Statistics, PhD

Learning Outcomes

Graduates will be able to:

- have a solid understanding of the mathematical and statistical theory that underlies statistical methods;
- conduct literature reviews to summarize the state of the art for specific theoretical and applied topics;
- formulate, implement, and assess appropriate statistical models for analyzing data;
- identify limitations of existing methods and independently develop and assess novel methods (e.g., for analyzing new types of data);
- appreciate the issues of uncertainty, reproducibility, and computability in data analysis;
- collaborate with non-statisticians to help collect and analyze data; and
- acquire effective communication skills for disseminating statistical findings.

Requirements

The Doctor of Philosophy program in statistics requires a minimum of 76 s.h. of graduate credit, including work completed for the MS.

The Graduate College requires a minimum grade-point average (GPA) of 3.00 to graduate with a PhD; however, the Department of Statistics and Actuarial Science requires a higher GPA of at least 3.40 to earn the PhD in statistics. This includes all courses used to meet degree requirements plus additional courses that are relevant to a student's program.

PhD students complete required coursework, including four courses in one of four concentration areas: actuarial science/financial mathematics, biostatistics, data science, or probability/mathematical statistics (see the section titled "Concentration Areas" for area descriptions and course lists). They may take coursework or seminars in other departments to relate an area of specialization to other fields of knowledge, to acquire the ability to use electronic digital computing equipment, or to learn non-English language skills necessary for reading scientific journals and communicating with scholars in other languages.

PhD Qualifying Procedure

Students enter the PhD program in one of two tracks.

Statistics

After passing the MS final examination, a student who will choose either biostatistics, probability/mathematical statistics, or data science as the selected concentration area can request, by notifying the director of graduate studies, to go through the PhD qualifying procedure. Upon this request, the faculty evaluates the student's body of work, which includes the MS final examination in statistics, coursework, and evidence for research potential. Usually, students need to achieve an A in at least one course numbered 7000 or above, complete at least 1 s.h. of STAT:6990 Readings in Statistics, be enrolled in a second semester of STAT:6990, and identify a faculty member who agrees to serve as the student's PhD advisor to be admitted. This evaluation and assessment results in one of three decisions: the student is officially admitted into the PhD program; the student must reapply to go through the PhD qualifying procedure after accumulating a larger body of work for evaluation; or the student is not admitted into the PhD program.

In exceptional cases, a student may petition to go through the PhD qualifying procedure early, or be admitted to the PhD program directly. However, passing the MS final exam is required before any student can take the PhD comprehensive exam (see the "Final Exam").

Actuarial Science

After successfully passing the MS final examination in actuarial science (in exceptional cases, a student may petition to go through the PhD qualifying procedure early), a student who will choose actuarial science/financial mathematics as the selected concentration area, can request, by notifying the director of graduate studies, to go through the PhD qualifying procedure. Upon this request, the faculty evaluate the student's body of work and assess the student's potential for research. The body of work will include the MS final examination in actuarial science, professional examinations passed, and coursework. This evaluation and assessment results in one of two decisions: the student is officially admitted into the PhD program in the actuarial science/financial mathematics concentration area, or the student is not admitted into the PhD program.

Students complete the program by passing the PhD final (comprehensive) examination and writing and defending a dissertation. Students usually complete the program three years after earning the MS.

A plan of study that does not conform to the requirements described as follows but is of high quality may be approved by the director of graduate studies.

The PhD with a major in statistics requires the following coursework.

Required Coursework

Actuarial Science/Financial Mathematics Concentration Area

Actuarial science/financial mathematics emphasizes the theory of actuarial science, finance, and risk management. It is excellent preparation for academic positions in universities that offer actuarial science programs and for positions in the insurance, pension, and financial industries.

Course #	Title	Hours
One of these sequences:		
STAT:4100-STAT:4101	Mathematical Statistics I-II (same as IGPI:4100-IGPI:4101)	6
STAT:5100-STAT:5101	Statistical Inference I-II (for well-prepared students)	6
All of these from the MS in actuarial science program:		
ACTS:4130	Quantitative Methods for Actuaries	3
ACTS:4180	Life Contingencies I	3
ACTS:4280	Life Contingencies II	3
STAT:6300	Probability and Stochastic Processes I	3
All of these:		
STAT:5120	Mathematical Methods for Statistics	3

STAT:7100	Advanced Inference I	3
STAT:7200	Linear Models	4
STAT:7300	Advanced Probability	3
STAT:7400/ DATA:7400/ IGPI:7400	Computer Intensive Statistics	3
STAT:7990	Reading Research	19
DATA:7350	High-Dimensional Probability for Data Science	3
Seminars chosen from STAT:7190, STAT:7290, and STAT:7390		2
At least four of these, with at least one numbered 7000 or above:		
STAT:4560	Statistics for Risk Modeling I	3
STAT:4561	Statistics for Risk Modeling II	3
STAT:6301	Probability and Stochastic Processes II	3
STAT:7560	Time Series Analysis	3
ACTS:6200/ DATA:6200/ STAT:6200	Predictive Analytics	3
ACTS:7730	Advanced Topics in Actuarial Science/Financial Mathematics	3
FIN:7110	Finance Theory I	3
FIN:7130	Finance Theory II	3

Biostatistics Concentration Area

Biostatistics emphasizes exposure to various biostatistical methods, such as survival analysis, categorical data analysis, and longitudinal data analysis. It prepares students for consulting and other positions in industry.

Course #	Title	Hours
All of these from the MS in statistics program:		
STAT:5090	ALPHA Seminar	1
STAT:5100	Statistical Inference I	3
STAT:5101	Statistical Inference II	3
STAT:5200/ IGPI:5199	Applied Statistics I	4
STAT:5201	Applied Statistics II	3
STAT:5400/ DATA:5400/ IGPI:5400	Computing in Statistics	3
STAT:6220/ DATA:6220	Consulting and Communication with Data	3
STAT:6300	Probability and Stochastic Processes I	3
STAT:6990	Readings in Statistics (two consecutive enrollments)	2
All of these:		
STAT:5120	Mathematical Methods for Statistics	3
STAT:7100	Advanced Inference I	3
STAT:7101	Advanced Inference II	3
STAT:7200	Linear Models	4
STAT:7300	Advanced Probability	3
STAT:7400/ DATA:7400/ IGPI:7400	Computer Intensive Statistics	3
STAT:7990	Reading Research	18
Seminars chosen from STAT:7190, STAT:7290, and STAT:7390		2
At least four of these, with at least one numbered 7000 or above:		
STAT:6530/ IGPI:6530	Environmental and Spatial Statistics	3
STAT:7510/ BIOS:7410	Analysis of Categorical Data	3
STAT:7570/ BIOS:7210/ IGPI:7210	Survival Data Analysis	3
BIOS:6650/ EPID:6655/ IGPI:6650	Causal Inference	3
BIOS:6720	Statistical Machine Learning for Biomedical and Public Health Data	3
BIOS:7240	High-Dimensional Data Analysis	3
BIOS:7310/ IGPI:7310	Longitudinal Data Analysis	3
DATA:7350	High-Dimensional Probability for Data Science	3

Data Science Concentration Area

The data science track emphasizes the theory, methodology, and application of techniques for working with and learning from data. This concentration area prepares students to develop new methods for visualizing and modeling data, managing reproducible data analysis workflows, and collaborating with scientists and other data stakeholders. It is excellent preparation for students interested in academic, industrial, or government positions that involve data visualization, modeling, and analysis.

Course #	Title	Hours
All of these from the MS in statistics program:		
STAT:5090	ALPHA Seminar	1
STAT:5100	Statistical Inference I	3
STAT:5101	Statistical Inference II	3
STAT:5200/ IGPI:5199	Applied Statistics I	4
STAT:5201	Applied Statistics II	3
STAT:5400/ DATA:5400/ IGPI:5400	Computing in Statistics	3
STAT:6220/ DATA:6220	Consulting and Communication with Data	3
STAT:6300	Probability and Stochastic Processes I	3
STAT:6990	Readings in Statistics (two consecutive enrollments)	2
All of these:		
STAT:4540/ BAIS:4540/ DATA:4540/ IGPI:4540	Statistical Learning	3
STAT:4580/ DATA:4580/ IGPI:4580	Data Visualization and Data Technologies	3
STAT:5120	Mathematical Methods for Statistics	3
STAT:7100	Advanced Inference I	3

STAT:7200	Linear Models	4
STAT:7400/ DATA:7400/ IGPI:7400	Computer Intensive Statistics	3
STAT:7500/ BAIS:7500	Statistical Machine Learning	3
STAT:7990	Reading Research	18
DATA:7350	High-Dimensional Probability for Data Science	3
Seminars chosen from STAT:7190, STAT:7290, and STAT:7390		2
At least two of these, with at least one numbered 7000 or above:		
STAT:4750/ DATA:4750	Probabilistic Statistical Learning	3
STAT:6200/ ACTS:6200/ DATA:6200	Predictive Analytics	3
STAT:6530/ IGPI:6530	Environmental and Spatial Statistics	3
STAT:6560	Applied Time Series Analysis	3
STAT:6970	Topics in Statistics	3
STAT:7101	Advanced Inference II	3
STAT:7300	Advanced Probability	3
STAT:7510/ BIOS:7410	Analysis of Categorical Data	3
STAT:7520	Bayesian Analysis	3
STAT:7560	Time Series Analysis	3

Probability/Mathematical Statistics Concentration Area

Probability/mathematical statistics emphasizes a broad, solid foundation in techniques and underpinnings of mathematical statistics. Its focus on breadth and depth is intended to produce well-rounded, knowledgeable scholars. It is excellent preparation for academic positions in mathematical statistics and industrial or government positions that require broadly trained statisticians with a strong understanding of statistical theory.

Course #	Title	Hours
All of these from the MS in statistics program:		
STAT:5090	ALPHA Seminar	1
STAT:5100	Statistical Inference I	3
STAT:5101	Statistical Inference II	3
STAT:5200/ IGPI:5199	Applied Statistics I	4
STAT:5201	Applied Statistics II	3
STAT:5400/ DATA:5400/ IGPI:5400	Computing in Statistics	3
STAT:6220/ DATA:6220	Consulting and Communication with Data	3
STAT:6300	Probability and Stochastic Processes I	3
STAT:6990	Readings in Statistics (two consecutive enrollments)	2
All of these:		
STAT:5120	Mathematical Methods for Statistics	3
STAT:7100	Advanced Inference I	3
STAT:7101	Advanced Inference II	3
STAT:7200	Linear Models	4
STAT:7300	Advanced Probability	3
STAT:7400/ DATA:7400/ IGPI:7400	Computer Intensive Statistics	3
STAT:7990	Reading Research	18
Seminars chosen from STAT:7190, STAT:7290, and STAT:7390		2
At least four of these, with at least one numbered 7000 or above:		
STAT:6301	Probability and Stochastic Processes II	3
STAT:7500/ BAIS:7500	Statistical Machine Learning	3
STAT:7520	Bayesian Analysis	3
STAT:7560	Time Series Analysis	3
BIOS:6650/ EPID:6655/ IGPI:6650	Causal Inference	3
BIOS:7240	High-Dimensional Data Analysis	3
DATA:7350	High-Dimensional Probability for Data Science	3

Committee

After admission to the PhD program and before taking the PhD comprehensive exam, the candidate chooses a committee of at least four members, which is approved by the advisor. At least three of the faculty members must be University of Iowa tenure-track faculty members. At least two of the faculty members must be from the major department (defined as faculty members who hold any appointment in the major department), and University of Iowa tenure-track faculty members.

The department may request the Graduate College dean's permission to replace one of the four committee members with a recognized scholar of professorial rank from another academic institution.

PhD Comprehensive Exam (Prospectus)

After passing the MS final exam and within 12–18 months (12 months is ideal, 18 months is acceptable) of admittance to the PhD program, the candidate should present a written and oral prospectus to the committee, which serves as the PhD comprehensive exam. The prospectus describes the problems the student is considering for the thesis, an extensive review of relevant background materials, open problems of interest and ideas for solving problems, and any preliminary results. Failure to successfully complete the prospectus within 18 months of admittance to the PhD program will jeopardize the continuation of a student's financial support.

Each PhD committee member will sign the examination report as satisfactory, reservations, or unsatisfactory. A vote of "Reservations" should only be used when a faculty member feels that the deficiencies displayed by the student were modes and can be readily rectified. In the event of a report with two or more votes of "Reservations," the committee's requirements of the student to correct the deficiencies must be recorded and submitted to the Graduate College with the examination report form. The statement must specify the

time allotted for completion of the aforementioned actions. For example, if additional coursework is required, a list of suitable courses must be presented. If the candidate must rewrite their research prospectus, the deficient areas must be identified. If the candidate satisfies the required actions within the specified period of time, the comprehensive examination will be recorded as "Satisfactory" as of that date. If the actions are not satisfied on time, or if the actions are not of sufficient quality, the comprehensive examination will be recorded as "Unsatisfactory" as of that date. The candidate will not be admitted to the PhD final examination of the dissertation until a grade of "Satisfactory" has been recorded for the comprehensive exam.

In the case of a report of unsatisfactory on a comprehensive examination, the committee may grant the candidate permission to attempt a reexamination no sooner than four months after the first examination. The examination may be repeated only once, at the option of the department.

PhD Final Exam (Dissertation Defense)

Students should plan to defend their dissertation within 24–30 months (24 months is ideal, 30 months is acceptable) of passing the PhD comprehensive exam. Failure to successfully defend the dissertation within 30 months of passing the PhD comprehensive exam or within 5 years of starting the graduate program at the University of Iowa, whichever comes first, will jeopardize the continuation of a student's financial support.

Admission

Applicants must meet the admission requirements of the Graduate College; see the Manual of Rules and Regulations on the Graduate College website.

Financial Support

Funds are available to help support outstanding PhD applicants. Fellowships, teaching assistantships, and research assistantships provide an attractive stipend plus tuition at the resident rate and tuition scholarships for students who are appointed at least one-quarter time. In most cases, full tuition waivers are granted.

Students who wish to be considered for financial assistance for their third year in the program should request to go through the PhD qualifying process no later than the spring semester of their second year.

Career Advancement

Statistics and probability are vital to many fields, so the demand for well-trained statisticians is strong. Statisticians work in medicine, engineering, law, public policy making, marketing, manufacturing, engineering, agriculture, varied social and natural sciences, and numerous other areas.

The program prepares students for careers in research, applications, and teaching. To learn more about job opportunities, see ASA JobWeb on the American Statistical Association website.

The Pomerantz Career Center offers multiple resources to help students find internships and jobs.

Academic Plans

Sample Plan of Study

Sample plans represent one way to complete a program of study. Actual course selection and sequence will vary and should be discussed with an academic advisor. For additional sample plans, see MyUI.

Statistics, PhD

Data Science Concentration

Course	Title	Hours
Academic Career		
Any Semester		
76 s.h. must be graduate level coursework; graduate transfer credits allowed upon approval. More information is included in the General Catalog and on department website. [a]		
	Hours	**0**
First Year		
Fall		
STAT:5090	ALPHA Seminar	1
STAT:5100	Statistical Inference I	3
STAT:5200	Applied Statistics I	4
STAT:5400	Computing in Statistics	3
	Hours	**11**
Spring		
STAT:5101	Statistical Inference II	3
STAT:5120	Mathematical Methods for Statistics	3
STAT:5201	Applied Statistics II	3
	Hours	**9**
Second Year		
Fall		
Written Exam [b]		
Creative Component [c, d]		
STAT:6300	Probability and Stochastic Processes I	3
STAT:6990	Readings in Statistics [e]	1
STAT:7100	Advanced Inference I	3
STAT:7200	Linear Models	4
	Hours	**11**
Spring		
Present Creative Component [f]		
STAT:4580	Data Visualization and Data Technologies	3
STAT:6220	Consulting and Communication with Data	3
STAT:6990	Readings in Statistics [e]	1
STAT:7400	Computer Intensive Statistics	3
	Hours	**10**
Third Year		
Any Semester		
Identify dissertation advisor, dissertation topic, and dissertation committee		
	Hours	**0**
Fall		
Exam: Doctoral Comprehensive Exam [g]		

DATA:4540	Statistical Learning	3
STAT:7990	Reading Research [h]	4
Concentration Area course [i]		3
	Hours	**10**
Spring		
DATA:7350	High-Dimensional Probability for Data Science	3
STAT:7290 or STAT:7390 or STAT:7190	Seminar: Applied Statistics or Seminar: Probability or Seminar: Mathematical Statistics	2
STAT:7500	Statistical Machine Learning	3
STAT:7990	Reading Research [h]	2
	Hours	**10**
Fourth Year		
Fall		
STAT:7990	Reading Research [h]	3
Concentration Area course [i]		3
	Hours	**6**
Spring		
Prospectus Defense [j]		
STAT:7990	Reading Research [h]	3
	Hours	**3**
Fifth Year		
Fall		
STAT:7990	Reading Research [h]	3
	Hours	**3**
Spring		
STAT:7990	Reading Research [h]	3
Exam: Doctoral Final Exam [k]		
	Hours	**3**
	Total Hours	**76**

a Students must complete specific requirements in the University of Iowa Graduate College after program admission. Refer to the Graduate College website and the Manual of Rules and Regulations for more information.

b Written two-part exam to fulfill the master's final exam requirement; taken prior to start of second year fall semester classes.

c Satisfactorily complete the creative component requirement draft by the end of the semester.

d Students must complete a creative component that is related to their application and career interests. It entails writing an 8-15 page report on a suitable topic, under an advisor's supervision with two consecutive 1 s.h. enrollments in STAT:6990, normally during the fall and spring semesters of the second year.

e Two consecutive enrollments are required.

f The creative component requirement must be completed and presented by mid-spring; the paper is then presented orally in a public seminar.

g Typically completed at the beginning of the third year, the comprehensive examination consists of both written and oral components in two of the following four areas: statistical inference, linear models, probability, and statistical computing. See the General Catalog and the department website for specifics.

h Students must complete at least 18 s.h. of Reading Research credit.

i Students must complete a minimum of two courses (6 s.h.) with at least one numbered 7000 or above; see the General Catalog for list of approved courses. Work with faculty advisor to determine appropriate coursework and sequence.

j Within 18 months of passing the comprehensive exam, students typically present a written and oral prospectus to their PhD committee. See the General Catalog and department website for specifics.

k Dissertation defense.