

# STATISTICS/APPLIED STATISTICS (BS/MS)

The BS/MS (Accelerated Bachelor's-Master's) program in Applied Statistics is a five-year program that gives academically successful Loyola undergraduates the opportunity to pursue the MS degree in Applied Statistics while completing their BS degree. The applicant can be pursuing any of the BS degrees offered by the Department of Mathematics and Statistics. There are several advantages to enrolling in the BS/MS program.

- The MS program requirement to take the GRE is waived for students applying to the BS/MS program. The application fee to the program is also waived.
- Students can begin taking their Masters courses during their senior year of undergraduate study.
- The MS program in Applied Statistics requires 30 credits of graduate courses. This generally takes one and a half years to complete. Students in the BS/MS program are permitted to "double count" up to three of their Loyola 400-level STAT courses for both their BS and MS degrees; since this depends upon whether the BS is in Data Science, Mathematics or Statistics, speak with the Director for further details. Hence BS/MS students are required to take as few as 21 credits (instead of 30 credits) of additional 400-level courses in the fifth year, and can finish the program in five years.

## Further Information

If you have additional questions about the program, please contact Timothy O'Brien (<https://www.luc.edu/math/profiles/obrientimothy.shtml/>), Graduate Program Director for Applied Statistics.

## Related Programs

### Minor

- Statistics Minor (<https://catalog.luc.edu/undergraduate/arts-sciences/mathematics-statistics/statistics-minor/>)

### Combined

- Mathematics (BS/MS) (<https://catalog.luc.edu/undergraduate/accelerated-bachelors-masters-program/mathematics-bs-ms/>)
- Statistics/Mathematics (BS/MS) (<https://catalog.luc.edu/undergraduate/accelerated-bachelors-masters-program/statistics-bs-mathematics-ms/>)

## Curriculum

AP Credit Policies (<https://catalog.luc.edu/undergraduate/arts-sciences/mathematics-statistics/#policiestext>)

Code	Title	Hours
<b>BS Requirements</b>		
MATH 161	Calculus I	4
MATH 162	Calculus II	4
MATH 263	Multivariable Calculus	4
MATH 212	Linear Algebra	3
STAT 203	Introduction to Probability & Statistics	3
or STAT 335	Introduction to Biostatistics	
STAT 303	SAS Programming & Applied Statistics	3

STAT 304	Introduction to Probability	3
STAT 305	Introduction to Mathematical Statistics	3
STAT 307	Statistical Design & Analysis of Experiments (capstone)	3
STAT 308	Applied Regression Analysis	3

### Science Requirement

Select two of the following:		6
ANTH 101	Human Origins	
BIOL 101	General Biology I	
BIOL 102	General Biology II	
CHEM 160	Chemical Structure and Properties	
CHEM 180	Chemical Reactivity I	
ENVS 101	The Scientific Basis of Environmental Issues	
PHYS 121	College Physics I with Calculus Lecture/Discussion	
PHYS 122	College Physics II with Calculus Lecture/Discussion	

### Electives<sup>1</sup>

Select three of the following:		9
STAT 306	Intro to Stochastic Processes	
STAT 310	Categorical Data Analysis	
STAT 311	Applied Survival Analysis	
STAT 321	Computational Aspects of Modeling and Simulation	
STAT 336	Advanced Biostatistics	
STAT 337	Quantitative Methods in Bioinformatics	
STAT 338	Predictive Analytics	
STAT 351	Nonparametric Statistical Methods	
STAT 370	Data Science Consulting	
STAT 388	Topics	

### MS Requirements

STAT 401	Introduction to Applied Statistics Using R	1
STAT 403	SAS Program & Applied Statistics	3
STAT 404	Probability & Statistics I	3
STAT 405	Probability & Statistics II	3
STAT 407	Statistical Design	3
STAT 408	Applied Regression Analysis	3
STAT 495	Statistical Consulting Capstone	2
<b>Select Four (4) Elective Courses</b>		12

STAT 406	Stochastic Processes	
STAT 410	Categorical Data Analysis	
STAT 411	Applied Survival Analysis	
STAT 421	Math Modeling & Simulation	
STAT 426	Advanced Statistical Inference	
STAT 436	Topics in Biostatistics	
STAT 438	Introduction to Predictive Analytics	
STAT 444	Longitudinal Data Analysis and Mixed Modeling	
STAT 451	Applied Nonparametric Methods	
STAT 488	Topics in Statistics	
STAT 498	Independent Study Statistics	

<b>Total Hours</b>	<b>69</b>
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<sup>1</sup> These courses can be replaced with 400-level courses that can count toward both degrees.

The BS degree has waivers for both Quantitative and Scientific core.

Specializations

Our flexible program allows students to focus on their interests by choosing a specialization. Possibilities include:

Specialization	Description
Biostatistics	The Biostatistics specialization covers non- and pre-clinical statistical methods, bioassay, statistical genetics, clinical trials, and bioinformatics.
Environmental Statistics	The Environmental Statistics specialization addresses Geographic Information Systems (GIS), spatial statistics, and environmetrics.
General Applied Statistics	The specialization in General Applied Statistics includes non-medical applications such as actuarial, commercial, data-mining, industrial, marketing, and national defense.
Predictive Analytics/ Modeling	The Predictive Modeling specialization focuses on big data analytics and modeling.

Suggested Sequence of Courses

**Note:** This is only one possibility. Among other things, depending on initial math placement, which can range from MATH 100 to MATH 263, the schedule will look very different. Especially for students starting at MATH 161 or above, there is a lot of space to pursue a minor or even a second major.

Course	Title	Hours
<b>Year 1</b>		
<b>Fall</b>		
MATH 161	Calculus I	4
<b>Hours</b>		<b>4</b>
<b>Spring</b>		
MATH 162	Calculus II	4
STAT 203	Introduction to Probability & Statistics	3
<b>Hours</b>		<b>7</b>
<b>Year 2</b>		
<b>Fall</b>		
MATH 263	Multivariable Calculus	4
STAT 303	SAS Programming & Applied Statistics	3
Science Requirement		3
<b>Hours</b>		<b>10</b>
<b>Spring</b>		
MATH 212	Linear Algebra	3
STAT 308	Applied Regression Analysis	3
Science Requirement		3
<b>Hours</b>		<b>9</b>
<b>Year 3</b>		
<b>Fall</b>		
STAT 304	Introduction to Probability	3
<b>Hours</b>		<b>3</b>

<b>Spring</b>		
STAT 305	Introduction to Mathematical Statistics	3
300-level Major Elective		3
<b>Hours</b>		<b>6</b>
<b>Year 4</b>		
<b>Fall</b>		
STAT 307	Statistical Design & Analysis of Experiments	3
400-level Major Course		3
<b>Hours</b>		<b>6</b>
<b>Spring</b>		
400-level Major Course		3
400-level Major Course		
<b>Hours</b>		<b>3</b>
<b>Year 5</b>		
Students complete MS requirements in consultation with the Graduate Program Director.		21
<b>Hours</b>		<b>21</b>
<b>Total Hours</b>		<b>69</b>

Guidelines for Accelerated Bachelor’s/ Master’s Programs

- Terms
- Accelerated Bachelor’s/Master’s programs: In this type of program, students share limited credits between their undergraduate and graduate degrees to facilitate completion of both degrees.
  - Shared credits: Graduate level credit hours taken during the undergraduate program and then applied towards graduate program requirements will be referred to as shared credits.

**Admission Requirements**  
Accelerated Bachelor’s/Master’s programs are designed to enhance opportunities for advanced training for Loyola’s undergraduates. Admission to these programs must be competitive and will depend upon a positive review of credentials by the program’s admissions committee. Accordingly, the admission requirements for these programs may be higher than those required if the master’s degree were pursued entirely after the receipt of a bachelor’s degree. That is, programs may choose to have more stringent admissions requirements in addition to those minimal requirements below.

- Requirements:
- Declared appropriate undergraduate major,
  - By the time students begin taking graduate courses as an undergraduate, the student has completed approximately 90 credit hours, or the credit hours required in a program that is accredited by a specialty organization,<sup>1</sup>
  - A minimum cumulative GPA for coursework at Loyola that is at or above the program-specific requirements, a minimum major GPA that is at or above the program-specific requirements, and/or appropriate designated coursework for evaluation of student readiness in their discipline.<sup>2</sup>

Students not eligible for the Accelerated Bachelor’s/Master’s program (e.g., students who have not declared the appropriate undergraduate major) may apply to the master’s program through the regular admissions process. Students enrolled in an Accelerated Bachelor’s/Master’s

program who choose not to continue to the master's degree program upon completion of the bachelor's degree will face no consequences.<sup>3</sup>

Ideally, a student will apply for admission (or confirm interest in proceeding towards the graduate degree in opt-out programs) as they approach 90 credit hours. Programs are encouraged to begin advising students early in their major so that they are aware of the program and, if interested, can complete their bachelor's degree requirements in a way that facilitates completion of the program. Once admitted as an undergraduate, Program Directors should ensure that students are enrolled using the plan code associated with the Accelerated Bachelor's/Master's program. Using the plan code associated with the Accelerated Bachelor's/Master's program will ensure that students may be easily identified as they move through the program. Students will not officially matriculate into the master's degree program and be labeled as a graduate student by the university, with accompanying changes to tuition and Financial Aid (see below), until the undergraduate degree has been awarded. Once admitted to the graduate program, students must meet the academic standing requirements of their graduate program as they complete the program curriculum.

<sup>1</sup> Programs that have specialized accreditation will adhere to the admissions criteria provided by, or approved by, their specialized accreditors.

<sup>2</sup> The program will identify appropriate indicators of student readiness for graduate coursework (e.g., high-level performance in 300 level courses). Recognizing differences between how majors are designed, we do not specify a blanket requirement.

<sup>3</sup> If students choose not to enroll in the Accelerated Bachelor's/Master's program, they still must complete all of the standard requirements associated with the undergraduate degree (e.g., a capstone).

For more information on Admissions requirements, visit here (<https://gpem.luc.edu/portal/admission/?tab=home>).

## Curriculum

*Level and progression of courses.* The Accelerated Bachelor's/Master's programs are designed to be competitive and attractive to our most capable students. Students admitted to Accelerated Bachelor's/Master's programs should be capable of meeting graduate level learning outcomes. Following guidance from the Higher Learning Commission, only courses taken at the 400 level or higher (including 300/400 level courses taken at the 400 level) will count toward the graduate program.<sup>1,2</sup>

Up to 50% of the total graduate level credit hours, required in the graduate program, may come from 300/400 level courses where the student is enrolled in the 400 level of the course. Further, at least 50% of the credit hours for the graduate program must come from courses that are designed for and restricted to graduate students who have been admitted to a graduate program at Loyola (e.g., enrolled in plan code that indicates the Accelerated Bachelor's/Master's program, typically ending with the letter "D").<sup>3</sup>

In general, graduate level coursework should not be taken prior to admission into the Accelerated Bachelor's/Master's program. Exceptions may be granted for professional programs where curriculum for the Accelerated Bachelor's/Master's program is designed to begin earlier. On the recommendation of the program's Graduate Director, students may take one of their graduate level courses before they are admitted to the Accelerated Bachelors/Master's program if they have advanced abilities in their discipline and course offerings warrant such an exception.<sup>4</sup>

Undergraduate degree requirements outside of the major are in no way impacted by admission to an Accelerated Bachelor's/Master's program.<sup>5</sup>

*Shared credits.* Undergraduate courses (i.e., courses offered at the 300 level or below) cannot be counted as shared credits nor count towards the master's degree. Up to 50% of the total graduate level credit hours, required in the graduate program, may be counted in meeting both the undergraduate and graduate degree requirements. Of those shared credits, students in an Accelerated Bachelor's/Master's program should begin their graduate program with the standard introductory course(s) for the program whenever possible. So that students may progress through the Accelerated Bachelor's/Master's program in a timely manner, undergraduate programs are encouraged to design their curriculum such that a student can complete some required graduate credit hours while completing the undergraduate degree. For instance, some of the graduate curriculum should also satisfy electives for the undergraduate major.

The program's Graduate Director will designate credit hours to be shared through the advising form and master's degree conferral review process. Shared credit hours will not be marked on the undergraduate record as having a special status in the undergraduate program. They will be included in the student's undergraduate earned hours and GPA. Graduate credit hours taken during the undergraduate program will not be included in the graduate GPA calculation.

<sup>1</sup> If students wish to transfer credits from another university to Loyola University Chicago, the program's Graduate director will review the relevant syllabus(es) to determine whether it meets the criteria for a 400 level course or higher.

<sup>2</sup> Programs with specialized accreditation requirements that allow programs to offer graduate curriculum to undergraduate students will conform to those specialized accreditation requirements.

<sup>3</sup> In rare cases, the Graduate Director may authorize enrollment in a 400-level course for a highly qualified and highly motivated undergraduate, ensuring that the undergraduate's exceptional participation in the graduate class will not diminish in any way the experience of the graduate students regularly enrolled.

<sup>4</sup> For example, if a particular course is only offered once every 2-3 years, and a student has demonstrated the necessary ability to be successful, the Graduate Director may allow a student to take a graduate level course to be shared prior to the student being formally admitted to the graduate program. See, also, footnote 3.

<sup>5</sup> Students should not, for example, attempt to negotiate themselves out of a writing intensive requirement on the basis of admission to a graduate program.

## Graduation

Degrees are awarded sequentially. All details of undergraduate commencement are handled in the ordinary way as for all students in the School/College/Institute. Once in the graduate program, students abide by the graduation deadlines set forth by the graduate program. Students in these programs must be continuously enrolled from undergraduate to graduate degree program unless given explicit permission by their program for a gap year or approved leave of absence. In offering the option of an Accelerated Bachelor's/Master's program, the university is making possible the acceleration of a student's graduate degree completion. It should be understood that students may not request deferral of their matriculation into the Master's degree program. If students would like to delay their graduate studies after earning the undergraduate degree, they may apply for admission to the traditional master's degree program. Any application of graduate credit earned while

in the undergraduate program is subject to the policies of the graduate degree granting school.

## Learning Outcomes

- Upon completing the program, students majoring in statistics will be able to properly use statistical reasoning as it applies to inferential methods in a written analysis and/or oral presentation. [Statistics BS]
- Upon completing the program, students majoring in statistics will be able to create and interpret statistical models including understanding the limitations of the model in a written analysis and/or oral presentation. [Statistics BS]
- Upon completing the program, students majoring in statistics will be able to use statistical software to generate appropriate output for data analysis. [Statistics BS]
- Students are expected to have mastered the art and science of choosing and/or developing the appropriate statistical model(s) for a given dataset-situation, and have mastered the skill of interpreting the chosen model. [Applied Statistics MS]
- Students are expected to have received sufficient exposure to basic theorems and proofs used in introductory probability and statistical inference. [Applied Statistics MS]
- Students are expected to have worked with data from application fields such as public/global health, medical, industrial and environmental research. [Applied Statistics MS]
- Students are expected to have received training to ethically apply statistical training in the real world. [Applied Statistics MS]
- Students are expected to have obtained hands-on experience and assimilated course material via our 2cr Statistical Consulting capstone/practicum class. [Applied Statistics MS]
- Students are expected to have sufficiently mastered the course and practicum material to either obtain gainful employment in the field of attend a Ph.D. program [Applied Statistics MS]