

# MATHEMATICS, B.A. (SCIENCE)

**Begin Campus:** Any Penn State Campus

**End Campus:** University Park

## Program Description

Two degrees are offered in mathematics: the Bachelor of Arts and the Bachelor of Science. Both programs have a common core of mathematics courses; both programs prepare students for graduate work in mathematics. In addition, the Bachelor of Arts degree is oriented toward applications of mathematics in the arts and the humanities. The Bachelor of Science degree has a number of options. These options are oriented toward actuarial science, applied and industrial mathematics, computational mathematics, graduate study and systems analysis.

Many of the options are designed for students who want to use mathematics in industry, commerce, or government. In short, the degree requirements have the flexibility to fit many individual interests. The student, with the assistance of a faculty adviser, should select an option by the end of the sophomore year.

## What is Mathematics?

The study of mathematics emphasizes careful problem analysis, precision of thought and expression, and the development of mathematical skills needed for work in many other areas. Theoretical mathematicians increase basic knowledge in "pure" fields like abstract algebra, analysis, or topology. Applied mathematicians use tools growing out of calculus, analysis, computing, statistics, and operations research to solve problems in science, industry, government, and other areas.

## You Might Like This Program If...

- You want to take a broad liberal arts program with a strong mathematical foundation.
- You want mathematics to complement your study of other subjects.
- You like mathematics, like to think, like a challenge, and like to know why things are true.
- You want to develop strong problem-solving skills, comprehension of abstract concepts, and creative thinking ability.

## Entrance to Major

In order to be eligible for entrance to the Mathematics major, a student must have:

1. attained at least a 2.00 cumulative grade-point average; and
2. completed MATH 140 and MATH 141 and earned a grade of C or better in each of these courses.

## Degree Requirements

**For the Bachelor of Arts degree in Mathematics, a minimum of 120 credits is required:**

Requirement	Credits
General Education	45
Electives	0-1

Bachelor of Arts Degree Requirements	24
Requirements for the Major	56

## General Education

Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (<http://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program>) section of the Bulletin and consult your academic adviser.

The keystone symbol appears next to the title of any course that is designated as a General Education course. Program requirements may also satisfy General Education requirements and vary for each program.

### Foundations (grade of C or better is required.)

- **Quantification (GQ):** 6 credits
- **Writing and Speaking (GWS):** 9 credits

### Knowledge Domains

- **Arts (GA):** 6 credits
- **Health and Wellness (GHW):** 3 credits
- **Humanities (GH):** 6 credits
- **Social and Behavioral Sciences (GS):** 6 credits
- **Natural Sciences (GN):** 9 credits

### Integrative Studies (may also complete a Knowledge Domain requirement)

- **Inter-Domain or Approved Linked Courses:** 6 credits

6 of these 45 credits are included in the Requirements for the Major.

## University Degree Requirements

### First Year Engagement

All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3 credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

### Cultures Requirement

6 credits are required and may satisfy other requirements

- United States Cultures: 3 credits
- International Cultures: 3 credits

### Writing Across the Curriculum

3 credits required from the college of graduation and likely prescribed as part of major requirements.

### Total Minimum Credits

A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

### Quality of Work

Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

### Limitations on Source and Time for Credit Acquisition

The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80 (<http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#83-80>)). For more information, check the Suggested Academic Plan for your intended program.

## B.A. Degree Requirements

**Foreign Language** (0-12 credits): Student must attain 12th credit level of proficiency in one foreign language. See the Placement Policy for Penn State Foreign Language Courses (<http://bulletins.psu.edu/undergraduate/general-information/academic-information/#advisingandplanningadegreeprogramtext>).

**B.A. Fields** (9 credits): Humanities, Social and Behavioral Sciences, Arts, Foreign Languages, Natural Sciences, Quantification (may not be taken in the area of the student's primary major; foreign language credits in this category must be in a second foreign language or beyond the 12th credit level of proficiency in the first language)

**Other Cultures** (0-3 credits): Select 3 credits from approved list. Students may count courses in this category in order to meet other major, minor, elective, or General Education requirements, except for the General Education US/IL requirement.

3 of these 24 credits are included in the Requirements for the Major, General Education, or Electives and 0-12 credits are included in Electives if foreign language proficiency is demonstrated by examination.

### Requirements for the Major

This includes 6 credits of General Education GQ courses.

To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44 (<http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44>).

Code	Title	Credits
<b>Prescribed Courses</b>		
STAT 200	Elementary Statistics	4
<i>Prescribed Courses: Require a grade of C or better</i>		
MATH 140	Calculus With Analytic Geometry I	4
MATH 141	Calculus with Analytic Geometry II	4
MATH 220	Matrices	2-3
MATH 230	Calculus and Vector Analysis	4
MATH 311W	Concepts of Discrete Mathematics	3-4
MATH 312	Concepts of Real Analysis	3

MATH 403	Classical Analysis I	3
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### Additional Courses

Select one of the following: 3

CMPSC 101 Introduction to C++ Programming

CMPSC 121 Introduction to Programming Techniques

CMPSC 201 Programming for Engineers with C++

*Additional Courses: Require a grade of C or better*

MATH 250 Ordinary Differential Equations 3-4

or MATH 251 Ordinary and Partial Differential Equations

MATH 435 Basic Abstract Algebra 3

or MATH 436 Linear Algebra

Select 3 credits of the following: 3

MATH 411 Ordinary Differential Equations

MATH 412 Fourier Series and Partial Differential Equations

MATH 417 Qualitative Theory of Differential Equations

MATH 419 Theoretical Mechanics

MATH 421 Complex Analysis

Select 6 credits of 400-level MATH courses <sup>1</sup> 6

### Supporting Courses and Related Areas

Select 8-11 credits from department list 8-11

<sup>1</sup> Select 6 credits of 400-level MATH courses except:

- MATH 401
- MATH 405
- MATH 406
- MATH 441
- MATH 470
- MATH 471

## Integrated B.A. in Mathematics and Master of Applied Statistics (M.A.S.)

The Integrated Undergraduate-Graduate (IUG) degree with B.A. in Mathematics and Master of Applied Statistics (M.A.S.) is designed to be completed in five years. This integrated degree will enable a select number of highly qualified and career oriented students to obtain training in statistics focused on developing data analysis skills, and exploration of core areas of applied statistics at the graduate levels in addition to an undergraduate degree in Mathematics. The M.A.S. degree is a professional masters degree that emphasizes applications. The degree prepares students with interests in mathematics, computation, and the quantitative aspects of science for careers in industry and government as statistical analysts. Research divisions in the pharmaceutical industry, quality control, and quality engineering divisions in manufacturing companies, clinical research units, corporate planning and research units, and other data intensive positions require persons with training in mathematics, computation, database management, and statistical analysis, which this program will provide.

### Application Process

The number of openings in the integrated B.A. in Mathematics and M.A.S. program is limited. Admission will be based on specific criteria and the recommendation of faculty. Applicants to the integrated program:

- Must be enrolled in the Mathematics B.A. program.
- Must have completed at least 60 credits of the undergraduate degree program including the two courses: STAT 414 and STAT 415 and the

students must apply to the integrated program prior to completing 110 credits.

- Must submit a transcript and a statement of purpose.
- Must present a departmental approved plan of study in the application process in consultation with the M.A.S. program director.
- Must be recommended by the chair of Mathematics Department's undergraduate program committee. Two additional recommendation letters must be sent to the M.A.S. admissions committee.
- Must submit the GRE to the M.A.S. admissions committee.
- Must apply to the M.A.S. program in Statistics.

For the IUG B.A. in Mathematics and M.A.S. degree, 120 credits are required for the B.A. and 30 credits for the M.A.S. The following twelve graduate level credits can apply to both B.A. and M.A.S. degrees, six of these are at the 500 level:

Code	Title	Credits
STAT 414	Introduction to Probability Theory	3
STAT 415	Introduction to Mathematical Statistics	3
STAT 501	Regression Methods	3
STAT 502	Analysis of Variance and Design of Experiments	3

Assuming all requirements for the B.A. in Mathematics are completed, students in the program can complete the B.A. degree and not advance to the M.A.S. degree if they desire.

### Degree Requirements

Code	Title	Credits
<b>Prescribed Statistics Courses</b>		
IUG Math B.A. students must fulfill the Math B.A. requirement while counting these prescribed Statistics courses:		
STAT 220	<sup>1</sup>	3
STAT 414	Introduction to Probability Theory	3
STAT 415	Introduction to Mathematical Statistics	3
STAT 501	Regression Methods	3
STAT 502	Analysis of Variance and Design of Experiments	3
<b>IUG M.A.S. Requirements</b>		
STAT 414	Introduction to Probability Theory	3
STAT 415	Introduction to Mathematical Statistics	3
STAT 501	Regression Methods	3
STAT 502	Analysis of Variance and Design of Experiments	3
STAT 580	Statistical Consulting Practicum I	2
STAT 581	Statistical Consulting Practicum II <sup>2</sup>	1

### Electives

Select 15 credits of the following:		15
STAT 464	Applied Nonparametric Statistics	
STAT 503	Design of Experiments	
STAT 504	Analysis of Discrete Data	
STAT 505	Applied Multivariate Statistical Analysis	
STAT 506	Sampling Theory and Methods	
STAT 507	Epidemiologic Research Methods	
STAT 509	Design and Analysis of Clinical Trials	
STAT 510	Applied Time Series Analysis	

See the departmental list of additional courses for the M.A.S. program with the approval of the adviser

- <sup>1</sup> Can be waived for students with an equivalent course, e.g. STAT 250 or STAT 301.
- <sup>2</sup> For all students in the M.A.S. program, STAT 581 will have a comprehensive written project report required as part of the course, which serves as the culminating experience.

## Academic Advising

The objectives of the university's academic advising program are to help advisees identify and achieve their academic goals, to promote their intellectual discovery, and to encourage students to take advantage of both in-and out-of class educational opportunities in order that they become self-directed learners and decision makers.

Both advisers and advisees share responsibility for making the advising relationship succeed. By encouraging their advisees to become engaged in their education, to meet their educational goals, and to develop the habit of learning, advisers assume a significant educational role. The advisee's unit of enrollment will provide each advisee with a primary academic adviser, the information need to plan the chosen program of study, and referrals to other specialized resources.

READ SENATE POLICY 32-00: ADVISING POLICY (<http://senate.psu.edu/policies-and-rules-for-undergraduate-students/32-00-advising-policy>)

### University Park

#### Undergraduate Mathematics Office

**Academic Advising**  
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## Suggested Academic Plan

### MATHEMATICS - Math BA Option - University Park Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

#### First Year

Fall	Credits Spring	Credits
MATH 140 <sup>*†#†</sup>	4 MATH 141 <sup>*†#†</sup>	4
STAT 200	4 MATH 220 <sup>*</sup>	2
ENGL 15 <sup>‡</sup>	3 World Language level 2	4
World Language level 1	4 General Education Course	3

PSU 16	1 General Education Course	3
	16	16

**Second Year**

Fall	Credits Spring	Credits
MATH 230*	4 MATH 250 or 251*	3-4
MATH 311W*	3 MATH 312*	3
World Language level 3	4 CMPSC 101, 121, or 201	3
General Education Course	3 General Education Course	3
	Supporting Course (Chosen in consultation with an academic adviser)	3
	14	15-16

**Third Year**

Fall	Credits Spring	Credits
MATH 411, 412, 417, 419, or 421*	3 MATH 435 or 436*	3
CAS 100, 100A, 100B, or 100C	3 B.A. Fields	3
General Education Course	3 Supporting Course (Chosen in consultation with an academic adviser)	3
General Education Course	3 ENGL 202C, 202A, 202B, or 202D	3
Other Cultures	3 Supporting Course (Chosen in consultation with an academic adviser)	3
General Education Course (GHW)	1.5 General Education Course (GHW)	1.5
	16.5	16.5

**Fourth Year**

Fall	Credits Spring	Credits
MATH 403*	3 MATH 400 level selection: any 400 level except MATH 401, 405, 406, 470 and 471	3
MATH 400 level selection: any 400 level except MATH 401, 405, 406, 470 and 471	3 General Education Course	3
General Education Course	3 B.A. Field	3
B.A. Field	3 Supporting Course (Chosen in consultation with an academic adviser)	3
Supporting Course (Chosen in consultation with an academic adviser)	2-3	
	14-15	12

Total Credits 120-122

\* Course requires a grade of C or better for the major

‡ Course requires a grade of C or better for General Education

# Course is an Entrance to Major requirement

† Course satisfies General Education and degree requirement

**Bachelor of Arts Requirements:**

Bachelor of Arts students must take 9 credits in Bachelor of Arts (B.A.) Fields (Humanities; Social and Behavioral Sciences; Arts; World Languages [2nd language or beyond the 12th credit level of proficiency in the 1st]; Natural Sciences; Quantification). The B.A. Fields courses may not be taken in the area of the student's primary major. See your adviser and the Degree Requirements section (<http://bulletins.psu.edu/undergraduate/general-information/academic-information>) of this Bulletin.

Bachelor of Arts students must take 3 credits in Other Cultures. See your adviser and the full list of courses approved as Other Cultures courses (<http://bulletins.psu.edu/undergraduate/general-education/course-lists/ba-other-cultures>).

**University Requirements and General Education Notes:**

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL/CAS 137 in the fall semester and ENGL/CAS 138 in the spring semester. These courses carry the GWS designation and replace both ENGL 30 and CAS 100. Each course is 3 credits.

## Career Paths

Students with an undergraduate degree in mathematics pursue graduate study or careers in business and industry.

### Careers

Students with an undergraduate degree in mathematics pursue careers in the fields of science and technology, business and consulting, research and industry, and teaching.

MORE INFORMATION (<https://math.psu.edu/undergraduate/advising/careers>)

### Opportunities for Graduate Studies

Students with an undergraduate degree in mathematics pursue graduate study in a variety of different fields such as mathematics, statistics, economics, finance, computer science, or operations research.

MORE INFORMATION (<https://math.psu.edu/undergraduate/advising/careers>)

### Professional Resources

- Mathematical Association of America (<http://www.maa.org>)
- American Mathematical Society (<http://www.ams.org/home/page>)

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

## Contact

### University Park

DEPARTMENT OF MATHEMATICS

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