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 problemsolving 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 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.
• You find irrational numbers to be very rational, and calculate pi for fun.

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 Science degree in Mathematics, a minimum of 120 credits is required:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>45</td>
</tr>
<tr>
<td>Electives</td>
<td>7-8</td>
</tr>
<tr>
<td>Requirements for the Major</td>
<td>85-92</td>
</tr>
</tbody>
</table>

18-24 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 9 credits of GN courses; 6 credits of GQ courses; 0-6 credits of GS courses; 3 credits of GWS courses.

Per Senate Policy 83.80.5, the college dean or campus chancellor and program faculty may require up to 24 credits of coursework in the major to be taken at the location or in the college or program where the degree is earned.

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

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). For more information, check the Suggested Academic Plan for your intended program.

Requirements for the Major
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 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44). For more information, check the Suggested Academic Plan for your intended program.

Requirements for the Major (All Options)
3 credits required from the college of graduation and likely prescribed as part of major requirements.

1. Prescribed Courses: Require a grade of C or better
   - ENGL 202C Effective Writing: Technical Writing
   - CMPSC 121 Introduction to Programming Techniques
   - CMPSC 122 Intermediate Programming
   - MATH 140 Calculus With Analytic Geometry I
   - MATH 141 Calculus with Analytic Geometry II
   - MATH 220 Matrices
   - MATH 230 Calculus and Vector Analysis
   - MATH 251 Ordinary and Partial Differential Equations
   - MATH 311W Concepts of Discrete Mathematics
   - MATH 312 Concepts of Real Analysis
   - STAT 301 Statistical Analysis I
   - STAT 401 Experimental Methods

2. 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 & CHEM 112 & CHEM 113 Chemical Principles I and Experimental Chemistry I and Chemical Principles II and Experimental Chemistry II

3. Prescribed Courses: Require a grade of C or better
   - STAT 401 Experimental Methods
   - STAT 461 Analysis of Variance
   - STAT 462 Applied Regression Analysis
   - STAT 464 Applied Nonparametric Statistics
   - STAT 466 Survey Sampling

Supporting Courses and Related Areas
Supporting Courses and Related Areas: Require a grade of C or better
   - Select 9 credits from a school-approved list

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.

1. Prescribed Courses: Require a grade of C or better
   - ACCTG 211 Financial and Managerial Accounting for Decision Making
   - ECON 102 Introductory Microeconomic Analysis and Policy
   - ECON 104 Introductory Macroeconomic Analysis and Policy
   - MIS 204 Introduction to Business Information Systems

2. Additional Courses: Require a grade of C or better
   - Select 6 credits from CMPSC 221 or higher, except CMPSC 360

Requirements for the Option
Requirements for the Option: Require a grade of C or better
   - Select an option (36-43 credits)

   Additional Courses
   - Select five of the following:
     - MATH 310 Elementary Combinatorics
     - MATH 412 Fourier Series and Partial Differential Equations
     - MATH 449 Applied Ordinary Differential Equations
     - MATH 455 Introduction to Numerical Analysis I
     - MATH 456 Introduction to Numerical Analysis II
     - MATH 482 Mathematical Methods of Operations Research
     - 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:
     - 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
   Supporting Courses and Related Areas: Require a grade of C or better
   - Select 9 credits from a school-approved list
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
MATH 455: Introduction to Numerical Analysis I
MATH 456: Introduction to Numerical Analysis II
MATH 465: Number Theory
MATH 482: Mathematical Methods of Operations Research
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 six of the following: 18

MATH 403: Classical Analysis I
MATH 421: Complex Analysis
MATH 429: Introduction to Topology
MATH 435: Basic Abstract Algebra
MATH 455: Introduction to Numerical Analysis I
MATH 456: Introduction to Numerical Analysis II
MATH 465: Number Theory
MATH 482: Mathematical Methods of Operations Research
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 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
Supporting Courses and Related Areas: Require a grade of C or better
Select 9 credits from a school-approved list

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 needed 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

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2019-20 academic year. To access previous years’ suggested academic plans, please visit the archive (http://bulletins.psu.edu/undergraduate/archive) to view the appropriate Undergraduate Bulletin edition (Note: the archive only contain suggested academic plans beginning with the 2018-19 edition of the Undergraduate Bulletin).

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.

<table>
<thead>
<tr>
<th>First Year</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 140&quot;#&quot;†</td>
<td>4</td>
<td>MATH 141&quot;#&quot;</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>15</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Second Year</td>
<td>Credits</td>
<td>Spring</td>
<td>Credits</td>
</tr>
<tr>
<td>Fall</td>
<td></td>
<td></td>
<td></td>
</tr>
<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>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></td>
<td>14.5</td>
<td></td>
<td>15.5</td>
</tr>
<tr>
<td>Third Year</td>
<td>Credits</td>
<td>Spring</td>
<td>Credits</td>
</tr>
<tr>
<td>Fall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 312†</td>
<td>3</td>
<td>ENGL 202C‡</td>
<td>3</td>
</tr>
</tbody>
</table>

Additional Course Selection (Group A)† | 3 |
Additional Course Selection (Group B)† | 3 |
General Education Course (GN Selection) † | 4 |
Program List Course* | 3 |

Fourth Year | Credits | Spring | Credits |
|            |         |        |         |
| Fall       |         |        |         |
| Additional Course Selection (Group A)† | 3 |
| Additional Course Selection (Group B)† | 3 |
| Elective Course | 3 | Program List Course † | 3 |
| General Education Course † | 3 | Elective Course | 3 |
| Program List Course* | 3 | General Education Course † | 3 |
|           | 15 |          | 15 |

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 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 465, STAT 462
**Spring (Odd Years)** - MATH 421, MATH 426, MATH 436, MATH 449, STAT 461
**Fall (Odd Years)** - MATH 412, MATH 435, STAT 414
**Spring (Even Years)** - MATH 410, MATH 429, MATH 456, MATH 482, one of either STAT 464 or STAT 466
**Spring (Occasional Offerings)** - MATH 403, MATH 426 or MATH 475W or MATH 497

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 462, 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, with the exception of CMPSC 360
- ACCTG 211
- 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 MKTG 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>Semester</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall</strong></td>
<td>MATH 140**#†</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>ENGL 15†</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CMPSC 121**†</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PSU 7</td>
<td>1</td>
</tr>
<tr>
<td><strong>General Education Course</strong></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>(GN Selection)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spring</strong></td>
<td>MATH 141**#</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>MATH 220*</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>CMPSC 122†</td>
<td>3</td>
</tr>
<tr>
<td><strong>General Education Course</strong></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>(GN Selection)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

### Second Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall</strong></td>
<td>CAS 100†</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MATH 230*</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>STAT 301*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ECON 104†</td>
<td>3</td>
</tr>
<tr>
<td><strong>General Education Course</strong></td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td>(GHW)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td></td>
<td>14.5</td>
</tr>
</tbody>
</table>

### Third Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall</strong></td>
<td>MATH 312*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ACCTG 211**</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Additional Course Selection</td>
<td></td>
</tr>
<tr>
<td>(Group A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>General Education Course</strong></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>(GN Selection)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

### Fourth Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall</strong></td>
<td>Additional Course Selection</td>
<td></td>
</tr>
<tr>
<td>(Group B)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Additional Course Selection</td>
<td></td>
</tr>
<tr>
<td>(Group C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Additional Course Selection</td>
<td></td>
</tr>
<tr>
<td>(Group D)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Program List Course*</td>
<td>3</td>
</tr>
<tr>
<td><strong>General Education Course</strong></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

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

* 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 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 465, STAT 462 |
| Spring (Odd Years) | MATH 421, MATH 426, MATH 436, MATH 449, STAT 461 |
| Fall (Odd Years) | MATH 412, MATH 435, STAT 414 |
| Spring (Even Years) | MATH 310, MATH 429, MATH 456, MATH 482, one of either STAT 464 or STAT 466 |
| Spring (Occasional Offerings) | MATH 403, MATH 426 or MATH 475W or MATH 497 |

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:** ECON 481, ECON 485, FIN 301, FIN 405, FIN 420, FIN 427, MGMT 301, MGMT 331, MGMT 341, MKTG 301, SCM 310
**Group B:** MATH 482, MIS 336, MIS 430, MIS 435, MIS 445, STAT 414, STAT 461, STAT 462, STAT 464, STAT 466

**Group C:** MATH 421, MATH 426, MATH 427, MATH 429, MATH 435, MATH 436, MATH 465
**Group D:** MIS 336, CMPSC 221 or higher, with the exception of CMPSC 360

No course may be used to fulfill the requirement in two different groups. For example, a student may not use MIS 336 to satisfy both the Group B and Group D requirements.

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.
- 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 MRKTD 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.

### First Year

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

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

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

### Fourth Year

<table>
<thead>
<tr>
<th>Program List Course</th>
<th>3 General Education Course</th>
<th>3 General Education Course</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

### Fall Credits Spring Credits

**Additional Course Selection (Group B)**
- 3 Additional Course Selection (Group B)

**Additional Course Selection (Group B)**
- 3 Program List Course

**Elective Course**
- 3 Elective Course

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

**Program List Course**
- 3 General Education Course

### Total Credits 121

1. Prerequisite: satisfactory performance on the MATH placement tests (ALEKS) - i.e. placement beyond the level of MATH 22; or MATH 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, QG, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and QG) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and QG) 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.

### 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 465, STAT 462
- **Spring (Odd Years)**: MATH 421, MATH 426, MATH 436, MATH 449, STAT 461
- **Fall (Odd Years)**: MATH 412, MATH 435, STAT 414
- **Spring (Even Years)**: MATH 310, MATH 429, MATH 456, MATH 482, one of either STAT 464 or STAT 466
- **Spring (Occasional Offerings)**: MATH 403, or MATH 426 or MATH 475W or MATH 497

### 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

### Program List Courses

- All 300- and 400-level courses in MATH 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
- CMPEN 441
- All 200- and above level courses in MIS
- All SCM courses, with the exception of SCM 200

### 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 report. Please consult with a Penn State academic adviser on a regular time. This plan should be used in conjunction with your degree audit report. Please consult with a Penn State academic adviser on a regular time.

### First Year

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

### Second Year

<table>
<thead>
<tr>
<th>Fall Credits</th>
<th>Spring Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS 100†</td>
<td>3 MATH 311W†</td>
</tr>
</tbody>
</table>
The document contains information about a program's requirements and course selections. Here is a summary of the key points:

### 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 pattern. The scheduling pattern below is tentative and subject to change:

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

### Scheduling Patterns

#### Fall (Odd Years)
- MATH 427, MATH 428, MATH 465, STAT 462
- MATH 412, MATH 435, STAT 414
- MATH 403, MATH 426 or MATH 475W or MATH 497

#### Fall (Even Years)
- MATH 421, MATH 426, MATH 436, MATH 449
- MATH 412, MATH 435, STAT 414

#### Spring (Odd Years)
- MATH 421, MATH 426, MATH 427, MATH 429, MATH 435, MATH 436, MATH 449
- MATH 412, MATH 435, STAT 414

#### Spring (Even Years)
- MATH 403, or MATH 426 or MATH 475W or MATH 497

### 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

### University Requirements and General Education Notes:

- **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:

- **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.**
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 additional coursework in statistics, management information systems, economics, and finance. The Computer Science Option emphasizes 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.

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, data analysis, financial analysis, national security and defense, 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.

Opportunities for Graduate Studies

Graduates may continue their studies to earn a master's or doctoral degree in pure math, applied math, or other technical fields. 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.

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