

Applied Mathematics (BS): Mathematical Foundations of Data Science Concentration

The Bachelor of Science in Applied Mathematics provides a strong foundation in mathematical theory, problem-solving, modeling, and computational methods, preparing students for careers in fields like engineering, finance, biomathematics, and data science. The program emphasizes practical applications and offers flexibility through "Applied Electives," allowing students to tailor their studies to interests in areas such as computer science, economics, physics, or operations research. Many students complement their degree with minors or second majors in related fields to enhance their career opportunities.

For more information about this program visit our website (<https://math.sciences.ncsu.edu/undergraduate/undergraduate-programs/applied-mathematics/>).

Department of Mathematics

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Plan Requirements

Code	Title	Hours
Orientation (verify requirement) ¹		0
COS 100	Science of Change	0
or E 115	Introduction to Computing Environments	
Communication and Advanced Writing		
ENG 101	Academic Writing and Research	4
Select one of the following Communications courses (Verify Requirement): ¹		0
COM 110	Public Speaking	
COM 112	Interpersonal Communication	
COM 211	Argumentation and Advocacy	
COM 292	Language, Communication, and Culture	
Select one of the following Advanced Writing courses:		3
ENG 331	Communication for Engineering and Technology	
ENG 332	Communication for Business and Management	
ENG 333	Communication for Science and Research	
ENG 425	Analysis of Scientific and Technical Writing	
Basic Mathematics		
MA 141	Calculus I ¹	4
MA 241	Calculus II ²	4
MA 242	Calculus III ⁵	4

MA 225	Foundations of Advanced Mathematics ⁵	3
MA 341	Applied Differential Equations I ⁵	3
Basic Science ³		
Courses must be taken from two different disciplines		8
CH 101 & CH 102	Chemistry - A Molecular Science and General Chemistry Laboratory	
CH 103 & CH 104	General Chemistry I for Students in Chemical Sciences and General Chemistry Laboratory I for Students in Chemical Sciences	
PY 205 & PY 206	Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory	
PY 201	University Physics I	
BIO 181	Introductory Biology: Ecology, Evolution, and Biodiversity	
BIO 183	Introductory Biology: Cellular and Molecular Biology	
Additional GEP Natural Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-natural-sciences/)		4
Select one of the following three options for the Statistics requirement: ⁴		6
ST 371 & ST 372	Introduction to Probability and Distribution Theory and Introduction to Statistical Inference and Regression	
MA 421 & ST 422	Introduction to Probability and Introduction to Mathematical Statistics II	
ST 421 & ST 422	Introduction to Mathematical Statistics I and Introduction to Mathematical Statistics II	
Note: Students considering graduate school are strongly encouraged to select (MA 421 or ST 421) with ST 422		
Select one of the following Introduction to Programming courses:		3
CSC 111	Introduction to Computing: Python	
PY 251	Introduction to Scientific Computing	
ST 114	Statistical Programming	
Advanced Mathematics ^{5, 6}		
MA 405	Introduction to Linear Algebra	3
MA 407	Introduction to Modern Algebra for Mathematics Majors	3
MA 425	Mathematical Analysis I	3
Data Science and Scientific Computing		9
MA 326	Mathematical Foundations of Data Science I	
MA 402	Mathematics of Scientific Computing	
MA 404	Mathematical Foundations of Data Science II	
Math Electives (p. 2) ⁵		9
Data Science Electives		6
Select two of the following courses:		
CSC 422	Automated Learning and Data Analysis	
or CSC 522	Automated Learning and Data Analysis	
ST 442	Introduction to Data Science	
or CSC 442	Introduction to Data Science	
ST 445	Introduction to Statistical Computing and Data Management	
ST 452	Statistical Learning and Data Analytics	
ST 453	Advanced Computing for Statistical Reasoning	

MA 542	Convex Optimization Methods in Data Science	
Concentration Requirements		
PHI 227	Data Ethics	3
DSA 202	Introduction to Data Visualization	1
DSA 405	Data Wrangling and Web Scraping	1
General Data Science Electives: Select 4 credits of DSA courses, at least 2 at the 400-level		4
Advised Electives		9
A personalized plan for the 9 credits of Advised Electives will be developed in collaboration with the student's academic advisor. These courses offer the opportunity for the student to explore areas of interest in greater depth, particularly in subjects related to data science. Students are also encouraged to use these electives to pursue a minor or a second major.		
GEP Courses		
GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/)		3
GEP Social Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/)		6
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		2
GEP Interdisciplinary Perspectives (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/)		5
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
GEP Global Knowledge (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/) (verify requirement)		
GEP Foundations of American Democracy (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-fad/) (verify requirement)		
World Language Proficiency (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/world-language-proficiency/) (verify requirement)		
Free Electives ⁷		4
Free Electives (4 Hr S/U Lmt)		
Total Hours		120

* Minimum 2.0 math GPA required for graduation.

¹ The Orientation and Communication verify requirements are satisfied by some General Education Program courses which could potentially double count.

² MA 141 and MA 241 must be completed with a grade of C or better.

³ At most one grade below a C- is permitted in Basic Science Electives (CH, PY, BIO). The Statistics and programming requirements must be satisfied with a letter grade of C- or better.

⁴ (ST 370 with MA 421) or (ST 370 with ST 421) will be accepted for students transferring into the Mathematics major having already taken ST 370.

⁵ At most one letter grade of D +/- is permitted in Math Elective courses. No grades of D +/- are permitted in required math courses (MA141, MA241, MA242, MA225, MA341, MA 326, MA 402, MA404, MA405, MA407, MA425).

⁶ No more than 6 total credits each from undergraduate research (MA 491), independent study (MA 499), or credit by examination may be used to meet program requirements (credit from AP exams or transfer credits is not included under this restriction). Also, students must

complete at least one-half of the required mathematics credit hours (21) at NC State University.

⁷ Students are encouraged to use Free Electives credits to pursue a minor or second major. Free electives courses cannot be CH 100, CH 111, CSC 226, ECE 220, MA 101, MA 107, MA 108, MA 111, MA 121, MA 131, MA 231, PY 131, PY 211, PY 212, ENG 100. 100-level World Language Courses (WL*) can be used if not satisfying the language proficiency requirement.

Math Electives

Code	Title	Hours
MA 325	Introduction to Applied Mathematics	3
MA 335	Symbolic Logic	3
LOG 335	Symbolic Logic	3
MA 351	Introduction to Discrete Mathematical Models	3
MA 401	Applied Differential Equations II	3
MA 408	Foundations of Euclidean Geometry	3
MA 410	Theory of Numbers	3
MA 412	Long-Term Actuarial Models	3
ST 412	Long-Term Actuarial Models	3
MA 413	Short-Term Actuarial Models	3
ST 413	Short-Term Actuarial Models	3
MA 414	Foundations of Cryptography	3
CSC 414	Foundations of Cryptography	3
MA 416	Introduction to Combinatorics	3
CSC 416	Introduction to Combinatorics	3
MA 421	Introduction to Probability	3
MA 426	Mathematical Analysis II	3
MA 427	Introduction to Numerical Analysis I	3
CSC 427	Introduction to Numerical Analysis I	3
MA 428	Introduction to Numerical Analysis II	3
CSC 428	Introduction to Numerical Analysis II	3
MA 432	Mathematical Models in Life Sciences	3
MA 437	Applications of Algebra	3
MA 450	Methods of Applied Mathematics I	3
MA 451	Methods of Applied Mathematics II	3
MA 491	Reading in Honors Mathematics	1-3
MA 501	Advanced Mathematics for Engineers and Scientists I	3
MA 504	Introduction to Mathematical Programming	3
OR 504	Introduction to Mathematical Programming	3
MA 505	Linear Programming	3
ISE 505	Linear Programming	3
OR 505	Linear Programming	3
MA 513	Introduction To Complex Variables	3
MA 514	Foundations of Cryptography	3
CSC 514	Foundations of Cryptography	3
MA 515	Analysis I	3
MA 518	Geometry of Curves and Surfaces	3
MA 520	Linear Algebra	3
MA 521	Abstract Algebra I	3
MA 522	Computer Algebra	3

MA 523	Linear Transformations and Matrix Theory	3
MA 524	Combinatorics I	3
MA 526	Mathematical Analysis II	3
MA 528	Options and Derivatives Pricing	3
FIM 528	Options and Derivatives Pricing	3
ECG 528	Options and Derivatives Pricing	3
MBA 528	Options and Derivatives Pricing	3
MA 531	Dynamic Systems and Multivariable Control I	3
E 531	Dynamic Systems and Multivariable Control I	3
OR 531	Dynamic Systems and Multivariable Control I	3
MA 532	Ordinary Differential Equations I	3
MA 534	Introduction To Partial Differential Equations	3
MA 537	Nonlinear Dynamics and Chaos	3
MA 540	Uncertainty Quantification for Physical and Biological Models	3
MA 542	Convex Optimization Methods in Data Science	3
MA 544	Computer Experiments In Mathematical Probability	3
MA 546	Probability and Stochastic Processes I	3
ST 546	Probability and Stochastic Processes I	3
MA 547	Stochastic Calculus for Finance	3
MA 548	Monte Carlo Methods for Financial Math	3
FIM 548	Monte Carlo Methods for Financial Math	3
MA 549	Financial Risk Analysis	3
FIM 549	Financial Risk Analysis	3
MA 551	Introduction to Topology	3
MA 555	Introduction to Manifold Theory	3
MA 561	Set Theory and Foundations Of Mathematics	3
MA 565	Graph Theory	3
CSC 565	Graph Theory	3
OR 565	Graph Theory	3
MA 573	Mathematical Modeling of Physical and Biological Processes I	3
BMA 573	Mathematical Modeling of Physical and Biological Processes I	3
MA 574	Mathematical Modeling of Physical and Biological Processes II	3
BMA 574	Mathematical Modeling of Physical and Biological Processes II	3
MA 580	Numerical Analysis I	3
CSC 580	Numerical Analysis I	3
MA 583	Introduction to Parallel Computing	3
CSC 583	Introduction to Parallel Computing	3
MA 584	Numerical Solution of Partial Differential Equations--Finite Difference Methods	3
MA 587	Numerical Solution of Partial Differential Equations--Finite Element Method	3

First Year

Fall Semester		Hours
COS 100	Science of Change ¹	2
MA 141	Calculus I ²	4
DSA 202	Introduction to Data Visualization	1
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3

GEP Natural Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-natural-sciences/) ³	4
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)	1

Hours 15
Spring Semester

ENG 101	Academic Writing and Research	4
MA 241	Calculus II ²	4
PY 205	Physics for Engineers and Scientists I ³	3
PY 206	Physics for Engineers and Scientists I Laboratory ²	1
COM 292	Language, Communication, and Culture ¹	3

Hours 15
Second Year**Fall Semester**

MA 242	Calculus III ⁵	4
MA 225	Foundations of Advanced Mathematics ⁵	3
CSC 111	Introduction to Computing: Python	3
BIO 181	Introductory Biology: Ecology, Evolution, and Biodiversity ³	4
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1

Hours 15
Spring Semester

MA 341	Applied Differential Equations I ⁵	3
MA 405	Introduction to Linear Algebra ⁵	3
ST 371	Introduction to Probability and Distribution Theory ^{3, 4}	3
PHI 227	Data Ethics	3
Advised Electives		3

Hours 15
Third Year**Fall Semester**

MA 407	Introduction to Modern Algebra for Mathematics Majors ⁵	3
MA 326	Mathematical Foundations of Data Science I	3
ST 372	Introduction to Statistical Inference and Regression ^{3, 4}	3
DSA 405	Data Wrangling and Web Scraping	1
Advanced Writing/Speaking Elective (p. 1)		3
Advised Electives		3

Hours 16
Spring Semester

MA 425	Mathematical Analysis I	3
MA 404	Mathematical Foundations of Data Science II	3
ST 442	Introduction to Data Science	3
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
General DSA Electives		2

Hours 14

Fourth Year**Fall Semester**

MA 402	Mathematics of Scientific Computing	3
Advanced Mathematics Elective (p. 1) ⁵		3
CSC 422	Automated Learning and Data Analysis	3
Advised Electives		3
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
Hours		15

Spring Semester

Advanced Mathematics Elective (p. 1) ⁵		6
General DSA Electives		2
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
Free Electives ⁷		4
Hours		15
Total Hours		120

* Minimum 2.0 math GPA required for graduation.

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² MA 141 and MA 241 must be completed with a grade of C or better.

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Career Opportunities

Career Titles

- Actuary
- Architectural Drafters
- Astronomer
- Biophysicist
- Computer and Information Scientists
- Computer Programmer
- Computer Systems Analyst
- Computer Systems Engineer

- Database Administrator
- Economist
- Elementary School Teacher
- Employee Benefits Analyst
- Epidemiologists
- Financial Analyst
- Financial Planner
- High School Teacher
- Insurance Claim Examiner
- Insurance Underwriter
- Market Research Analyst
- Materials Scientist
- Math Professor
- Mathematician
- Meteorologist
- Middle School Teacher
- Operations Research Analyst
- Physicist
- Software Developers - Applications
- Statistician

Learn More About Careers

NCcareers.org (<https://nccareers.org/>)

Explore North Carolina's central online resource for students, parents, educators, job seekers and career counselors looking for high quality job and career information.

Occupational Outlook Handbook (<https://www.bls.gov/ooh/>)

Browse the Occupational Outlook Handbook published by the Bureau of Labor Statistics to view state and area employment and wage statistics. You can also identify and compare similar occupations based on your interests.

Career One Stop Videos (<https://www.careeronestop.org/>)

View videos that provide career details and information on wages, employment trends, skills needed, and more for any occupation. Sponsored by the U.S. Department of Labor.

Focus 2 Career Assessment (<https://careers.dasa.ncsu.edu/explore-careers/career-assessments/>) (NC State student email address required) This career, major and education planning system is available to current NC State students to learn about how your values, interests, competencies, and personality fit into the NC State majors and your future career. An NC State email address is required to create an account. Make an appointment with your career counselor (<https://careers.dasa.ncsu.edu/about/hours-appointments/>) to discuss the results.

Focus 2 Apply Assessment (<https://www.focus2career.com/Portal/Register.cfm?SID=1929>) (Available to prospective students)

A career assessment tool designed to support prospective students in exploring and choosing the right major and career path based on your unique personality, interests, skills and values. Get started with Focus 2 Apply and see how it can guide your journey at NC State.

American Mathematical Society (<https://www.ams.org/home/page/>)

Society for Industrial and Applied Mathematics (<https://www.siam.org/>)