BIOSTATISTICS (MS)

Master of Science in Biostatistics (BDSCMS)
Unit: School of Public Health and Information Sciences (https://louisville.edu/sphis/) (GH)
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 *(*https://louisville.edu/online/programs/masters/master-of-science-in-biostatistics/*).*

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/)
- 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.
  - 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 under Provisional Probation status and required to complete remedial coursework in calculus, offered by the Department in the University of Louisville's summer term. A minimum grade of B- 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 Provisional Probation status will be "discontinued" 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
  - Duolingo test score of 105 or higher
  - Demonstration of a degree awarded from an institution with instruction primarily in English, as formally documented by an appropriate institutional official

Application Deadline

- Fall semester – June 30 (all applicants).
- Spring semester – Applications are not accepted.
- Summer semester – April 1 (all applicants).
  - *Summer admission is only for student seeking provisional admission to the MS with the requirement to complete our Math Tools sequence in remedial calculus*.

Program Requirements

The MS program in biostatistics can be completed by 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/certificate-programs/certificate-in-biostatistics/).
- **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.

Academic Standing

To maintain good academic standing in the MS in Biostatistics program, students must maintain a cumulative GPA of 3.0 or higher for all coursework in the program. A student must be in good academic standing in order to receive the degree.

Any MS in Biostatistics student with a program cumulative GPA below 3.0 will be placed in probationary status. Any student who remains in probationary status for two consecutive terms may be considered for dismissal from the program.

Coursework Requirements

Code	Title	Hours
Core Coursework [1]		12
Concentration Coursework		18
Thesis (optional)		[6]
Minimum Total Hours		**30**

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. Students with a prior degree and/or coursework from a CEPH accredited school or program of public health may be relieved of this requirement, per approval of the Associate Dean for Academic Affairs.

Program Core

The following courses are required for all three tracks:

Year 1		
Fall		**Hours**
PHST 661	Probability	3
PHST 680	Biostatistical Methods I	3
PHPH 523	Public Health in the United States [1]	(3)
	Hours	**6**
Spring		
PHST 662	Mathematical Statistics	3
PHST 681	Biostatistical Methods II	3
	Hours	**6**
	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 three (3) 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 from a CEPH accredited school or program of public health 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

Year 1		
Fall		**Hours**
PHST 661	Probability	3
PHST 680	Biostatistical Methods I	3
PHST 624	Clinical Trials I: Planning and Design	2
PHPH 523	Public Health in the United States [1]	(3)
	Hours	**8**
Spring		
PHST 662	Mathematical Statistics	3
PHST 681	Biostatistical Methods II	3
PHST 684	Categorical Data Analysis	3

PHST 625	Clinical Trials II	2
	Hours	**11**
Year 2		
Fall		
PHST 683	Survival Analysis	3
PHST 620	Introduction to Statistical Computing	3
Various Electives [2]		5
	Hours	**11**
	Minimum Total Hours	**30**

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 three (3) 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 from a CEPH accredited school or program of public health 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

Code	Title	Hours
PHST 603	Biostatistics Public Health Practicum I	1-2
PHST 640	Statistical Methods for Research Design in Health Sciences	3
PHMS 641	Data Mining I	3
PHST 675	Independent Study in Biostatistics	1-3
PHST 682	Multivariate Statistical Analysis	3

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 Curriculum

Since the curriculum for the Bioinformatics concentration differs from the standard program at the beginning of the first semester of study, students electing the Bioinformatics concentration must declare this choice at or before enrollment.

Year 1		
Fall		**Hours**
PHST 661	Probability	3
PHST 680	Biostatistical Methods I	3
BIOC 545	Biochemistry I	3
PHPH 523	Public Health in the United States [1]	(3)
	Hours	**9**
Spring		
PHST 662	Mathematical Statistics	3
PHST 681	Biostatistical Methods II	3
Various electives [2]		3
	Hours	**9**
Year 2		
Fall		
PHST 710	Advanced Statistical Computing I	3
PHST 655	Basic Statistical Methods for Bioinformatics	3
PHMS 641	Data Mining I	3
Various electives [2]		3
	Hours	**12**
	Minimum Total Hours	**30**

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 three (3) 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 from a CEPH accredited school or program of public health may be relieved of this requirement, per approval of the Associate Dean for Academic Affairs.

2 Students must accumulate a minimum of six (6) credit hours of electives. These may be distributed among semesters as the student chooses. Electives are chosen with the approval of a faculty advisor. Students are encouraged to select electives from among the following courses:

Bioinformatics Concentration Electives

Code	Title	Hours
PHST 603	Biostatistics Public Health Practicum I	1-2
PHST 620	Introduction to Statistical Computing	3
PHST 675	Independent Study in Biostatistics	1-3
PHST 682	Multivariate Statistical Analysis	3
PHST 684	Categorical Data Analysis	3
BIOC 547	Advanced Biochemistry II	3
BIOC 603	Special Topics in Biochemistry	1-4

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 to enroll 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.

Year 2		
Spring		**Hours**
PHST 666	Master's Thesis Research [1]	6
	Hours	**6**
	Minimum Total Hours	**6**

1 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 additional 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 (digital/electronic signature page (http://louisville.edu/graduate/current-students/thesis-dissertation-information/ElectronicDissertationSignaturePage.pdf)or a hard copy 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.