Statistics

Programs

- Data Science, B.S. *major*
- Statistics, B.S. *major*

Data Science, B.S. *major*

Data science is an interdisciplinary field of scientific methods, processes, algorithms and systems that use data to draw conclusions and make predictions. The data science major provides a strong foundation in statistics and computer science, along with courses in applied areas of study. Students will learn the statistical, computational, and programing tools necessary to prepare them for employment in many applied fields that rely on data. In addition to the overall graduation requirements, the B.S. Data Science major requires each student complete 58 credits in the major with an overall minimum GPA of 2.25. All prerequisite and required courses must be completed with grades of C- or above. This major offers courses in statistics, mathematics, computer science and applied areas.

A total of 120 semester credits are needed for the **Data Science** B.S. degree and include the following:

- 40 upper division credits (level 3000/4000)
- 58 required major core credits
- Completion of Core Curriculum credits (Minnesota Transfer Curriculum [MnTC] Goal Areas 1-10) - required for all baccalaureate degrees
- Completion of BSU Focus and Nisidotaading Course Requirements

Dual Degrees
Students wishing to complete two degrees concurrently, (example: Bachelor of Science and Bachelor of Arts) must complete a minimum of an additional 30 credits above the required 120 credits.

Multiple Credentials
Any additional major, minor or certificate in a degree must have at least 6 credits of course work not used to meet the requirements of another major, minor or certificate in the degree.

Required Credits: 58
Required GPA: 2.25

I REQUIRED MATH COURSES

Complete the following courses:

- MATH 2471 Calculus I (5 credits)
- MATH 2472 Calculus II (5 credits)
- MATH 3310 Linear Algebra (4 credits)

II REQUIRED STATISTICS COURSES

Complete the following courses:

- STAT 2610 Applied Statistics (4 credits)
- STAT 3610 Time Series Analysis (3 credits)
- STAT 3620 Applied Regression Analysis (3 credits)
- STAT 3631 Probability and Statistics I (4 credits)
- STAT 4000 Capstone in Statistics (3 credits)

III REQUIRED COMPUTER SCIENCE COURSES

Complete the following courses:

- CS 2321 Computer Science I (4 credits)
- CS 2322 Computer Science II (4 credits)
- CS 2750 Introduction to Data Analysis (3 credits)
- CS 3507 Introduction to Databases (3 credits)
- CS 3528 Data Structures and Algorithms (4 credits)
- CS 3752 Data Mining (3 credits)

IV OTHER REQUIRED COURSES

Select two of the following courses:

- TADT 3880 Quality Assurance (3 credits)
- TADT 4899 Design of Experiments (3 credits)
- BUAD 3232 Predictive Analytics (3 credits)
- BUAD 4385 Data Modeling and Visualization (3 credits)
- ENVR 3800 Sustainability Analytics & Modeling (3 credits)
- GEOG 3231 Introduction to Geographic Information Systems (3 credits)
- GEOG 4150 Applications of Machine Learning (3 credits)
- GEOG 4265 Spatial Analysis (3 credits)
- SOC 3001 Quantitative Research Methods in the Social Sciences (3 credits)

Program Learning Outcomes | Data Science, B.S.

1. Knowledge: Students will understand the content and methods of the core areas of undergraduate statistics.

2. Analysis: Students will use data and data visualization to identify, interpret and analyze problems, find patterns in data and make conjectures.

3. Application: Students will apply appropriate statistics and computer science procedures and technology to solve problems.

4. Articulate how biases, both unintended and intended, in data collection techniques, mining algorithms, and analyses can skew the information derived from the data and the effect this can have on diverse groups

5. Communication: Students will communicate results effectively and accurately, both verbally, in writing, and through data visualization.

6. Career Readiness: Students will be prepared for a variety of careers in industry and further study in data science.

Suggested Semester Schedule | Data Science, B.S.

The following is a list of required Data Science Major, B.S. courses by year. This schedule is intended to help students plan their courses in an orderly fashion; however, these are only suggestions and this schedule is flexible.

Freshman

- MATH 1470 Precalculus (3 credits) (if needed)
- MATH 2471 Calculus I (5 credits)
- STAT 2610 Applied Statistics (4 credits)
- CS 2321 Computer Science I (4 credits)
- CS 2322 Computer Science II (4 credits)
- Core Curriculum requirements

Sophomore

- MATH 2472 Calculus II (5 credits)
- MATH 3310 Linear Algebra (4 credits)
- STAT 3610 Time Series Analysis (3 credits)
  or STAT 3620 Applied Regression Analysis (3 credits)
  or STAT 3631 Probability and Statistics I (4 credits)
- CS 2750 Introduction to Data Analysis (3 credits)
- Courses in the Field of Emphasis (consult with advisor)
- Core Curriculum requirements

Junior/Senior

- STAT 3610 Time Series Analysis (3 credits)
  or STAT 3620 Applied Regression Analysis (3 credits)
  or STAT 3631 Probability and Statistics I (4 credits)
- CS 3507 Introduction to Databases (3 credits)
- CS 3528 Data Structures and Algorithms (4 credits)
- CS 3752 Data Mining (3 credits)
- Courses in the Field of Emphasis (consult with advisor)
- STAT 4000 Capstone in Statistics (3 credits)
- Complete Core Curriculum requirements

Statistics, B.S. *major*

This program in statistics is designed to provide a basic applied and theoretical background in statistics including descriptive and inferential statistics. Students will become proficient in statistical applications using statistical software. Coursework in statistics is useful for anyone as a tool in another area of study such as environmental studies, sociology, biology, psychology, and economics, or as preparation for more advanced study of statistics. The major provides a background in statistics, mathematics, and computer science to enable students to pursue a variety of careers. The program also prepares students for graduate work in statistics and related fields. In addition to the overall graduation requirements, the B.S. Statistics major requires each student complete 52 credits in the major with an overall minimum GPA of 2.25. This major offers courses in statistics, mathematics, computer science and applied areas.

A total of 120 semester credits are needed for the **Statistics B.S.** degree and includes the following:

- 40 upper division credits (level 3000/4000)
- 52 required major core credits
- Completion of Core Curriculum credits (Minnesota Transfer Curriculum [MnTC] Goal Areas 1-10) - required for all baccalaureate degrees
- Completion of BSU Focus and Nisidotaading Course Requirements

Dual Degrees
Students wishing to complete two degrees concurrently, (example: Bachelor of Science and Bachelor of Arts) must complete a minimum of an additional 30 credits above the required 120 credits.

Multiple Credentials
Any additional major, minor or certificate in a degree must have at least 6 credits of course work not used to meet the requirements of another major, minor or certificate in the degree.

Required Credits: 52
Required GPA: 2.25

I REQUIRED COURSES

Complete the following courses:

- CS 2321 Computer Science I (4 credits)
- CS 2322 Computer Science II (4 credits)
- CS 3507 Introduction to Databases (3 credits)
- MATH 2471 Calculus I (5 credits)
- MATH 2472 Calculus II (5 credits)
- MATH 2480 Multivariable Calculus (4 credits)
- MATH 3310 Linear Algebra (4 credits)
- STAT 2610 Applied Statistics (4 credits)
- STAT 3620 Applied Regression Analysis (3 credits)
- STAT 3631 Probability and Statistics I (4 credits)
- STAT 3632 Probability and Statistics II (3 credits)
- STAT 4000 Capstone in Statistics (3 credits)

II ELECTIVES

Select two of the following courses:

- BUAD 3232 Predictive Analytics (3 credits)
- GEOG 3231 Introduction to Geographic Information Systems (3 credits)
- GEOG 4265 Spatial Analysis (3 credits)
- MATH 3710 Mathematical Modeling (3 credits)
- PHYS 3300 Thermal and Statistical Physics (3 credits)
- SOC 3001 Quantitative Research Methods in the Social Sciences (3 credits)
- STAT 3610 Time Series Analysis (3 credits)
- TADT 3880 Quality Assurance (3 credits)
- TADT 4899 Design of Experiments (3 credits)

Program Learning Outcomes | Statistics, B.S.

1. Knowledge: Students will understand the content and methods of the core areas of undergraduate statistics.

2. Analysis: Students will identify, interpret and analyze problems, discern structure and pattern and make conjectures.

3. Application: Students will apply appropriate statistical procedures and technology to solve problems.

4. Communication: Students will communicate statistical ideas and understanding effectively both verbally and in writing.

5. Career Readiness: Students will be prepared for a variety of careers in industry and further study in statistics.

6. Articulate how biases, both unintended and intended, in data collection techniques, mining algorithms, and analyses can skew the information derived from the data and the effect this can have on diverse groups.

Suggested Semester Schedule | Statistics, B.S.

The following is a list of required Statistics Major, B.S. courses by year. This schedule is intended to help students plan their courses in an orderly fashion; however, these are only suggestions and this schedule is flexible.

Freshman

- MATH 1470 Precalculus (3 credits)
- MATH 2471 Calculus I (5 credits)
- STAT 2610 Applied Statistics (4 credits)
- Core Curriculum requirements

Sophomore

- MATH 2472 Calculus II (5 credits)
- MATH 2480 Multivariable Calculus (4 credits)
- MATH 3310 Linear Algebra (4 credits)
- STAT 3620 Applied Regression Analysis (3 credits) or STAT 3631 Probability and Statistics I (4 credits)
- Courses in the Field of Emphasis (consult with advisor)
- Core Curriculum requirements

Junior/Senior

- STAT 3632 Probability and Statistics II (3 credits)
- Courses in the Field of Emphasis (consult with advisor)
- STAT 4000 Capstone in Statistics (3 credits)
- Complete Core Curriculum requirements

Computer Science Courses

CS 1310 Computational Problem Solving & Society (3 credits)
Introduction to general problem-solving techniques applicable to solving problems in computing, including elementary computational problems. Other techniques include using systematic lists, using diagrams, and looking for patterns. Includes fundamental computational concepts in information representation, computer organization, and social and ethical issues in computing. Occasional use of the computer lab allows the use of software to solve a variety of problems. The prospective student should have a general understanding of computers and their operation. Prerequisite(s): Successful completion of MATH 0800 with a grade of B or better, or three years of high school mathematics (including two years of algebra) and a score on the Mathematics Placement Test appropriate for placement into MATH 1170. [Core Curriculum Goal Area(s) 4 & 9]

CS 2270 Introduction to Web Programming (3 credits)
This course expands on basic knowledge of markup languages and web programming languages. Students learn how to use current web markup languages, aspects of various transfer protocols, and client-side scripting languages. All of these topics support the development of both web pages and web sites. Prerequisite: CS 1309.

CS 2321 Computer Science I (4 credits)
Introduction to the basic principles of software development using a modern high-level language, including using selection, looping, function calls, and recursion, along with simple data structures such as arrays and objects, to solve problems. Includes an introduction to software engineering techniques such as interactive debugging, software testing, and methods of software validation. Includes a two-hour lab. Prerequisite(s): MATH 1170 or higher.

CS 2322 Computer Science II (4 credits)
Topics include recursion and the study of object-oriented concepts including encapsulation, inheritance and polymorphism. It includes the study of fundamental data structures including strings, lists, stacks, queues, containers classes, binary trees, and hash tables. Also includes a group-oriented software design and implementation project. Includes a two-hour lab. Prerequisite: CS 2321.

CS 2750 Introduction to Data Analysis (3 credits)
This course provides an introduction to the basic concepts of data analysis and machine learning models, methods, and techniques pioneered within the fields of Artificial Intelligence and Statistical Modeling. Topics covered can include any/all of the following: statistics for data analysis, knowledge representation, data clustering, categorization and regression methods, decision trees, perceptions, and neural networks. Some student facility with mathematics and Excel is assumed. Prerequisite(s): CS 1309, or Instructor permission.

CS 2810 Computer Organization and Assembly Language Programming (3 credits)
An introduction to the register level architecture of a modern computer and programming with an assembly language for that processor. Includes a two-hour lab. Prerequisite or Corequisite: CS 2322.

CS 3270 Web Programming (4 credits)
This course expands on basic knowledge of markup languages and web programming languages. Students learn how to use current web markup languages, aspects of various transfer protocols, and client-side scripting languages. All of these topics support the development of both web pages and web sites. Students also learn server-side scripting, database connectivity, and dynamic web-page updating. Web development frameworks are also studied.

CS 3350 Event-Driven Programming in a Windows Environment (3 credits)
Uses a language suitable for creating event-driven programs while focusing on methodology suitable for developing event handlers in windows-oriented programs. Prerequisite: CS 2322 or equivalent.

CS 3360 Object-Oriented Software Development (3 credits)
Techniques used in object-oriented software development. Key components of these techniques include design patterns, abstraction, encapsulation, modularity, message passing, polymorphism, inheritance, and incremental software development. Students translate a design into software using an object-oriented programming language. Additional topics may include applets, markup languages, multi-threaded programming, and rudimentary network programming. Prerequisite: CS 2322 or equivalent. May not be offered every year.

CS 3370 Mobile Application Development (3 credits)
A study of development techniques to address issues that arise in the development of interactive applications for mobile devices using a popular mobile application development platforms such as the iPhone and Android SDKs. Examines the specific requirements for mobile systems. Emphasizes how the requirements in mobile application development link to other core areas in computing. May not be offered every year. Prerequisites: CS 2321 or CS 3270.

CS 3380 Game Development (3 credits)
An overview of how to develop interactive games. Essential aspects of interactive fiction, sprites, animation, audio, graphics, physics, threading, scripting, and event handling in the context of game development. Students develop a game in a group. Prerequisite: CS 2322. Might not be offered every year.

CS 3507 Introduction to Databases (3 credits)
Provides an introduction to the theory and use of modern database systems, with particular focus on SQL, the relational data model, and relational database design. Prerequisite: CS 2322. May not be offered every year.

CS 3528 Data Structures and Algorithms (4 credits)
This course presents a study of advanced abstract information storage structures, including priority queues, binary trees, generalized trees, and graphs. Particular emphasis will be placed on algorithm development techniques, including divide and conquer, greedy algorithms, and dynamic programming. Prerequisite(s): CS 2322 or consent of the instructor.

CS 3560 Data Communications and Networks (3 credits)
Principles of data communications as applied to modern computer networks. Prerequisite: CS 2810. May not be offered every year.

CS 3752 Data Mining (3 credits)
This course will provide an investigation into common Data Mining models, methods and techniques pioneered within the field of Artificial Intelligence. Topics covered may include any/all of the following: knowledge representation, clustering schema, decision trees and neural networks. Some student facility with mathematics and basic statistics is assumed. Prerequisities: CS 3528. May not be offered every year.

CS 3931 Experimental Course (3 credits)
A course proposed for inclusion in the University curriculum. May not be offered more than two times as an experimental course.

CS 4298 Compiler Construction (3 credits)
The theory, design, and construction of a compiler. Prerequisite(s): CS 2810 and CS 3528. May not be offered every year.

CS 4360 Software Engineering (3 credits)
Software Engineering (SE) provides students with a capstone experience that integrates the theory and practice of SE. SE investigates a variety of SE models and guidelines used in industry, culminating in the design, specification and implementation of a software project of real-world import. Includes a two-hour lab. Prerequisites: CS 2810 and CS 3528.

CS 4390 Social, Ethical, and Professional Issues in Computing (3 credits)
Features strategies for analyzing the social, ethical, and professional implications of issues and decisions that computing professionals might encounter. Those strategies are practiced and refined in a variety of areas of concern for computing. Prerequisite(s): At least one CS course numbered 3000 or higher.

CS 4410 Digital Image Processing (3 credits)
This course covers techniques for image acquisition, transformation, enhancement, restoration, compression, segmentation and recognition. A brief introduction to advanced topics such as motion detection, optical flow, etc., is also included. Prerequisite(s): CS2322 and either Math 1470 or MATH 2471

CS 4627 Theory of Computation (3 credits)
Explores the theoretic roots and limits of computing. Prerequisites: CS 2322 and MATH 2210.

CS 4840 Operating Systems (3 credits)
Fundamentals of operating system design with emphasis on at least one modern operating system. Topics include scheduling, memory management, paging, file management, and mutual exclusion. Required work will include programming investigations. Prerequisites: CS 2322 and CS 2810.

CS 4910 Directed Independent Study (3 credits)
Arranged individual study.

CS 4917 DIS Tchg Assoc | (1-2 credits)
Directed Independent Study | Teaching Associate

CS 4970 Internship (3 credits)
Graded Satisfactory/Unsatisfactory only. Student internships may be either full-time or part-time in a public or private agency appropriate to the degree objective. Internships consist of closely supervised periods of service that are arranged in advance of the course registration. Students should consult their advisor concerning prerequisites.

All-University Courses

The course numbers listed below, not always included in the semester class schedule, may be registered for by consent of the advisor, instructor, or department chair, or may be assigned by the department when warranted. Individual registration requires previous arrangement by the student and the completion of any required form or planning outline as well as any prerequisites.

1910, 2910, 3910, 4910 DIRECTED INDEPENDENT STUDY
1920, 2920, 3920, 4920 DIRECTED GROUP STUDY
1930, 2930, 3930, 4930 EXPERIMENTAL COURSE
1940, 2940, 3940, 4940 IN-SERVICE COURSE
1950, 2950, 3950, 4950 WORKSHOP, INSTITUTE, TOUR

1960, 2960, 3960, 4960 SPECIAL PURPOSE INSTRUCTION
1970, 2970, 3970, 4970 INTERNSHIP
1980, 2980, 3980, 4980 RESEARCH
1990, 2990, 3990, 4990 THESIS

Statistics Courses

STAT 1000 Companion to Statistical Reasoning (1 credit)
An optional companion course designed to support students concurrently enrolled in STAT 1100, this course will provide support for Statistical Reasoning, including supplementary instruction and just-in-time review of prerequisite concepts. Topics, which will parallel those in STAT 1100, include shape, center and spread of distributions; sampling methods; representing data; and basic probability. This course is intended strictly as support for STAT 1100 and does not fulfill a college goal area requirement.

STAT 1100 Statistical Reasoning (3 credits)
A non-theoretical course designed to improve a student's statistical literacy. Topics include: describing distributions; introduction to sampling and study design; creating and interpreting data representations; introduction to probability; statistical issues in the news; interpreting statistical inferences. [Core Curriculum Goal Area 4.]

STAT 2610 Applied Statistics (4 credits)
A nontheoretical introduction to statistics with an emphasis on applications in a variety of disciplines. Topics include measures of central tendency, position and dispersion; basic probability; hypothesis testing; estimation; analysis of variance; linear correlation and regression; nonparametric statistics. Prerequisite: Three years of high school mathematics (including two years of algebra) and an appropriate score on the Mathematics Placement Test, or completion of MATH 1170 or higher, or completion of STAT 1100. [Core Curriculum Goal Area 4]

STAT 3610 Time Series Analysis (3 credits)
Linear time models, seasonal models, stationary models, moving average, autoregressive and ARIMA models, model identification, confidence intervals and testing, forecasting and error analysis. Prerequisites: (MATH 2472 and STAT 2610) or STAT 3631. (Might not be offered every year.)

STAT 3620 Applied Regression Analysis (3 credits)
This is a first course in regression analysis with an emphasis on applications. Topics covered include simple and multiple linear regression, hypothesis testing, analysis of residuals, polynomial regression, variable selection and model building, and general linear models. Students will use statistical software. Prerequisite(s): MATH 3310 and STAT 2610 or consent of instructor

STAT 3631 Probability and Statistics I (4 credits)
Probability of finite sample spaces, discrete and continuous probability distributions, exploratory data analysis, statistical models. Prerequisites: MATH 2472.

STAT 3632 Probability and Statistics II (3 credits)
Multivariable distributions, sampling distribution theory, estimation, hypothesis testing, regression and correlation. Prerequisites: MATH 2480 and STAT 3631. (Might not be offered every year.)

STAT 3660 Statistics for the Health Sciences (3 credits)
Introduction to descriptive and inferential statistics in the context of the health sciences. Covers data types, methods for summarizing and displaying data, measures of central tendency and variability, hypothesis testing including the analysis of variance and nonparametric techniques, correlation and regression. Students learn to use the statistical software package SPSS for data analysis. Prerequisite: MATH 1170 or consent of instructor.

STAT 4000 Capstone in Statistics (3 credits)
Students design and complete a data science project in conjunction with the course professor. The project requires the student¿s accumulated academic experience to solve a challenging problem. The project will focus on real data sets and students will be expected to effectively use oral & written communication, research skills, teamwork, and planning. Prerequisite(s): Senior status with an expected graduation date in the year the course is taken. Prerequisite(s): Senior Status

STAT 4917 DIS Tchg Assoc | (1-2 credits)
Directed Independent Study | Teaching Associate

All-University Courses

The course numbers listed below, not always included in the semester class schedule, may be registered for by consent of the advisor, instructor, or department chair, or may be assigned by the department when warranted. Individual registration requires previous arrangement by the student and the completion of any required form or planning outline as well as any prerequisites.

1910, 2910, 3910, 4910 DIRECTED INDEPENDENT STUDY
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1960, 2960, 3960, 4960 SPECIAL PURPOSE INSTRUCTION
1970, 2970, 3970, 4970 INTERNSHIP
1980, 2980, 3980, 4980 RESEARCH
1990, 2990, 3990, 4990 THESIS