<td>PHST 620</td>
<td>Introduction to Statistical Computing</td>
<td>3</td>
</tr>
<tr>
<td>PHST 675</td>
<td>Independent Study in Biostatistics</td>
<td>1-3</td>
</tr>
<tr>
<td>PHST 682</td>
<td>Multivariate Statistical Analysis</td>
<td>3</td>
</tr>
<tr>
<td>PHST 684</td>
<td>Categorical Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>PHPH 648</td>
<td>Data Management and Analysis for Epidemiology I</td>
<td>1</td>
</tr>
<tr>
<td>BIOC 547</td>
<td>Biochemistry II</td>
<td>3</td>
</tr>
<tr>
<td>BIOC 603</td>
<td>Special Topics in Biochemistry</td>
<td>1-4</td>
</tr>
</tbody>
</table>

### Thesis Option (Standard Curriculum)

The curriculum for the thesis option of the MS degree consists of additional thesis hours beyond the completion of the curriculum for the standard program. Students must declare in the thesis option at the completion of the spring semester of the first year for full-time students (the completion of at least 19 credit hours for part-time students). Only after completion of the required 30 credit hours of coursework in the standard program curriculum, students electing the thesis option enroll for a minimum of six (6) credit hours of thesis research (PHST 666) in the spring semester of the second year, and typically write and defend a thesis by the end of that semester.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHST 666</td>
<td>Master's Thesis Research¹</td>
<td>6</td>
</tr>
</tbody>
</table>

Students wishing to maintain full-time status may register for more than six (6) credit hours of thesis or additional coursework.

### Thesis

A student may apply to pursue preparation and defense of a master's thesis following completion of the required standard program coursework. Pursuing an optional thesis requires permission of the program director. The thesis topic is approved by the major professor and thesis committee, chaired by the major professor. The student identifies a desired mentor to become his or her major professor,
who is recommended by the program director and appointed by the academic dean. The major professor (or at least one when there are co-major professors) must be from the Department of Bioinformatics and Biostatistics. Following appointment, the major professor becomes the student’s faculty advisor. Procedures for the thesis are given below.

**Thesis Committee**

Working with the major professor, the student identifies at least two or more desired committee members. Including the major professor, at least two members of the committee must be faculty in the Department of Bioinformatics and Biostatistics and at least one member must be from outside the department. The committee members are then recommended by the program director and appointed by the academic dean.

**Thesis Preparation**

The thesis is prepared in format according to the guidelines (http://louisville.edu/graduate/current-students/thesis-dissertation-information) established by the Graduate School. It is the responsibility of each student to ensure that the readability and quality of writing in his/her thesis meets professional standards. Students are strongly encouraged to take advantage of the services offered by the University Writing Center (http://louisville.edu/writingcenter) when writing their theses. The services offered by the Writing Center are free to the student.

**Thesis Approval**

Final approval of the thesis is voted upon by the thesis committee after an oral defense of the thesis by the student. Students submit their theses to members of their committee two or more weeks prior to the date of the oral defense. Approval of the thesis is by majority vote of the committee after the oral defense.

Students are required by the Graduate School to provide two weeks’ notice when scheduling oral defenses (http://louisville.edu/graduate/current-students/thesis-dissertation-information). This requirement permits those wanting to attend the oral defense adequate time to make arrangements for attending. Students must follow the below procedure for scheduling oral defenses:

1. Identify a date and time for the oral defense in consultation with the thesis advisor and members of the committee.
2. Request a room reservation for the oral defense through the Department’s Administrative Assistant.
3. Notify the Department’s Administrative Assistant of the date, time, and location of the oral defense as well as the title of the thesis. The Department’s Administrative Assistant will circulate an announcement of the defense as well as notify the SPHIS Office of Student Services of the defense, who in turn notify Graduate School.
4. Distribute technically and grammatically error-free copies of the thesis to all committee members at least two weeks prior to the defense date.

There are no exceptions to these requirements and students will not be permitted by the Department to schedule defenses with less than two weeks’ notice. Students are expected to be aware of university deadlines for theses (http://louisville.edu/graduate/current-students/thesis-dissertation-information) and to ensure that the two weeks’ notice requirement is fulfilled within these university deadlines. Students are strongly encouraged to allow for even greater than two weeks’ notice to ensure that all deadlines and requirements are fulfilled.

**Thesis Submission**

The following steps must be taken to submit the final copy of the thesis electronically after oral defense and approval of the committee:

1. Final document must be converted to a PDF (following the guidelines as noted above) and sent to the Graduate School and the department’s administrative assistant.
2. Submit as advised by the Graduate School through the ThinkIR repository. The directions on submission will be provided upon review of the thesis by the Graduate School.
3. The signature page within the electronic version must have the names of the committee members typed under the signature line; the signatures cannot be scanned into the document.
4. Submit a signed signature page on white paper, with original signatures, to the Graduate School.

An electronic copy of the thesis must be provided to the Department’s Administrative Assistant.