APPLIED STATISTICS

The rapid rise of data and technology requires a new set of skills, trained in our Applied Statistics major, which leads to a Bachelor of the Arts or a Bachelor of Science degree.

Statistics is the science of learning from data. It includes planning the collection of data, managing data, analyzing, interpreting, and drawing conclusions from data, and identifying problems, solutions, and opportunities based on statistical analysis. Massive amounts of data are collected from digital applications and mobile devices in addition to traditional sources in engineering, life sciences, social sciences, the environment, financial markets, healthcare, and retail. The volume, variety, and velocity of this data pose unique opportunities and challenges.

Data analysis requires a new set of skills, offered by the Applied Statistics major. The Applied Statistics major builds critical thinking and problem-solving skills into data analysis and empirical research. Our major prepares students for careers in business, industry, and government. Our major also prepares students for advanced degree programs in statistics and quantitative fields.

Dearborn Discovery Core (General Education)

All students must satisfy the University's Dearborn Discovery Core requirements (http://catalog.umd.umich.edu/undergraduate/gen_ed_ddc/), in addition to the requirements for the major.
Students must also complete all CASL Degree Requirements. (http://catalog.umd.umich.edu/undergraduate/college-arts-sciences-letters/)

Prerequisites to the Major

Students majoring in Applied Statistics must take the following Prerequisites. Some of these can be completed while also completing Major requirements.

Code	Title	Credit Hours
MATH 115	Calculus I [1]	4
MATH 116	Calculus II	4
MATH 227	Introduction to Linear Algebra	3
STAT 305	Introduction to Data Science for All [2]	3
Total Credit Hours		**14**

1. Students should take Math 115 instead of Math 113. However, students who previously took Math 113 before deciding to do the Applied Statistics major may count Math 113 in place of 115. Please be aware that such students may not be adequately prepared for the next requirement MATH 116. Please see a STAT faculty advisor to discuss.
2. It is recommended that STAT 305 be taken within the first year of the program.

Major Requirements

26 credit hours at the 300+ level are required for the Mathematics Core, the Applied Statistics Core, and the Statistics Electives. In addition, 6-8 credit hours of Cognates are required.

Code	Title	Credit Hours
Mathematics Core		
6 credits required:		6
MATH 325	Probability	
MATH 425	Statistical Inference	
Applied Statistics Core		
14 credits required:		14
STAT 325	Applied Statistics I	
or STAT 301	Biostatistics I	
STAT 327	Statistical Computing	
STAT 430	Applied Regression Analysis	
STAT 431	Machine Learning and Computational Statistics	
Electives in Statistics		
Select any two upper level STAT courses excluding STAT 305, STAT 455, and the above Applied Statistics Core.		6
Cognates		
Select two courses from the following:		6-8
DS 350	Quantitative Model and Anly II	
ECON 4015	Introduction to Econometrics	
IMSE 4675	Six Sigma & Stat Proc Improv	
MATH 300	Math Lang Proof & Struct	
MATH 413	Linear Algebra	
MATH 420	Stochastic Processes	
MATH 451	Advanced Calculus I	
MATH 472	Introduction to Numerical Analysis	
MATH 473	Matrix Computation	
MATH 492	Introduction to Topology	
Other courses by Petition. See the Applied Statistics Program Advisor.		
Total Credit Hours		**32-34**

Notes:

1. At least 13 of the 26 upper level credit hours in Statistics (STAT) must be elected at UM-Dearborn
2. Students cannot receive credit for both STAT 301 and STAT 325. It is recommended that students complete STAT 325.
3. STAT 305 and STAT 455 do not count toward the upper level electives. Statistics major students should NOT take Stat 455.
4. Students wishing to use graduate level courses (STAT 500+) as part of the 26 credit hours required for the major must submit a Petition to obtain the approval of the Applied Statistics Program Advisor.

Minor or Integrative Studies Concentration Requirements

A minor or concentration consists of 12 credit hours of upper-level courses (300 or above level) in Applied Statistics (STAT). Only one of STAT 301 or STAT 325 can be used to satisfy this requirement. STAT 455 does not count for this minor. Students with majors in the natural sciences, the social sciences, pre-med, or mathematics may find the Applied Statistics Minor to be a valuable supplement to their major.

- A minimum GPA of 2.0 is required for the minor/concentration. The GPA is based on all coursework required within the minor (excluding prerequisites).

- The use of transfer credit, field placements, internships, seminars, S/E graded courses, and independent study/research courses is limited to 3 credits in a 12 credit hour minor/concentration and 6 credits in a 15 credit hour and above minor/concentration.
- Courses within a minor/concentration cannot be taken as Pass/Fail (P/F)
- Minors requiring 12 credits may share one course with a major. Minors requiring 15 credits or more may share two courses with a major. This does not apply to concentrations for the Integrative Studies major.

Learning Goals

1. Understand the fundamentals of probability theory
2. Understand statistical and inferential reasoning
3. Become proficient at statistical computing
4. Understand the fundamentals of statistical modeling and understand its limitations
5. Become skilled in the description, interpretation and exploratory analysis of data by graphical and other means
6. Learn how to effectively communicate statistics

STAT 263 Introduction to Statistics 3 Credit Hours
This algebra-based introduction to statistics is designed to provide students from various majors with a foundational understanding of statistical concepts and techniques. The course uses practical application of statistical methods to real-world scenarios across different disciplines. Key topics include data visualization, descriptive statistics, sampling, elementary probability, statistical inference, and simple linear regression. This course uses technology, such as statistical software, to analyze data and draw meaningful conclusions. Students will develop the skills to critically evaluate data-driven studies, make informed decisions, and apply statistical methods in their academic, professional, and everyday life. This course does not count for the Statistics minor nor the Statistics major. Students who have already taken Calculus I should not take this course, instead they should take STAT 301 or STAT 325, both of which use R and count for the Statistics minor and major. (F, W, S).

STAT 301 Biostatistics I 4 Credit Hours
This course focuses on statistical techniques and applications for biological and life sciences, as well as the relevant mathematical aspects of these statistical techniques. Topics include samples and populations, quantitative vs. categorical data, clinical vs. epidemiological studies, comparative displays and analysis, probability, Bayes' Theorem, point estimation, confidence intervals, hypothesis tests, ANOVA, and linear regression. Study design is emphasized: clinical trials in experimental settings, case-control, cohort studies in epidemiological settings, and review of some case studies from the literature. This course includes learning statistical software in labs with a biological focus. Students will be expected to write short lab reports. Students can receive credit for only one of STAT 301 and STAT 325. (F, W, S).
Prerequisite(s): MATH 113 or MATH 115

STAT 305 Introduction to Data Science for All 3 Credit Hours
With the growing availability of data, companies, governments, and nonprofits alike are striving to convert this data into insightful knowledge. This course will provide students with the fundamental skills in the statistical software called R needed to handle such data. The course will focus on three broad areas: computation, inferential thinking, and real-world applications. We will also discuss data collection, data cleaning, and exploratory data analysis. Students will connect data to underlying phenomena and think critically about the conclusions of data analyses. Students will also learn how to write short programs that automate data analysis processes. Students will gain an applied understanding of various analytical methods, including data visualization, linear regression, and classification or clustering. Most of the material will be taught using real-world data. (F, W).

STAT 325 Applied Statistics I 4 Credit Hours
This course studies the principles and applications of statistics. Topics include descriptive statistics, random variables, probability distributions, sampling distributions, the central limit theorem, confidence intervals, hypothesis testing for means and variances, and the use of normal, chi-square, F, and t distributions in statistical problems. Other topics are selected from regression and correlation, the design of experiments, and analysis of variance. A minimum grade of C- is required in the prerequisite. Students can receive credit for only one of STAT 301 and STAT 325. (F).
Prerequisite(s): MATH 113 or MATH 115

STAT 327 Statistical Computing 3 Credit Hours
This course focuses on computational techniques that are crucial for statistics applications. Using the statistical packages R and SAS, the course teaches students about importing and storing data, manipulating and visualizing data, debugging and re-sampling, as well as simulation methods including bootstrap and Monte Carlo methods. A minimum grade of C- is required in the prerequisite course(s). (YR).
Prerequisite(s): STAT 325 or (STAT 301 and STAT 305)

STAT 330 Introduction to Survey Sampling 3 Credit Hours
An introduction to survey sampling techniques assuming only a limited knowledge of higher-level mathematics. Topics include: simple and stratified random sampling, estimation, systematic sampling, simple and two stage cluster sampling, and population size estimation. (F, AY).
Prerequisite(s): STAT 301 or STAT 325 or MATH 425 or IMSE 317 or ME 364

STAT 390 Topics in Applied Statistics 3 Credit Hours
A course designed to offer selected topics in applied statistics. The specific topic or topics will be announced together with the prerequisites when offered. Course may be repeated for credit when specific topics differ. (OC)
Restriction(s):
Can enroll if Level is Undergraduate

STAT 430 Applied Regression Analysis 3 Credit Hours
Topics include single variable linear regression, multiple linear regression and polynomial regression. Model checking techniques based on the analysis of residuals will be emphasized. Remedies to model inadequacies, such as transformations, will also be covered along with basic time series analysis and forecasting using moving averages and autoregressive models with prediction errors. Statistical packages will be used. A minimum grade of C- is required in the prerequisite course(s). Students are encouraged to take MATH 227 before STAT 430. Students cannot receive credit for both STAT 430 and STAT 530. (F, W).
Prerequisite(s): STAT 325 or MATH 325 or IMSE 317 or ME 364 or (STAT 301 and STAT 305)

STAT 431 Machine Learning and Computational Statistics 4 Credit Hours
Computational models trained with high dimensional data are increasingly important in industry and many academic disciplines. We will cover a wide range of topics in machine learning and statistical programming that enhance learning from data. Topics include an introduction to statistical learning, a review of simple and multiple linear regression, logistic regression, classification with linear and quadratic discriminant analysis and naïve Bayes, variable selection, shrinkage methods, dimension reduction methods, decision trees, deep learning (neural networks), and clustering methods. Students cannot receive credit for both STAT 431 and STAT 531. (W).
Prerequisite(s): STAT 325 or MATH 325 or IMSE 317 or ME 364 or (STAT 301 and STAT 305)

STAT 440 Design and Analysis of Experiments 3 Credit Hours
An introduction to the basic methods of designed experimentation. Fixed and random effects models together with the analysis of variance techniques will be developed. Specialized designs including randomized blocks, latin squares, nested, full, and fractional factorials will be studied. The statistical computer package R will be used. In addition to the course prerequisite, students are strongly encouraged to complete STAT 305 prior to enrolling in STAT 440 for a more comprehensive understanding. Students cannot receive credit for both STAT 440 and STAT 540. (W, AY).
Prerequisite(s): STAT 301 or STAT 325 or MATH 425 or IMSE 317

STAT 455 Environmental Statistics 3 Credit Hours
The primary objective of the course is to teach students majoring in the environmental and biological sciences how to make data-driven decisions with statistics. This course aims to nurture the importance of statistical methods to enhance the understanding of issues related to environmental sciences. A one-semester course cannot be exhaustive in depth and width of literature but the aim of this course is to create interest and encourage students to delve more into the subject. This course does not count for the Statistics minor nor the Statistics major. Students who have already taken Calculus I should not take this course, instead they should take STAT 301 or STAT 325, both of which use R and count for the Statistics minor and major. Students cannot receive credit for both STAT 455 and STAT 555. (AY).
Restriction(s):
Can enroll if Level is Undergraduate

STAT 460 Time Series Analysis 3 Credit Hours
An introduction to time series, including trend effects and seasonality, while assuming only a limited knowledge of higher-level mathematics. Topics include: linear Gaussian processes, stationarity, autocovariance, and autocorrelation; autoregressive (AR), moving average (MA), and mixed (ARMA) models for stationary processes; likelihood in a simple case such as AR(1); ARIMA processes, differencing, seasonal ARIMA as models for non-stationary processes; the role of sample autocorrelation, partial autocorrelation, and correlograms in model choice; inference for model parameters; forecasting: dynamic linear models and the Kalman filter. Students cannot receive credit for both STAT 460 and STAT 560. (F, AY).
Prerequisite(s): STAT 430

STAT 490 Topics in Applied Statistics 3 Credit Hours

*An asterisk denotes that a course may be taken concurrently.

Frequency of Offering

The following abbreviations are used to denote the frequency of offering: (F) fall term; (W) winter term; (S) summer term; (F, W) fall and winter terms; (YR) once a year; (AY) alternating years; (OC) offered occasionally