The Department of Statistical Sciences and Operations Research offers programs leading to a Bachelor of Science in Mathematical Sciences, a Master of Science in Mathematical Sciences with a concentration in either operations research or statistics and a Doctor of Philosophy in Systems Modeling and Analysis. The curriculum of the programs is run jointly with the Department of Mathematics and Applied Mathematics (http://bulletin.vcu.edu/undergraduate/college-humanities-sciences/departmentofmathematicsandappliedmathematics/).

The department also offers a post-baccalaureate undergraduate certificate in statistics.

- Mathematical Sciences, Bachelor of Science (B.S.) with a concentration in operations research (http://bulletin.vcu.edu/undergraduate/college-humanities-sciences/statistical-sciences-operations-research/mathematical-sciences-bs-concentration-operations-research/)
- Mathematical Sciences, Bachelor of Science (B.S.) with a concentration in statistics (http://bulletin.vcu.edu/undergraduate/college-humanities-sciences/statistical-sciences-operations-research/mathematical-sciences-bs-concentration-statistics/)
- Statistics, minor in (http://bulletin.vcu.edu/undergraduate/college-humanities-sciences/statistical-sciences-operations-research/statistics-minor/)
- Statistics, Certificate in (Post-baccalaureate undergraduate certificate) (http://bulletin.vcu.edu/undergraduate/college-humanities-sciences/statistical-sciences-operations-research/statistics-certificate/)
- Operations research (OPER) (p. 1)
- Statistical sciences and operations research (SSOR) (p. 1)
- Statistics (STAT) (p. 2)

Operations research

OPER 327. Mathematical Modeling. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: MATH 200.
Fundamental concepts of mathematical modeling. Topics may include differential equation models, optimization models and probabilistic models. Practical problems will be discussed throughout.

OPER 391. Topics in Operations Research. 1-3 Hours.
Semester course; 1-3 lecture hours. 1-3 credits. May be repeated with different topics for a maximum of 6 credits. A study of selected topics in operations research. See the Schedule of Classes for specific topics to be offered each semester and prerequisites. Because of the changing subject matter to be treated in this course, enrollment requires permission of the instructor.

OPER 427. Deterministic Operations Research. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: CMSC 245 or CMSC 255, MATH 310 and OPER 327. Introduction to topics in optimization including linear programming, network models and integer programming. Focuses on constructing sound models and on solving them using appropriate software. Algorithms and model properties are also discussed. Students may not receive degree credit for both OPER 427 and OPER 527.

OPER 428. Stochastic Operations Research. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: CMSC 245 or CMSC 255, MATH 310 and STAT 309. Introduction to topics in discrete-event and Monte Carlo simulation including the application of probabilistic models in real-world situations, random number generation, random variate generation and Monte Carlo integration. Students may not receive degree credit for both OPER 428 and OPER 528.

Statistical sciences and operations research

SSOR 490. Developing Professional Skills in Operations Research and Statistics. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: UNIV 200 or HONR 200; either OPER 427 and OPER 428, or STAT 321 and either STAT 305 or STAT 314. Capstone course designed to help students apply analysis techniques and attain proficiency in professional and academic communication in the context of statistics and operations research. Focuses on the discipline-specific skills necessary to excel in careers or graduate studies in these disciplines.

SSOR 492. Independent Study. 2-4 Hours.
Semester course; variable hours. 2-4 credits. Maximum 4 credits per semester; maximum total of 6 credits. Generally open only to students of junior or senior standing who have acquired at least 12 credits in the departmental discipline. Determination of the amount of credit and permission of instructor and department chair must be procured prior to registration in the course. The student must submit a proposal for investigating some area or problem not contained in the regular curriculum. The results of the student’s study will be presented in a report.

SSOR 493. Internship. 3 Hours.
Semester course; the equivalent of at least 15 work hours per week for a 15-week semester. 3 credits. Enrollment restricted to mathematical sciences/statistics and mathematical sciences/operations research majors only with junior or senior standing. Admission by permission from the department chair. Through placement in a position in business, industry, government or the university, the student will serve as an intern in order to obtain a broader knowledge of statistics or operations research techniques and their applications.

SSOR 495. Expositions in Statistical Sciences and Operations Research. 1 Hour.
Semester course; 1 lecture hour. 1 credit. Prerequisite: SSOR 490. Capstone course designed to help students obtain proficiency in professional writing and presentation skills. The students will present, both orally and in writing, the findings from their capstone projects.

SSOR 690. Research and Communications Seminar. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Enrollment restricted to students with nine graduate credits in OPER and/or STAT courses and with permission of the instructor. Designed to help students attain proficiency in professional and academic communication and research in the context of statistics and operations research. The course focuses on the discipline-specific communication and research skills necessary to excel in careers or graduate studies in these disciplines.
Statistics

STAT 206. Data Analysis and Statistics for Elementary Education. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Enrollment is restricted to students majoring in liberal studies for early and elementary education who have received a passing score on the PRAXIS I exam. Understanding probability, describing data both graphically and numerically, regression/correlation, common distributions and interpretation, item analysis for tests, interpreting test scores and educational studies, experimental design and limitations, comparing results using t-tests. This course relies heavily on using a graphing calculator as a data-analysis tool. Students may receive credit toward graduation for only one of STAT 206, STAT 208, STAT 210, STAT 212, STAT 312 or SCMA 301.

STAT 208. Statistical Thinking. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: satisfactory score on the VCU Mathematics Placement Test within the one-year period immediately preceding the beginning of the course, or a minimum grade of C in MATH 131, MATH 141, MATH 151, MATH 200 or MATH 201. An exploration of the use of statistics in the world around us through in-depth case studies. Emphasis is on understanding statistical studies, charts, tables and graphs frequently seen in various media sources. Some lectures involve activities centered on case studies. Students may receive credit toward graduation for only one of STAT 206, STAT 208, STAT 210, STAT 212, STAT 312 or SCMA 301.

STAT 210. Basic Practice of Statistics. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: satisfactory score on the VCU Mathematics Placement Test within the one-year period immediately preceding the beginning of the course, or a minimum grade of C in MATH 131, MATH 141, MATH 151, MATH 200 or MATH 201. An exception to this policy is made in the case where the stated alternative prerequisite course has been completed at VCU. Designed for students who will likely take another quantitative reasoning course for which statistics may be a prerequisite. Not open to mathematical sciences or computer science majors. Topics include examining distributions, examining relationships, producing data, sampling distributions and probability, introduction to inference. Students may receive credit toward graduation for only one of STAT 206, STAT 208, STAT 210, STAT 212, STAT 312 or SCMA 301.

STAT 212. Concepts of Statistics. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: satisfactory score on the VCU Mathematics Placement Test within the one-year period immediately preceding the beginning of the course, or MATH 151, MATH 200 or MATH 201. Introductory statistics course with an emphasis on descriptive statistics, correlation and regression, probability, normal distributions, t distributions, and statistical inference. Graphing calculators will be used extensively. A core course for mathematical sciences. Students may receive credit toward graduation for only one of STAT 206, STAT 208, STAT 210, STAT 212, STAT 312 or SCMA 301.

STAT 291. Topics in Statistics. 1-3 Hours.
Semester course; 1-3 lecture hours. 1-3 credits. A study of selected topics in statistics. Specific topics may fulfill general education requirements. See the Schedule of Classes for specific topics and prerequisites.

STAT 305. Intermediate Statistics. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: MATH 200 and STAT 212, or their equivalents. A study of intermediate-level statistical inference procedures, including categorical data analysis, analysis of variance, multiple regression and nonparametric procedures. Students may receive credit toward graduation for only one of STAT 305 or STAT 314.

STAT 309. Introduction to Probability Theory. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: MATH 307 and either MATH 211 or MATH 300. A study of the mathematical theory of probability, including finite and infinite sample spaces, random variables, discrete and continuous distributions, mathematical expectation, functions of random variables and sampling distributions.

STAT 310. Introduction to Statistical Inference. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 212 and STAT 309, or permission of instructor. Framework for statistical inference. Point and interval estimation of population parameters. Hypothesis testing concepts, power functions, Neyman-Pearson lemma and likelihood ratio tests. Elementary decision theory concepts.

STAT 314. Applications of Statistics. 4 Hours.
Semester course; 4 lecture hours. 4 credits. Prerequisite: STAT 210 or 212. A study of the concepts and application of statistical methods including: estimation and hypothesis testing for two sample problems; one factor analysis of variance and multiple comparisons; randomized block designs and analysis; inferences on categorical data, including chi-square test for independence for contingency tables; simple linear regression and correlation; multiple linear regression. Special topics include distribution-free (nonparametric) methods in various statistical problems, two factor analysis of variance and the use of a statistical software package for data analysis. Students may receive credit toward graduation for only one of STAT 305 or STAT 314.

STAT 321. Introduction to Statistical Computing. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 212 and MATH 200 or their equivalents. The application of computers and computing software to statistical concepts using R, SAS and other quantitative software. Topics include data storage and retrieval, data modification and file handling, standard statistical analyses, graphical representations, practical presentation of results.

STAT 391. Topics in Statistics. 1-3 Hours.
Semester course; 1-3 lecture hours. 1-3 credits. Prerequisite: because of the changing subject matter to be treated in this course, permission of the instructor is required. A study of selected topics in statistics. See the Schedule of Classes for specific topics to be offered each semester and prerequisites.

STAT 403. Introduction to Stochastic Processes. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: MATH 307 and STAT 309. Introduction to the theory of stochastic processes and their applications. In-depth studies of random variables, conditional probability and conditional expectation. Topics include Markov chains, random walks, Poisson processes, birth and death processes and applications to classical problems (e.g., gambler’s ruin, physics, etc.).

STAT 415. Statistical Consulting. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 305 and STAT 321, or their equivalents. An introduction to the techniques of statistical consulting. Topics include applying statistical concepts to real-world scenarios, dealing with messy data and communicating results.

Semester course; 3 lecture hours. 3 credits. Prerequisites: MATH 310 and either STAT 305 or STAT 314, or their equivalents. Completion of STAT 321 is strongly recommended. Introduction to object-oriented programming in the R environment for use with statistical analyses. Topics include basic algorithms in R and applications involving random number generation, parametric and non-parametric data analysis and inference, linear models, simulation, and advanced data manipulation.
STAT 422. Structured Problem Solving Using Statistics. 3 Hours.  
Semester course; 3 lecture hours. 3 credits. Prerequisite: STAT 314, 
PSYC 214 or SCMA 302, or permission of instructor. Focuses on using 
analytic frameworks and applying statistics to solve problems in a real-
world environment. Topics include discussion of analytical frameworks, 
problem restatement, divergent/convergent thinking, causal flow 
diagramming, the matrix method, decision tree analysis, review of 
sampling, confidence intervals, regression, ANOVA, chi squared tests, as 
well as applications of these concepts to solve case studies.

STAT 423. Nonparametric Statistics. 3 Hours.  
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 305 and 
STAT 321. Introduction to statistical estimation and inference methods 
that require relatively mild assumptions about the underlying population 
distribution. Topics include classical nonparametric hypothesis testing 
methods, permutation tests, bootstrap methods and density estimation.

STAT 425. Multivariate Statistics. 3 Hours.  
Semester course; 3 lecture hours. 3 credits. Prerequisites: MATH 307, 
MATH 310, STAT 309, and either STAT 305 or STAT 314. Completion 
of STAT 421 is strongly recommended. Introduction to multivariate 
statistical analysis methods. Topics include multivariate probability 
distributions and their properties, conditional and marginal distributions, 
multivariate normal distribution, Hotelling's T2 distribution, multivariate 
analysis of variance, repeated measures, multivariate regression, principle 
component analysis, exploratory factor analysis, linear discriminant 
analysis, cluster analysis, and regression trees. Students will use modern 
statistical software to perform these analyses.

STAT 435. Industrial Statistics. 3 Hours.  
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 309; and 
STAT 305 or STAT 314. Introduction to statistical methods for quality 
control and process improvement. Topics include special versus common 
causes of variation, statistical thinking in industrial settings, Shewhart 
control charts, capability analysis, components of variation, design 
of experiments and response surface methods. Incorporates use of 
statistical software.

STAT 441. Applied Statistics for Engineers and Scientists. 3 Hours.  
Semester course; 3 lecture hours. 3 credits. Prerequisite: MATH 201 or 
equivalent. An introduction to applied statistics intended primarily for 
students in engineering. The fundamental ideas about the collection 
and display of information, descriptive statistics and exploratory data 
analysis, elementary probability theory, frequency distributions, and 
sampling are covered. Other topics include tests of hypotheses and 
confidence intervals for one and two sample problems; ANOVA; principles 
of one-factor experimental designs including randomized complete block 
designs, fixed and random effects and multiple comparisons; correlation 
and linear regression analysis; control charts; contingency tables and 
goodness-of-fit. Statistical software is used extensively in this course, so 
a working knowledge of computers is necessary. Students may receive 
degree credit for only one of BIOS 543, STAT 441, STAT 541, STAT 543 or 
STAT 641.

STAT 443. Regression. 3 Hours.  
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 305 
and STAT 321, or permission of instructor. Completion of MATH 310 
is strongly recommended. Introduction to the concepts and methods 
of linear regression, logistic regression, and other nonlinear regression 
models. Topics include model development and assumptions, estimation 
of model parameters, statistical inferences about the regression 
model, selection of an appropriate model, and diagnostics regarding 
multicollinearity and influence points. Applications involve the use of a 
statistical software package.