MATHEMATICS, B.S. (BEHREND)

Begin Campus: Any Penn State Campus

End Campus: Erie

Program Description

This major builds a foundation in mathematics with emphasis on the applications of mathematics and to the development of problem-solving skills. The major has four options that share a common core of mathematics courses for the first two years. The options are Applied Mathematics, Business, Computer Science, and Pure Mathematics. They allow students to concentrate on developing mathematical skills suitable either for entry level positions in areas including applied mathematics, actuarial sciences, statistics and computer programming, or for graduate studies in mathematics and related fields. Students, with the assistance of a faculty adviser, should select an option in their sophomore year. In addition, students are strongly encouraged to participate in faculty supervised research.

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 find irrational numbers to be very rational, and calculate pi for fun.
• You enjoy solving challenging problems.
• You like to know why and how things work.
• You are interested in multiple academic disciplines.
• You are looking for a foundational major that supports diverse career paths in the sciences, engineering, research, education, and computer science.

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>7-11</td>
<td></td>
</tr>
<tr>
<td>Requirements for the Major</td>
<td>85-92</td>
<td></td>
</tr>
</tbody>
</table>

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

18-24 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.

Requirements for the Major
This includes 18-24 credits of General Education courses: 9 credits of GN courses; 6 credits of GQ courses; 0-6 credits of GS courses; 3 credits of GWS courses.

A student enrolled in this major must earn at least a grade of C in each 300- and 400-level course in the major.

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. (A maximum of 30 credits through the School of Business may be used to fulfill General Education, Major Requirements and Option Requirements.)

Common Requirements for the Major (All Options)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 202C</td>
<td>Effective Writing: Technical Writing</td>
<td>3</td>
</tr>
</tbody>
</table>

Prescribed Courses: Require a grade of C or better

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPSC 121</td>
<td>Introduction to Programming Techniques</td>
<td>3</td>
</tr>
<tr>
<td>MATH 140</td>
<td>Calculus With Analytic Geometry I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 141</td>
<td>Calculus With Analytic Geometry II</td>
<td>4</td>
</tr>
<tr>
<td>CMPSC 122</td>
<td>Intermediate Programming</td>
<td>3</td>
</tr>
<tr>
<td>MATH 311W</td>
<td>Concepts of Discrete Mathematics</td>
<td>4</td>
</tr>
<tr>
<td>STAT 301</td>
<td>Statistical Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 220</td>
<td>Matrices</td>
<td>2</td>
</tr>
<tr>
<td>MATH 230</td>
<td>Calculus and Vector Analysis</td>
<td>4</td>
</tr>
<tr>
<td>MATH 251</td>
<td>Ordinary and Partial Differential Equations</td>
<td>4</td>
</tr>
<tr>
<td>MATH 312</td>
<td>Concepts of Real Analysis</td>
<td>3</td>
</tr>
<tr>
<td>STAT 401</td>
<td>Experimental Methods</td>
<td>3</td>
</tr>
</tbody>
</table>

Additional Courses
Select 1 credit of GN designated course and 8 additional credits in one of the following sequences:

- BIOL 110 & BIOL 220W: Biology: Basic Concepts and Biodiversity and Biology: Populations and Communities
- CHEM 110 & CHEM 111: Chemical Principles I and Experimental Chemistry I
- CHEM 112 & CHEM 113: Chemical Principles II and Experimental Chemistry II
- PHYS 211 & PHYS 212: General Physics: Mechanics and General Physics: Electricity and Magnetism

Additional Courses
Select one of the following:

- PHYS 250 & PHYS 251: Introductory Physics I and Introductory Physics II

Requirements for the Option
Select an option 36-43

Requirements for the Option
Applied Mathematics Option (36 credits)
A student enrolled in this major must receive a grade of C or better, as specified in Senate Policy 82-44.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 310</td>
<td>Elementary Combinatorics</td>
<td>3</td>
</tr>
<tr>
<td>MATH 412</td>
<td>Fourier Series and Partial Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 449</td>
<td>Applied Ordinary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 455</td>
<td>Introduction to Numerical Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 456</td>
<td>Introduction to Numerical Analysis II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 482</td>
<td>Mathematical Methods of Operations Research</td>
<td>3</td>
</tr>
<tr>
<td>STAT 414</td>
<td>Introduction to Probability Theory</td>
<td>3</td>
</tr>
<tr>
<td>STAT 461</td>
<td>Analysis of Variance</td>
<td>3</td>
</tr>
<tr>
<td>STAT 462</td>
<td>Applied Regression Analysis</td>
<td>3</td>
</tr>
<tr>
<td>STAT 464</td>
<td>Applied Nonparametric Statistics</td>
<td>3</td>
</tr>
<tr>
<td>STAT 466</td>
<td>Survey Sampling</td>
<td>3</td>
</tr>
</tbody>
</table>

Select two of the following:

- MATH 421: Complex Analysis
- MATH 426: Introduction to Modern Geometry
- MATH 427: Foundations of Geometry
- MATH 429: Introduction to Topology
- MATH 435: Basic Abstract Algebra
- MATH 436: Linear Algebra
- MATH 465: Number Theory

Supporting Courses and Related Areas
Select 9 credits from a school-approved list 9

1 Except CMPSC 360.

Business Option (43 credits)
(A maximum of 30 credits through the School of Business may be used to fulfill General Education, Major Requirements and Option Requirements.)

A student enrolled in this major must receive a grade of C or better, as specified in Senate Policy 82-44.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCTG 211</td>
<td>Financial and Managerial Accounting for Decision Making</td>
<td>4</td>
</tr>
<tr>
<td>ECON 102</td>
<td>Introductory Microeconomic Analysis and Policy</td>
<td>3</td>
</tr>
<tr>
<td>ECON 104</td>
<td>Introductory Macroeconomic Analysis and Policy</td>
<td>3</td>
</tr>
<tr>
<td>MIS 204</td>
<td>Introduction to Business Information Systems</td>
<td>3</td>
</tr>
</tbody>
</table>

Additional Courses
Select 6 credits from CMPSC 221 or higher, except CMPSC 360, and MIS 336

Select two of the following:

- MIS 336

- ACCTG 211
- ECON 102
- ECON 104
- MIS 204
- MATH 311W
- STAT 401
- STAT 461
- STAT 462
- STAT 464
- STAT 466
- ENGL 202C
- CMPSC 121
- MATH 140
- MATH 141
- CMPSC 122
- MATH 311W
- STAT 301
- MATH 220
- MATH 230
- MATH 251
- MATH 312
- STAT 401
- CMPSC 121
- MATH 140
- MATH 141
- CMPSC 122
- MATH 311W
- STAT 301
- MATH 220
- MATH 230
- MATH 251
- MATH 312
- STAT 401
ECON 481 Business Forecasting Techniques
ECON 485 Econometric Techniques
FIN 301 Corporation Finance
FIN 405 Advanced Financial Management
FIN 420 Investment and Portfolio Analysis
FIN 427 Derivative Securities
MGMT 301 Basic Management Concepts
MGMT 331 Management and Organization
MGMT 341 Human Resource Management
MKTG 301 Principles of Marketing
SCM 310 Introduction to Operations Management
Select two of the following: 6
MATH 482 Mathematical Methods of Operations Research
MIS 336 Database Management Systems
MIS 430 Systems Analysis
MIS 435 Systems Design and Implementation
MIS 445 Business Intelligence
STAT 414 Introduction to Probability Theory
STAT 461 Analysis of Variance
STAT 462 Applied Regression Analysis
STAT 464 Applied Nonparametric Statistics
STAT 466 Survey Sampling
Select two of the following: 6
MATH 421 Complex Analysis
MATH 426 Introduction to Modern Geometry
MATH 427 Foundations of Geometry
MATH 429 Introduction to Topology
MATH 435 Basic Abstract Algebra
MATH 436 Linear Algebra
Select three of the following: 9
MATH 403 Classical Analysis I
MATH 421 Complex Analysis
MATH 429 Introduction to Topology
MATH 435 Basic Abstract Algebra
Supporting Courses and Related Areas
Select 6 credits from a school-approved list 6

Computer Science Option (36 credits)
A student enrolled in this major must receive a grade of C or better, as specified in Senate Policy 82-44.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPSC 455</td>
<td>Introduction to Numerical Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>CMPSC 465</td>
<td>Data Structures and Algorithms</td>
<td>3</td>
</tr>
</tbody>
</table>

Additional Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPSC 221</td>
<td>Object Oriented Programming with Web-Based Applications</td>
<td>3</td>
</tr>
<tr>
<td>or SWENG 311</td>
<td>Object- Oriented Software Design and Construction</td>
<td></td>
</tr>
<tr>
<td>CMPSC 312</td>
<td>Computer Organization and Architecture</td>
<td>3</td>
</tr>
<tr>
<td>or CMPEN 351</td>
<td>Microprocessors</td>
<td></td>
</tr>
</tbody>
</table>

Select 12 credits from CMPSC courses at the 300- and 400-level 12

Supporting Courses and Related Areas
Select 12 credits from a school-approved list 12

Pure Mathematics Option (36 credits)
A student enrolled in this major must receive a grade of C or better, as specified in Senate Policy 82-44.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 403</td>
<td>Classical Analysis I</td>
<td></td>
</tr>
<tr>
<td>MATH 421</td>
<td>Complex Analysis</td>
<td></td>
</tr>
<tr>
<td>MATH 429</td>
<td>Introduction to Topology</td>
<td></td>
</tr>
<tr>
<td>MATH 435</td>
<td>Basic Abstract Algebra</td>
<td></td>
</tr>
</tbody>
</table>

Supporting Courses and Related Areas
Select 9 credits from a school-approved list 9

Program Learning Objectives
1. Proofs: Students will demonstrate and apply proof techniques.
2. Problem Solving: Students will demonstrate the knowledge to apply logical skills in order to understand how to approach and solve mathematical problems.
3. Communication: Students will demonstrate and apply communicating mathematics in written form.
4. Modeling: Students will demonstrate the knowledge to describe physical situations mathematically.
5. Opportunity: Students will demonstrate knowledge of internship opportunities and opportunities to participate in mathematical research directed by mathematics faculty. Furthermore, each student who participated in an internship or in undergraduate research will be able to describe in a paragraph what he or she learned through the 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)

Erie
Andrew George
Lecturer in Mathematics
7-B Prischak
Erie, PA 16563
814-898-6196
jag35@psu.edu

Suggested Academic Plan
Applied Mathematics Option At Erie 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
<table>
<thead>
<tr>
<th>Program List Course</th>
<th>Credits</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 140 †‡</td>
<td>4</td>
<td>MATH 141 †#</td>
</tr>
<tr>
<td>ENGL 15 or 30‡</td>
<td>2</td>
<td>MATH 220*</td>
</tr>
<tr>
<td>CMPSC 121 ††</td>
<td>3</td>
<td>MATH 220*</td>
</tr>
<tr>
<td>General Education Course (GN Selection) ††</td>
<td>3</td>
<td>General Education Course (GN Selection) †</td>
</tr>
<tr>
<td>PSU 7</td>
<td>1</td>
<td>General Education Course †</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

Second Year
<table>
<thead>
<tr>
<th>Program List Course</th>
<th>Credits</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS 100‡</td>
<td>3</td>
<td>MATH 311W*</td>
</tr>
<tr>
<td>MATH 230†</td>
<td>4</td>
<td>MATH 251†</td>
</tr>
<tr>
<td>STAT 301†</td>
<td>3</td>
<td>STAT 401†</td>
</tr>
<tr>
<td>General Education Course †</td>
<td>3</td>
<td>General Education Course</td>
</tr>
<tr>
<td>General Education Course (GHW)</td>
<td>1.5</td>
<td>General Education Course (GHW)</td>
</tr>
<tr>
<td></td>
<td>14.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15.5</td>
<td></td>
</tr>
</tbody>
</table>

Third Year
<table>
<thead>
<tr>
<th>Program List Course</th>
<th>Credits</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 312*</td>
<td>3</td>
<td>ENGL 202C‡</td>
</tr>
<tr>
<td>Additional Course Selection (Group A)‡</td>
<td>3</td>
<td>Additional Course Selection (Group A)†</td>
</tr>
<tr>
<td>Additional Course Selection (Group B)‡</td>
<td>3</td>
<td>Additional Course Selection (Group B)†</td>
</tr>
<tr>
<td>General Education Course (GN Selection) †</td>
<td>3</td>
<td>Additional Course Selection (Group A)†</td>
</tr>
<tr>
<td>Program List Course †</td>
<td>3</td>
<td>General Education Course †</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

Fourth Year
<table>
<thead>
<tr>
<th>Program List Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Course Selection (Group A)†</td>
<td>3</td>
</tr>
<tr>
<td>Additional Course Selection (Group B)†</td>
<td>3</td>
</tr>
<tr>
<td>Elective Course</td>
<td>3</td>
</tr>
<tr>
<td>General Education Course †</td>
<td>3</td>
</tr>
<tr>
<td>Program List Course †</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

Total Credits 121

Prerequisite: satisfactory performance on the MATH placement tests (ALEKS) - i.e. placement beyond the level of MATH 22; or CHEM 101 and MATH 22 or MATH 41

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

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.

Program Notes

1.) Students who have not met the admissions requirement of two units of a high school world language must complete a college-level one world language within their first 60 credits. In order to be eligible for entrance to the mathematics major, a student must have attained at least a 2.00 cumulative GPA and completed MATH 140 and MATH 141 earning a grade of C or better in both courses.

2.) Students graduating from a major must achieve a minimum GPA of 2.00 and earn a grade of C or better in all 300- and 400-level courses within the “prescribed,” “additional,” and “supporting” courses as specified in Senate Policy 82-44. If a student received a grade below a C, s/he must repeat that course or a School approved alternative, and earn a grade of C or better.

3.) Students should inquire whether their Program List courses count toward a minor or a certificate.

4.) A student must earn at least a total of 120 credits for graduation.

Scheduling patterns
Some courses are offered only in the fall or in the spring semester, and some upper-level courses are offered in alternative year patterns. The scheduling pattern below is tentative and subject to change:

**Every Fall** - MATH 312, MATH 455
**Every Spring** - STAT 401

**Fall (Even Years)** - MATH 427, MATH 428, MATH 455, MATH 465, STAT 462

**Spring (Odd Years)** - MATH 421, MATH 426, MATH 436, MATH 449, STAT 461, one of either MATH 426 or MATH 497

**Fall (Odd Years)** - MATH 412, MATH 435, MATH 455, STAT 414

**Spring (Even Years)** - MATH 410, MATH 437, MATH 448, MATH 482, one of either STAT 464 or STAT 466

### Advising Notes

**Science Sequence Course**

Student must complete one of the following two-semester science course sequences, which will also count toward their general education Science (GN) requirement:

- BIOL 110S and BIOL 220W
- CHEM 110, CHEM 111, CHEM 112, and CHEM 113
- PHYS 211 and PHYS 212
- PHYS 250 and PHYS 251

**Additional Course Selections**

**Group A:** MATH 310, MATH 412, MATH 449, MATH 455, MATH 456, MATH 482, STAT 414, STAT 461, STAT 464, STAT 465, STAT 466

**Group B:** MATH 421, MATH 426, MATH 427, MATH 429, MATH 435, MATH 436, MATH 465

**Group C:** CMPSC 221 or higher, with the exception of CMPSC 360

**Program List Courses**

- All 300- and 400-level courses in BIOL, CHEM, MATH, PHYS, and STAT. No more than three credits of any 495 can be used as supporting courses.
- All 300- and 400-level computer courses, CMPSC 102 and CMPSC 109
- ACCTG 211
- All 300- and 400-level courses in ECON courses
- All 300- and 400-level courses in FIN
- All 200- and above level courses in MIS
- All SCM courses, with the exception of SCM 200
- BA 241 and BA 242
- All MGMT courses
- All MRKTG courses

### Business Option at Erie 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

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 140</td>
<td>3</td>
<td>MATH 141</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 15</td>
<td>3</td>
<td>MATH 220</td>
<td>3</td>
</tr>
<tr>
<td>CMPSC 121</td>
<td>3</td>
<td>CMPSC 122</td>
<td>3</td>
</tr>
<tr>
<td>PSY 101</td>
<td>3</td>
<td>ECON 102</td>
<td>3</td>
</tr>
<tr>
<td>General Education Course (GN Selection)</td>
<td>4</td>
<td>General Education Course (GN Selection)</td>
<td>4</td>
</tr>
<tr>
<td>General Education Course (GN Selection)</td>
<td>4</td>
<td>General Education Course (GN Selection)</td>
<td>4</td>
</tr>
<tr>
<td>General Education Course (GN Selection)</td>
<td>4</td>
<td>General Education Course (GN Selection)</td>
<td>4</td>
</tr>
</tbody>
</table>

### Second Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 230</td>
<td>3</td>
<td>MATH 251</td>
<td>4</td>
</tr>
<tr>
<td>STAT 301</td>
<td>3</td>
<td>STAT 401</td>
<td>3</td>
</tr>
<tr>
<td>ECON 104</td>
<td>3</td>
<td>MIS 204</td>
<td>3</td>
</tr>
</tbody>
</table>

**General Education Course (GHW)**

| Credits | 15 |

**Total Credits 123.5**

1. **Prerequisite:** Satisfactory performance on the MATH placement tests (ALEKS) - i.e. placement beyond the level of MATH 22; or CHEM 101 and MATH 22 or MATH 41

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

3. **Course requires a grade of C or better for General Education**

4. **Course is an Entrance to Major requirement**

5. **Course satisfies General Education and degree requirement**

### 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.

Program Notes
1.) Students who have not met the admissions requirement of two units of a high school world language must complete a college level-one world language within their first 60 credits. In order to be eligible for entrance to the mathematics major, a student must have attained at least a 2.00 cumulative GPA and completed MATH 140 and MATH 141 earning a grade of C or better in both courses.
2.) Students graduating from a major must achieve a minimum GPA of 2.00 and earn a grade of C or better in all 300- and 400-level courses within the "prescribed," "additional," and "supporting" courses as specified in Senate Policy 82-44. If a student received a grade below a C, s/he must repeat that course or a School approved alternative, and earn a grade of C or better.
3.) Students should inquire whether their Program List courses count toward a minor or a certificate.
4.) A student must earn at least a total of 120 credits for graduation.

Scheduling patterns
Some course are offered only in the fall or in the spring semester, and some upper-level courses are offered in alternative year pattern. The scheduling pattern below is tentative and subject to change:
- **Every Fall** - MATH 312, MATH 455
- **Every Spring** - STAT 401

- **Fall (Even Years)** - MATH 427, MATH 428, MATH 455, MATH 465, STAT 462
- **Spring (Odd Years)** - MATH 421, MATH 426, MATH 436, MATH 449, STAT 461, one of either MATH 426 or MATH 497
- **Fall (Odd Years)** - MATH 412, MATH 435, MATH 455, STAT 414
- **Spring (Even Years)** - MATH 310, MATH 429, MATH 456, MATH 482, one of either STAT 464 or STAT 466

Advising Notes
Science Sequence Course
Student must complete one of the following two semester science course sequences, which will also count toward their general education Science (GN) requirement:
- BIOL 110S and BIOL 220W
- CHEM 110, CHEM 111, CHEM 112, and CHEM 113
- PHYS 211 and PHYS 212
- PHYS 250 and PHYS 251

Program List Courses
- All 300- and 400-level courses in BIOL, CHEM, MATH, PHYS, and STAT.
- No more than three credits of any 495 can be used as supporting courses.
- All 300- and 400-level computer courses, CMPSC 102 and CMPSC 109
- All 300- and 400-level courses in ECON
- All 300-and 400-level courses in FIN
- All 200- and above level courses in MIS
- All SCM courses, with the exception of SCM 200
- BA 241 and BA 242
- All MGMT courses
- All MRKTG courses

Computer Science Option At Erie 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.

<table>
<thead>
<tr>
<th>First Year</th>
<th>Credits</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 140*</td>
<td>4</td>
<td>MATH 141*</td>
<td>4</td>
</tr>
<tr>
<td>ENGL 15 or 30†</td>
<td>3</td>
<td>MATH 220*</td>
<td>2</td>
</tr>
<tr>
<td>CMPSC 121†</td>
<td>3</td>
<td>CMPSC 122‡</td>
<td>3</td>
</tr>
<tr>
<td>General Education Course (GN Selection)‡</td>
<td>4</td>
<td>General Education Course (GN Selection)‡</td>
<td>4</td>
</tr>
<tr>
<td>PSU 7</td>
<td>1</td>
<td>General Education Course‡</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second Year</th>
<th>Credits</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS 100‡</td>
<td>3</td>
<td>MATH 311W‡</td>
<td>4</td>
</tr>
<tr>
<td>MATH 230*</td>
<td>4</td>
<td>MATH 251*</td>
<td>4</td>
</tr>
<tr>
<td>STAT 301†</td>
<td>3</td>
<td>STAT 401†</td>
<td>3</td>
</tr>
<tr>
<td>General Education Course‡</td>
<td>3</td>
<td>Additional Course Selection (Group A)‡</td>
<td>3</td>
</tr>
<tr>
<td>General Education Course (GHW)</td>
<td>1.5</td>
<td>General Education Course (GHW)</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>14.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Third Year</th>
<th>Credits</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 312*</td>
<td>3</td>
<td>ENGL 202C‡</td>
<td>3</td>
</tr>
<tr>
<td>Additional Course Selection (Group A)</td>
<td>3</td>
<td>Additional Course Selection (Group A)</td>
<td>3</td>
</tr>
<tr>
<td>Additional Course Selection (Group A)</td>
<td>3</td>
<td>Additional Course Selection (Group B)</td>
<td>3</td>
</tr>
<tr>
<td>General Education Course‡</td>
<td>3</td>
<td>Program List Course*</td>
<td>3</td>
</tr>
<tr>
<td>Program List Course*</td>
<td>3</td>
<td>General Education Course‡</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fourth Year</th>
<th>Credits</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Course Selection (Group B)</td>
<td>3</td>
<td>Additional Course Selection (Group B)</td>
<td>3</td>
</tr>
<tr>
<td>Additional Course Selection (Group B)</td>
<td>3</td>
<td>Program List Course*</td>
<td>3</td>
</tr>
</tbody>
</table>
### Elective Course
- 3 Elective Course

### General Education Course
- 3 General Education Course (GN Selection)
- 3 General Education Course

### Program List Course
- 3 General Education Course

<table>
<thead>
<tr>
<th>Elective Course</th>
<th>3 Elective Course</th>
<th>3 Elective Course</th>
<th>3 Elective Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education Course</td>
<td>3 General Education Course (GN Selection)</td>
<td>3 General Education Course</td>
<td>3 General Education Course</td>
</tr>
<tr>
<td>Program List Course</td>
<td>3 General Education Course</td>
<td>3 General Education Course</td>
<td>3 General Education Course</td>
</tr>
</tbody>
</table>

Total Credits 121

1. Prerequisite: satisfactory performance on the MATH placement tests (ALEKS) - i.e. placement beyond the level of MATH 22; or CHEM 101 and MATH 22 or MATH 41

* 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

### 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.

### PROGRAM NOTES

1. Students who have not met the admissions requirement of two units of a high school world language must complete a college level-one world language within their first 60 credits. In order to be eligible for entrance to the mathematics major, a student must have attained at least a 2.00 cumulative GPA and completed MATH 140 and MATH 141 earning a grade of C or better in both courses.

2. Students graduating from a major must achieve a minimum GPA of 2.00 and earn a grade of C or better in all 300- and 400-level courses.

3. Students should inquire whether their Program List courses count toward a minor or a certificate.

4. A student must earn at least a total of 120 credits for graduation.

### Scheduling patterns

Some courses are offered only in the fall or in the spring semester, and some upper-level courses are offered in alternative year pattern. The scheduling pattern below is tentative and subject to change:

- **Every Fall**: MATH 312, MATH 455
- **Every Spring**: STAT 401
- **Fall (Even Years)**: MATH 427, MATH 428, MATH 455, MATH 465, STAT 462
- **Spring (Odd Years)**: MATH 421, MATH 426, MATH 436, MATH 449, STAT 461, one of either MATH 426 or MATH 497
- **Fall (Odd Years)**: MATH 412, MATH 435, MATH 455, STAT 414
- **Spring (Even Years)**: MATH 310, MATH 429, MATH 456, MATH 482, one of either STAT 464 or STAT 466

### ADVISING NOTES

Science Sequence Course

Student must complete one of the following two semester science course sequences, which will also count toward their general education Science (GN) requirement:

- BIOL 110S and BIOL 220W
- CHEM 110, CHEM 111, CHEM 112, and CHEM 113
- PHYS 211 and PHYS 212
- PHYS 250 and PHYS 251

### Additional Course Selections

**Group A**: CMPSC 221, CMPSC 312, CMPSC 455, CMPSC 465

**Group B**: CMPSC courses at the 300- and 400-level, with the exception of CMPSC 360

### Pure Mathematics Option At Erie 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

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 140</td>
<td>4</td>
<td>MATH 141</td>
<td>4</td>
</tr>
<tr>
<td>ENGL 15 or 30 ‡</td>
<td>2</td>
<td>3 MATH 220 *</td>
<td>2</td>
</tr>
<tr>
<td>CMPSC 121 †</td>
<td>3</td>
<td>CMPSC 122 *</td>
<td>3</td>
</tr>
<tr>
<td>General Education Course (GN Selection) †</td>
<td>4</td>
<td>General Education Course (GN Selection) †</td>
<td>4</td>
</tr>
<tr>
<td>PSU 7</td>
<td>1</td>
<td>General Education Course †</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>15</td>
<td><strong>Total</strong></td>
<td>16</td>
</tr>
</tbody>
</table>

### Second Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS 100 ‡</td>
<td>4</td>
<td>MATH 311 W *</td>
<td>4</td>
</tr>
<tr>
<td>MATH 230 *</td>
<td>4</td>
<td>MATH 251 *</td>
<td>4</td>
</tr>
<tr>
<td>STAT 301 †</td>
<td>3</td>
<td>STAT 401 †</td>
<td>3</td>
</tr>
<tr>
<td>General Education Course †</td>
<td>3</td>
<td>General Education Course †</td>
<td>3</td>
</tr>
<tr>
<td>General Education Course (GHW)</td>
<td>1.5</td>
<td>General Education Course (GHW)</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>14.5</td>
<td><strong>Total</strong></td>
<td>15.5</td>
</tr>
</tbody>
</table>
cumulative GPA and completed MATH 140 and MATH 141 earning a grade of C or better in both courses.
2.) Students graduating from a major must achieve a minimum GPA of 2.00 and earn a grade of C or better in all 300- and 400-level courses within the “prescribed,” "additional," and "supporting" courses as specified in Senate Policy 82-44. If a student received a grade below a C, s/he must repeat that course or a School approved alternative, and earn a grade of C or better.
3.) Students should inquire whether their Program List courses count toward a minor or a certificate.
4.) A student must earn at least a total of 120 credits for graduation.

Scheduling patterns
Some course are offered only in the fall or in the spring semester, and some upper-level courses are offered in alternative year pattern. The scheduling pattern below is tentative and subject to change:
Every Fall - MATH 312, MATH 455
Every Spring - STAT 401
Fall (Even Years) - MATH 427, MATH 428, MATH 455, MATH 465, STAT 462
Spring (Odd Years) - MATH 421, MATH 426, MATH 436, MATH 449, STAT 461, one of either MATH 426 or MATH 497
Fall (Odd Years) - MATH 412, MATH 435, MATH 455, STAT 414
Spring (Even Years) - MATH 310, MATH 429, MATH 456, MATH 482, one of either STAT 464 or STAT 466

ADVISING NOTES
Science Sequence Course
Student must complete one of the following two semester science course sequences, which will also count toward their general education Science (GN) requirement:
- BIOL 110S and BIOL 220W
- CHEM 110, CHEM 111, CHEM 112, and CHEM 113
- PHYS 211 and PHYS 212
- PHYS 250 and PHYS 251

Additional Course Selections
Group A: MATH 310, MATH 412, MATH 449, MATH 455, MATH 456, MATH 482, STAT 414, STAT 462
Group B: MATH 421, MATH 426, MATH 427, MATH 429, MATH 435, MATH 436, MATH 465

No course may be used to fulfill the requirement in both Group A and Group B

Program List Courses
- All 300- and 400-level courses in BIOL, CHEM, MATH, PHYS, and STAT.
No more than three credits of any 495 can be used as supporting courses
- All 300- and 400-level computer courses, CMPSC 102 and CMPSC 109, with the exception of CMPSC 360
- All 300- and 400-level courses in ECON courses
- All 300- and 400-level courses in FIN
- All 200- and above level courses in MIS
- All SCM courses, with the exception of SCM 200
- BA 241 and BA 242
- All MGMT courses
- All MKRTG courses
- PHIL 10, PHIL 12

Career Paths
You can tailor your math degree to your career goals by pursuing one of four options. Applied Mathematics emphasizes numerical analysis, modeling, and problem solving. Pure Mathematics is excellent
preparation for graduate school. The Business Option includes statistics, management information systems, economics, and finance. The Computer Science Option includes programming, algorithms, and numerical methods. Penn State Behrend has a comprehensive support system to help you identify and achieve your goals for college and beyond. Meet with your academic adviser often and take advantage of the services offered by the Academic and Career Planning Center beginning in your first semester.

**Careers**

A degree in mathematics can lead to careers in fields as varied as actuarial planning, computer systems design, software engineering, information systems, mathematical biology, mathematics education, operations research, programming management, quality control analysis, system analysis, and technical writing. The demand for mathematicians is projected to be strong because of a shortage of science teachers and a growing need for specialists in actuarial mathematics, computer network efficiency, and data analysis. For students interested in both mathematics and teaching, Penn State Behrend also offers a B.S. in Secondary Education in Mathematics.

MORE INFORMATION (http://behrend.psu.edu/school-of-science/academic-programs/mathematics)

**Opportunities for Graduate Studies**

Mathematics is a common foundational major for graduate study in the natural sciences, engineering, business and economics, statistics or biostatistics, operations research, and national security analysis. Mathematics also is a useful undergraduate major for future architects, doctors, lawyers, and other professionals.

MORE INFORMATION (http://behrend.psu.edu/school-of-science/academic-programs/mathematics)

**Professional Resources**

- Mathematical Association of America (https://www.maa.org)
- American Mathematical Society (http://www.ams.org/home/page)
- National Association of Mathematicians (http://www.nam-math.org)
- Society for Industrial and Applied Mathematics (https://www.siam.org)

**Contact**

**Erie**

SCHOOL OF SCIENCE
1 Prischak
4205 College Drive
Erie, PA 16563
814-898-6105
behrend-science@psu.edu

http://behrend.psu.edu/school-of-science