

# THE HANDBOOK FOR MATHEMATICS

## AT BRYN MAWR COLLEGE

2017–2018

Greetings from the Department of Mathematics at Bryn Mawr College. You are about to embark on the exhilarating adventure of studying mathematics in the context of a liberal arts education. The field of mathematics offers students a vast array of opportunities for careers and for graduate school; the possibilities for your future are almost endless. In this handbook, you will find a variety of information from the mathematics department on this exciting discipline. However you choose to include mathematics in your four-year curriculum at Bryn Mawr, you may well find it to be more useful, practical, challenging, stimulating, rewarding, and beneficial than you ever imagined.

*Welcome aboard, and enjoy the ride!*

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Our Mathematics Department Web Site: <http://www.brynmawr.edu/math>

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## I. MAJORING IN MATHEMATICS AT BRYN MAWR

A minimum of 10 semester courses is required for the Mathematics Major at Bryn Mawr College, including the *six core courses* listed below and *four additional electives* at or above the 200-level.

### Core Requirements:

- Multivariable Calculus (201/H121)
- Linear Algebra (203/H215)
- Real Analysis I (301/H317)
- Abstract Algebra I (303/H333)
- Real Analysis II (302/H318) or Abstract Algebra II (304/H334)
- Senior Conference (398 or 399)

Math 301 and 303 are writing attentive (WA) courses that will satisfy the writing requirement in the discipline. Math 206 (Transition to Higher Mathematics) is also designated as a WA course and could be used in place of either Math 301 or Math 303 to fulfill the writing requirement. A list of all our courses, with brief descriptions, is contained in Section VI of this handbook. The Appendix contains a variety of sample four-year plans to complete the math major. However, each student *must* design a specific program of study with the advice of a Major Advisor.

Math majors are encouraged to complete their core requirements (other than Senior Conference) by the end of their junior year. With the exception of Senior Conference, equivalent courses at Haverford or elsewhere may be substituted for Bryn Mawr courses, but ***Senior Conference must be taken at Bryn Mawr during the senior year.***

Often, courses in fields outside of mathematics have serious mathematical content appropriate for the Mathematics major. Courses, taught in other departments, that currently satisfy the elective requirements of the major (or the 200 level courses required for the minor) are as follows: Economics 304 (Econometrics at Bryn Mawr or the analogous Haverford course); Physics 306 (Mathematical Methods in the Physical Sciences); Chemistry 221 (Physical Chemistry I); Chemistry 321 (Mathematical Modeling of Natural Processes or Quantum Chemistry); Computer Science 231 (Discrete Mathematics with Applications); Computer Science H340 (Analysis of Algorithms) or H345 (Theory of Computation), both at Haverford.

### The AB/MA Option

For students entering with advanced placement credits, it is possible to earn both the AB and the MA degrees in four years at Bryn Mawr. See a sample program to illustrate this option in Appendix F.

### Faculty Advisors

- For graduate students: Paul Melvin
- For seniors: Leslie Cheng (Fall), Lisa Traynor (Spring)
- For juniors: Djordje Milićević
- For sophomores: Victor Donnay
- For freshmen: Lisa Traynor
- For the Math Minor: Peter Kasius
- Non-Major Advising: Amy Myers
- Study Abroad Advising: Erica Graham
- Summer Research (REU) Advising: Erica Graham

II. FREQUENTLY ASKED QUESTIONS ABOUT MATHEMATICS AT BRYN MAWR

**(1) *Is there a math requirement at Bryn Mawr?***

No, but every student who enters Bryn Mawr is required to fulfill the 2-tiered Quantitative requirement.

Tier 1 of this requirement is “Quantitative Readiness” (QR). Every student is required to demonstrate Quantitative Readiness by reaching a benchmark on the SAT, ACT, or Bryn Mawr’s Q test (given during Customs Week) or by passing the Introduction to Quantitative Reasoning (Qsem) course during the first year at Bryn Mawr.

Tier 2 is a “Quantitative and Mathematical Reasoning” requirement (QM), which can be fulfilled by taking one course identified as a QM course. Many courses in Mathematics, the Sciences, and the Social Sciences fulfill the QM course requirement, including any mathematics course at the 100-level or above. Every student is required to complete one QM course prior to Fall semester of the senior year.

**(2) *What Advanced Placement Exam scores or IB Higher Level Exam scores are needed for credit in mathematics at Bryn Mawr?***

If you scored a 4 or 5 on the Advanced Placement Calculus BC Exam, or a 5, 6, or 7 on the IB Higher Level Exam, then you have earned *two* course credits toward your Bryn Mawr degree. Your first mathematics course will be Math 201 (Multivariable Calculus). If you scored a 4 or 5 on the Advanced Placement Calculus AB exam, then you have earned *one* course credit toward your degree. Your first math course will be either Math 102 (Calculus II) or Math 201. See Appendix C for the Sample Program to major in mathematics if Math 201 is your first math course and Appendix B for the Sample Program to major in mathematics if Math 102 is your first math course. All other students are strongly encouraged to take the Mathematics Placement Exam so they can be best advised.

**(3) *What help and support systems are available in Bryn Mawr’s math program?***

The support structure of the Bryn Mawr Mathematics Department is second to none. Faculty members post office hours to guarantee times when they are available to help students; but, in general, the faculty welcome students to ask questions at any time, both in and out of class. In addition to faculty office hours, the department has problem sessions scheduled for most courses several times during the week, so that students can get help on homework and course assignments. Student study groups are organized and strongly encouraged in most math classes. There is also a private tutoring service, free of charge, provided by the Deans’ Office for all introductory courses.

**(4) *What special arrangements are needed to complete double majors?***

A satisfactory program must be developed to meet the requirements of both majors. Typically, only one or two courses may be counted toward both major programs, and the details need to be approved. Meet with a Major Advisor in each department to plan a schedule. (See the Appendix of Sample Programs for examples.) It is wise to complete advanced courses (and some research, if possible) in the field you wish to pursue as a career. CAUTION: This can be an overload! Double majoring can mean that you do a minimum major in each subject instead of going more deeply into one or the other.

**(5) *What is required to minor in mathematics?***

A minor in mathematics requires five courses in mathematics at the 200-level or higher, of which at least two must be at the 300-level or higher.

**(6) *Can I take a semester abroad, while majoring in mathematics?***

Programs can be arranged at various foreign universities. Discussion with the Major Advisor must take place as early as possible to assess the feasibility of accomplishing this within the mathematics major. See Sample Programs in Appendix D and Appendix E. In recent years, students have attended programs in England, Scotland, Australia, and Spain, just to name a few. For those strongly interested in mathematics, there are very intensive programs in Budapest, Hungary and in Moscow, Russia. See the respective websites: [www.budapestsemesters.com](http://www.budapestsemesters.com) and [www.mccme.ru/mathinmoscow](http://www.mccme.ru/mathinmoscow). In addition, you may wish to speak with Professor Amy N. Myers ([anmyers@brynmawr.edu](mailto:anmyers@brynmawr.edu)) about her experience as a student in the Budapest Program.

**(7) *What should I do to prepare for high school teaching of mathematics?***

Students can major in mathematics and earn Pennsylvania Secondary School Teaching Certification in mathematics by completing the requirements set by the Education Program. Interested students should consult early with an advisor from the Education Program for appropriate Education courses that culminate with the Practice Teaching experience during the second semester of the senior year. See Appendix H for a Sample Program. It is also possible to major in Mathematics and complete just a minor in Education. In addition, there is a 5th year teacher certification option available where graduates of Bryn Mawr and Haverford Colleges may obtain PA state certification by completing an additional year of study at reduced tuition. See the Teacher Education web site at [www.brynmawr.edu/education](http://www.brynmawr.edu/education) for details. One can also consider private schools, which do not require education and teacher certification courses. Many masters degree programs in education or teaching give training and certification for students with undergraduate majors in science disciplines. In addition, the Teach for America program aims to encourage graduates with bachelors degrees in science to consider teaching as a career ([www.teachforamerica.org](http://www.teachforamerica.org)).

Keep in mind that employment in the mathematics department in the following capacities provides *excellent preparation* for teaching: grading homework assignments, running problem sessions, serving as a mathematics lab supervisor, tutoring, and peer instructing.

**(8) *What opportunities for student employment exist in the Math Department?***

Mathematics majors can apply for employment in the Mathematics Department. Positions that are available each academic year are as follows: grader of homework assignments, problem session instructor, mathematics computer lab supervisor and grader of labs, private tutor, or office assistant to the academic administrative assistant of the Mathematics Department. Fill out the application for employment online at: <http://www.brynmawr.edu/math/application-employment>. Any questions should be directed to Amy N. Myers at [anmyers@brynmawr.edu](mailto:anmyers@brynmawr.edu).

**(9) *Is independent research possible for undergraduates?***

Increasing numbers of undergraduates are getting a sneak preview of research mathematics by attending one of the many Research Experiences for Undergraduates (REUs) offered each summer throughout the country. Check out the list of programs at

*[http://www.nsf.gov/crssprgm/reu/list\\_result.cfm?unitid=5044](http://www.nsf.gov/crssprgm/reu/list_result.cfm?unitid=5044)*

Students may also apply for a summer stipend to do research at Bryn Mawr with a professor. During the academic year, research may be done for credit by making arrangements with a research supervisor and then enrolling in the proper sections of Math 395 or 396 (Research Seminar) or Math 403 (Supervised Work). Research in the summers and during the academic year is encouraged for students if it meets their career goals, but it is not required for the major. In all circumstances, research should not be viewed as a substitute for enrolling in advanced courses in the major.

**(10) *What is required to earn a degree with honors in mathematics?***

Students majoring in mathematics are eligible for a degree with honors if they complete the major in mathematics and meet the following additional criteria:

- A major grade point average of at least 3.6, calculated at the end of the senior year;
- At least two additional semesters of work at the 300-level or above (this may include research courses);
- Completion of a meritorious project consisting of a written thesis and an oral presentation of the thesis.

An honors project normally requires two semesters of independent study with a faculty member. Students interested in pursuing honors should approach faculty members at the end of their junior year to determine the availability of a project of mutual interest. The formal decision on honors is determined by a vote of the math faculty based on the written thesis and the oral presentation.

**(11) *Can I take graduate courses while maintaining undergraduate status?***

Students who have completed advanced undergraduate courses because of Advanced Placement exams or another acceleration process may be given permission by the department to enroll in graduate courses. This gives advanced students an opportunity to study mathematical content at a sophisticated level beyond the normal undergraduate challenges. Accelerated students may also choose to complete both an A.B. and an M.A. in mathematics, as part of the College's A.B./M.A. program. The norm for this program is for a student to complete the work in four years, doing research for and writing an M.A. thesis in the fourth year. Details of the requirements must be discussed with a Major Advisor as early as possible. See a Sample Program in Appendix F.

**(12) *What are the 4+1 and 3-2 Engineering Partnerships with Penn and Caltech?***

Students can, in five years, complete both their undergraduate degree at Bryn Mawr and a masters degree in engineering through partnerships with the University of Pennsylvania or the California Institute of Technology. To discuss the details, consult with any faculty member in the department.

### III. MATHEMATICS DEPARTMENT ACTIVITIES

The Mathematics Department at Bryn Mawr College believes in cultivating a vibrant and enriching environment with a sense of community and fellowship for all those studying mathematics. To that end, the shared Mathematics and Physics Lounge (Park 339) serves as a pleasant place for mathematics majors to congregate and to rest, relax, and revitalize at any time of the day. The room is a virtual haven for all majoring in mathematics, and one can replenish energy and ideas there. The room is furnished with tables and lounge chairs, as well as a full-size refrigerator and a microwave. Most of the mathematics department social activities will take place in this lounge.

There are many activities sponsored by the Department of Mathematics including:

- Welcome Back Toast in September,
- Majors' Information Sessions in the fall and the spring,
- Poster Session/Holiday Party in December,
- Math Appreciation Week in April,
- Weekly Bi-College Colloquium,
- Weekly Distressing Math Collective (DMC),
- Mathematics Problem Solving Seminars,
- Career Talks given by alumnae,
- Panel Discussions, and
- Excursions to Mathematical Conferences.

There are many opportunities for students to gain valuable leadership skills by volunteering! Here is a sample of some opportunities.

**Senior/Junior Major Reps:** The Major Reps are senior/junior mathematics majors who serve as liaisons between faculty and students. They give input in evaluating candidates to fill faculty positions. When a faculty member is going up for reappointment or promotion, the Major Reps are in charge of summarizing the student letters concerning the faculty member's teaching. The Major Reps are also involved in planning the primary social events during the school year, which include the Welcome Back Toast, Majors Information Sessions, and the Poster Session/Holiday Party.

**Distressing Math Collective (DMC) Coordinator:** This student organizes the meetings of the Distressing Math Collective, a group started in 1997 by students wanting to discuss mathematical paradoxes and other mathematical topics not usually covered in math courses. In recent years, meetings have consisted of a math talk given by a volunteer, followed by math-oriented-game-playing. The DMC attracts a mix of undergraduate students, graduate students, faculty, alumnae, and friends.

IV. CAREERS OF MATHEMATICS MAJORS

Studying or majoring in mathematics opens the door to an enormous number of opportunities in the job market as well as in graduate school – so much so that mathematics is hailed as one of the most versatile majors available. Check out a number of “best jobs” web sites, such as

- Glass Door — [http://www.glassdoor.com/List/Best-Jobs-in-America-LST\\_KQ0,20.htm](http://www.glassdoor.com/List/Best-Jobs-in-America-LST_KQ0,20.htm), or
- CNN — <http://money.cnn.com/pf/best-jobs/2017/list/>,

and you will find that jobs demanding strong quantitative skills are highly ranked in terms of big growth, high pay, and job satisfaction. The following sites contain valuable information regarding careers in mathematics:

<http://www.maa.org/students/career.html>  
<http://www.siam.org/careers/thinking.php>  
<http://sites.google.com/site/awmmath/info/undergrads>  
<http://www.beanactuary.org>  
<http://www.msri.org/ext/CareersInMathematics.html>  
<http://www.coolmath.com/careers.htm> .

**“Do math and a wide variety of exciting careers open up!”**

The Leadership, Innovation, and Liberal Arts Center (LILAC), located on the second floor of the Campus Center, can assist you in finding internships, research jobs, jobs in not-for-profit organizations, and summer jobs, as well as full-time jobs and information on graduate/professional schools upon graduation. Visit LILAC and explore their resources. Consider making an appointment with a Career and Professional Development counselor (ext. 5174) early in your college career. The web site is: <http://www.brynmawr.edu/cpd/> .

Below is a selection of statements from some Bryn Mawr graduates who majored in mathematics. The diversity of the fields pursued underscores the value of mathematics in every walk of life!

**Michelle Lacey '94, Associate Professor of Mathematics at Tulane University:**

“... My Mathematics degree helped me to secure my first job as a Research Assistant with a small software development contractor in Washington, DC. Through my work experience, I developed an interest in statistical models and decided to apply to graduate programs in Statistics. I was accepted into the Ph.D. program at Yale University in 1996 (I can definitely give my Bryn Mawr education most of the credit for that!), and my dissertation was related to statistical methods for reconstructing evolutionary relationships from molecular sequences. I joined the Mathematics Department at Tulane University in 2003. My position has been great – a nice mix of teaching undergraduate and graduate courses, working with students on independent study projects, and pursuing exciting research in collaboration with members of the Tulane Cancer Center. I’m really grateful to Bryn Mawr for giving me the opportunity to study in such a nourishing environment – if it wasn’t for the inspiring professors who encouraged me to major in Mathematics, my life would certainly have taken a very different path.”

**Hilary Cooke '98, Associate Rector at St. John's Episcopal Church Lafayette and formerly Princeton Theological Seminary:**

I did “a four year joint program with Rutgers, graduating with a Master of Divinity and a Master of Social Work and eventually practice pastoral counseling. I am living proof that you can do anything with a degree in mathematics. You might not believe it but I do actually use my math here.”

**Lindsay Moore '00, Postdoctoral Researcher at Technion Medical School in Israel:**

“I graduated in 2000 with a double major in math and physics. I was a graduate student in the physics department at Stanford University getting my PhD in condensed matter physics from summer 2000 and obtained my PhD in 2009. My research is about special properties of electrons in quantum dots. I design and make microchips so that I can control the behavior of small numbers of electrons that are confined to 2 dimensions. Some of the work that we did in my group may someday be used for quantum computers because we were able to control the spin and other quantum properties of the electrons in our devices. My math major has been extremely useful to me, partly because math is such an integral part of physics, and also because it allows me to broaden my PhD studies. For example, I could TA classes in the math and physics departments here at Stanford, as well as taking graduate courses in both fields. I also had an edge in my graduate physics classes because a number of my classmates had to learn about group theory, non-linear dynamics and complex analysis for the first time when they got here; whereas, I had already taken a course on each of those topics. In case you were wondering (as I did), BMC prepared me very well for graduate school. I found the work load at Stanford to be comparable to the work that I was doing my junior and senior years at Bryn Mawr with a double major.”

**Lisa Duffy-Reckner '01, pediatrics doctor at Holy Spirit Hospital and Pinnacle-health Community Campus General Osteopathic Hospital in Mechanicsburg, PA:**

“While I did not go into a career directly related to mathematics, my training at Bryn Mawr prepared me to be an analytic thinker. I think being a math major will help me as a diagnostician because as a math major you learn to be a good problem solver and thinker.”

**Rachael Thomas '01, high school math teacher at Hershey Christian School:**

“I am currently teaching Geometry, Algebra II, second-year Calculus, and an elective course called ‘Math for the Social Sciences’ which examines voting systems, fair division, growth models, symmetry, and the math of art and architecture. I definitely use what I learned at BMC every single day – not just the actual math I learned (which I do actually use – I even taught a seminar on Knot Theory last year!), but also the teaching skills I gleaned from interacting with talented educators every day. Bryn Mawr taught me a lot about math and a lot about life; even though I didn't realize it at first, I was completely prepared to enter the classroom, and I love what I do!”

**Meridith Unger '01, Founder and CEO of Nix**

“I’ve found that a degree in math demands a certain amount of respect from the business world. They seem to think we’re rocket scientists, allowing math majors to pursue almost any career path. In addition to playing the mathematics card, I’ve also been able to really use my liberal arts education to my advantage. It has been agreed time and time again that an individual with a degree from a liberal arts college has a determination, perseverance and well roundedness that is lacking in so many others. These are qualities far more impressive in the business world than what business, economics, or accounting classes you might have taken in school.”

**Anna Gordon A.B./M.A. '07, Sales Strategy Senior Manager at Salesforce:**

“After graduating from the A.B./M.A. program, I went on to GWU for a Ph.D. in Statistics. After finishing the Ph.D. in 2012, I moved to San Francisco to pursue a career as a data scientist in the tech industry. I am now a senior manager of sales strategy at Salesforce, which entails leading statistical analysis and forecasting projects, and disseminating the insights throughout the business. I do math every day, from business intelligence that helps decision makers gain critical insights, to machine learning that becomes data-driven features in the product.”

**Christine Kim '07, Senior Revenue Analyst at NBC Sports Group (Comcast Sportsnet):**

“...One thing I learned from how things worked out for me and other BMC grads is that a liberal arts math major really provides a great stepping stone into so many industries and professions (I could combine my communication/writing skills and my analytical skills and present to execs and crossover to many other aspects of a corporate setting). Colleagues and higher ups trusted my “data integrity” side because I was a math major, and they appreciated my ability to speak up and present trends/findings clearly. When I was interviewing for jobs, people were and still are impressed by the math major from a women’s college thing – it tends to stand out on its own....”

**Sarah Khasawinah A.B./M.A. '09, Senate Health and Aging Policy Fellow:**

“After Bryn Mawr, I went to Johns Hopkins, where I completed an MHS in Biostatistics and PhD in Mental Health. Now I am a Health and Aging Policy Fellow. I work in the Senate to improve the health and wellbeing of older Americans. Math connects with my position in myriad ways. From basic math literacy to advanced mathematical understanding, I use mathematics and statistics regularly when analyzing data, writing reports, and making recommendations.”

**Sarah Hockley '11, Medical Student at Marian University College of Osteopathic Medicine:**

“After graduating from Bryn Mawr, I got my M.S. in biology and am now in my last year of medical school at Marian University College of Osteopathic Medicine and am hoping to go into emergency medicine. I had thought that, at this point in my education, the raised eyebrows and grimaces would be over when I told people I majored in mathematics. However, whenever we need to calculate drug doses or infusion rates, or we’re analyzing new research studies, everyone turns to me to make sense of the graphs and numbers. What they may not realize is that it’s more than just being able to make sense of the Michaelis Menten equations or drug half lives; having a math degree, and particularly at Bryn Mawr, means I know how to think through problems.”

**Adèle Mirbey '11, Dentist in Orlando, Florida:**

“After graduating, I took a year off where I was working as a Research Administrator at the Hospital for Special Surgery in New York. In August 2012, I attended dental school at Nova Southeastern University in Florida for four years, and I am now working as a dentist in Orlando, Fla. Math is an important part of my work when it comes to determining the right dosage for anesthesia. A calculation that is based on the patient’s weight is necessary in order to administer a safe amount.”

**Ivy Gluck '14, Equity Analyst at Brandywine Global:**

“Since graduating Bryn Mawr, I have been working at Brandywine Global, a Philadelphia-based asset management firm. I work on a large-cap value investment fund as an equity analyst. My team has a value investment philosophy with a contrarian approach that emphasizes behavioral finance...The classes I most utilize day-to-day are statistics and probability. With every stock I research I am analyzing different possible outcomes and putting probabilities on each outcome to calculate an expected value. I am always thinking in term of risk-adjusted outcomes. From statistics, I frequently look at cross-sectional data and longitudinal data to analyze how a companys financial position differs from its peer group and has changed over time.”

**Mary Miller '14, Senior Statistician:**

“After graduating from Bryn Mawr, I continued working as an intern at the UPenn School of Nursing Biostatistics Consulting Unit while also completing a Master of Science degree in Biostatistics from the Dornsife School of Public Health at Drexel University. Near the end of my program, I accepted a position with Eli Lilly and Company as a Senior Statistician and later relocated to Indianapolis, Indiana, to begin my career in the pharmaceutical industry. I began working at Lilly in August of 2016 and currently provide statistical support to clinical trials in the Oncology Business Unit. My role as a statistician is very versatile and exciting. I collaborate with study personnel to provide input to statistical analysis plans (SAP), I’m accountable for implementing statistical methods for data analyses that comply with CDISC (Clinical Data Interchange Standards Consortium) as well as coding, and much more...”

### SAMPLE RESUME

*Below is a sample resume for a student applying for a summer internship in the field of mathematics. Contact the Career and Professional Development Office (x5174) for complete information on resume writing.*

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#### EAGER STUDENT

estudent@brynawr.edu

610-555-xxxx

#### Campus Address

Bryn Mawr College C-xxx  
Bryn Mawr, PA 19010-2899

#### Permanent Address

1776 Calculus Street  
Your Town, State Zip

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### EDUCATION

**Bryn Mawr College**, Bryn Mawr, PA; 2014–present

Bachelor of Arts Candidate: Expected graduation, May 2018

- Major: Mathematics                      Minor: History of Art
- GPA: 3.65                                      Major GPA: 3.75

**Relevant Coursework:** Real Analysis I, Abstract Algebra I and II, Differential Equations, Linear Algebra, Transition to Higher Mathematics, Multivariable Calculus, Calculus I and II.

**Glory Days High School**, Any Town, State; graduated 2014

*Honors:* Excellence in Science Award, History Day Award, National Honor Society, Rotary Club Student of the Month

### WORK EXPERIENCE

#### Bryn Mawr College Department of Mathematics

*Computer Laboratory Supervisor: 2015–present*

- Assist students with Mathematica computer assignments
- Grade lab work and semester projects

*Mathematics Grader: 2015–2016 academic year*

- Graded weekly assignments for Calculus I and II
- Assisted professor with quiz grading

#### Bryn Mawr College Admissions Office

*Tour Guide: Fall 2014–present*

- Conduct tours of Bryn Mawr College for prospective students and their parents
- Assist with mailings, filing, and telephone calls

### VOLUNTEER WORK

Mathematics tutor at Nearby Middle School (3 hours per week) during 2014–2015 academic year

### ACTIVITIES

*Bryn Mawr Mathematics Department, Student Leader*

- Organize excursions for mathematics majors to attend regional MAA meetings

*Bryn Mawr Business and Finance Society, member*

- Participate in workshops on resume writing and interview skills

### SKILLS

*Computer:* Microsoft Office: Word, PowerPoint, Excel, Mathematica, R, LaTeX, Dreamweaver

*Miscellaneous:* Proficient in written and spoken Spanish

V. PREPARING FOR GRADUATE STUDY IN MATHEMATICS

Students majoring in mathematics at Bryn Mawr often wish to go on to graduate school to continue their pursuit of mathematics or a related field. A faculty member in the Mathematics Department should be consulted as early as possible to outline a suitable course of action.

With this in mind, the student should plan to go well beyond the minimum requirements of the major by enrolling in mathematics electives at the 300-level as often as possible in the junior and senior years. Participation in summer research programs, such as REUs (Research Experiences for Undergraduates), is a good way to learn about mathematics research, as is writing an honors thesis during the senior year. Meetings of professional mathematics associations, such as the Mathematical Association of America [www.maa.org](http://www.maa.org) and the American Mathematical Society [www.ams.org](http://www.ams.org), can provide another useful perspective on mathematics research and graduate programs in mathematics. Preparation for the GRE Mathematics Subject Test, and taking the exam, should be accomplished in a timely fashion.

Students who decide to apply to graduate school may also wish to apply to the EDGE (Enhancing Diversity in Graduate Education) program [www.edgeforwomen.org](http://www.edgeforwomen.org), cofounded by Bryn Mawr Professor Emeritus Rhonda Hughes, which provides a curriculum designed to strengthen the ability of women and minority students to successfully complete graduate programs in the mathematical sciences.

Over the past years, Bryn Mawr mathematics majors have enrolled in graduate programs at a wide variety of institutions, including Brown, Cornell, Harvard, Johns Hopkins, MIT, Penn, Rice, Stanford, Texas, UCLA, Yale, U.C. Berkeley, Duke University, Boston University, U.C. Davis, University of Iowa, University of Maryland, University of Michigan, North Carolina State University, Temple University, University of Pittsburgh, U.C. Santa Barbara, Tufts University, and Wesleyan University.

Mathematics majors can pursue graduate study in a vast array of fields, including:

- Pure Mathematics
- Applied Mathematics
- Statistics
- Biostatistics
- Operations Research
- Financial Mathematics
- Financial Engineering
- Mathematical Biology
- Mathematics Education
- Actuarial Science
- Engineering Science.

For additional information on all aspects of graduate study please visit [gradschool.about.com](http://gradschool.about.com) .

VI. COURSE LIST

UNDERGRADUATE COURSES :

**MATH B001 Fundamentals of Mathematics**

Basic techniques of algebra, analytic geometry, graphing, and trigonometry for students who need to improve these skills before entering other courses that use them, both inside and outside mathematics. Placement in this course is by advice of the department and permission of the instructor. *Not offered in 2017–2018*

**MATH B101 Calculus I**

A first course in one-variable calculus: Functions, limits, continuity, the derivative, differentiation formulas, applications of the derivative, the integral, integration by substitution, fundamental theorem of calculus. May include a computer component. Prerequisite: adequate score on calculus placement exam or permission of the instructor. *Myers, Smiley: Fall 2017*

**MATH B102 Calculus II**

A continuation of Calculus I: Transcendental functions, techniques of integration, applications of integration, infinite sequences and series, convergence tests, power series. May include a computer component. Prerequisite: merit grade in MATH 101, adequate score on calculus placement exam or permission of the instructor. *Kasius: Fall 2017, Kasius, Myers: Spring 2018*

**MATH B104 Basic Probability and Statistics**

This course introduces students to key concepts in both descriptive and inferential statistics. Students learn how to collect, describe, display, and interpret both raw and summarized data in meaningful ways. Topics include summary statistics, graphical displays, correlation, regression, probability, the law of averages, expected value, standard error, the central limit theorem, hypothesis testing, sampling procedures, and bias. Students learn to use statistical software to summarize, present, and interpret data. This course may not be taken after any other statistics course. Prerequisite: math readiness or permission of instructor.

*Sudparid: Fall 2017, Spring 2018*

**MATH B201 Multivariable Calculus**

Vectors and geometry in two and three dimensions, partial derivatives, extremal problems, double and triple integrals, vector analysis (gradients, curl and divergence), line and surface integrals, the theorems of Gauss, Green and Stokes. May include a computer component. Prerequisite: adequate score on calculus placement exam, MATH 102, or permission of instructor. *Donnay, Kasius: Fall 2017*

**MATH B203 Linear Algebra**

Systems of linear equations, matrix algebra, determinants, vector spaces and subspaces, linear independence, bases and dimension, linear transformations and their representation by matrices, eigenvectors and eigenvalues, orthogonality, and applications of linear algebra. Pre or corequisite: MATH 102, or permission of the instructor.

*Donnay, Kasius: Spring 2018*

**MATH B205 Theory of Probability with Applications**

Random variables, probability distributions on  $\mathbb{R}^n$ , limit theorems, random processes. Prerequisite: MATH 201. *Not offered in 2017–2018*

**MATH B206 Transition to Higher Mathematics**

An introduction to higher mathematics with a focus on proof writing. Topics include active reading of mathematics, constructing appropriate examples, problem solving, logical reasoning, and communication of mathematics through proofs. Students will develop skills while exploring key concepts from algebra, analysis, topology, and other advanced fields. Corequisite: MATH 203; not open to students who have had a 300-level math course.

*Myers: Spring 2018*

**MATH B210 Differential Equations with Applications**

Ordinary differential equations, including general first-order equations, linear equations of higher order and systems of equations, via numerical, geometrical, and analytic methods. Applications to physics, biology, and economics. Corequisite: MATH 201 or 203. *Graham: Spring 2018*

**MATH B221 Introduction to Topology and Geometry**

An introduction to the ideas of topology and geometry through the study of knots and surfaces in three-dimensional space. The course will also include some historical perspectives, and some discussion of applications in the natural and life sciences. Corequisite: MATH 201 or 203. *Traynor: Spring 2018*

**MATH B225 Introduction to Financial Mathematics**

Topics to be covered include market conventions and instruments, Black-Scholes option-pricing model, and practical aspects of trading and hedging. All necessary definitions from probability theory (random variables, normal and lognormal distribution, etc.) will be explained. Prerequisite: MATH 102. *Cheng: Fall 2017*

**CMSC B231 Discrete Mathematics**

An introduction to discrete mathematics with strong applications to computer science. Topics include set theory, functions and relations, propositional logic, proof techniques, recursion, counting techniques, difference equations, graphs, and trees. Corequisite: CMSC B110 or CMSC H105. Cross-listed as CMSC B231. *Eisenberg: Fall 2017*

**MATH B251 Introduction to Chaotic Dynamical Systems**

Topics to be covered may include iteration, orbits, graphical and computer analysis, bifurcations, symbolic dynamics, fractals, complex dynamics and applications. Prerequisite: MATH 102. *Not offered in 2017–2018*

**MATH B261 Introduction to Harmonic Analysis and Wavelets**

A first introduction to harmonic analysis and wavelets. Topics to be covered: Fourier series, Fourier transform, wavelets, and their applications, including signal processing and medical imaging. Prerequisite: MATH 203 or permission of instructor. *Not offered in 2017–2018*

**MATH B290 Elementary Number Theory**

Properties of the integers, divisibility, primality and factorization, congruences, Chinese remainder theorem, multiplicative functions, quadratic residues and quadratic reciprocity, continued fractions, and applications to computer science and cryptography. Prerequisite: MATH 102. *Not offered in 2017–2018*

**MATH B295 Select Topics in Mathematics**

This course will cover topics that are not part of the standard departmental offerings and will vary from semester to semester. Students may take this course more than once. Prerequisites vary, depending on the topic.

This year there will be two sections of this course with the following topics.

**Computational Modeling:** Mathematical models are constructed to describe the world within and around us. Computational methods are often employed to visualize and solve these models. Collectively, computational modeling from a mathematical perspective focuses on using computers to simulate dynamics that are described mathematically. This course will provide an introduction to programming in R and mathematical modeling. Topics may include discrete and continuous dynamical systems, data fitting, regression, and simulation techniques. Prerequisite: MATH 102. *Graham: Fall 2017*

**Math Modeling and Sustainability:** This course will explore how to create mathematical models of problems in sustainability such as  $CO_2$  levels, ground water flow, energy use in transportation and heating, and energy generation via wind and solar power. This is Praxis II course in which students will work in teams and use their mathematical knowledge to carry out a sustainability project of use to a community partner. Prerequisite: MATH 102. Not open to first year students. *Donnay: Spring 2018*

**MATH B301 Real Analysis I**

A first course in real analysis, providing a rigorous development of single variable calculus, with a strong focus on proof writing. Topics covered: the real number system, elements of set theory and topology, limits, continuous functions, the intermediate and extreme value theorems, differentiable functions and the mean value theorem, uniform continuity, the Riemann integral, the fundamental theorem of calculus. Possible additional topics include analysis on metric spaces or dynamical systems. Prerequisite: MATH 201. Some students also find it helpful to have taken a proof oriented course such as MATH 206 before enrolling in this course.

*Donnay, Miličević: Fall 2017*

**MATH B302 Real Analysis II**

A continuation of Real Analysis I: Infinite series, power series, sequences and series of functions, pointwise and uniform convergence, and additional topics selected from: Fourier series, calculus of variations, the Lebesgue integral, dynamical systems, and calculus in higher dimensions. Prerequisite: MATH 301. *Miličević: Spring 2018*

**MATH B303 Abstract Algebra I**

A first course in abstract algebra, including an introduction to groups, rings and fields, and their homomorphisms.

Topics covered: cyclic and dihedral groups, the symmetric and alternating groups, direct products and finitely generated abelian groups, cosets, Lagrange's Theorem, normal subgroups and quotient groups, the isomorphism theorems, integral domains, polynomial rings, ideals, quotient rings, prime and maximal ideals. Additional topics may include group actions and the Sylow Theorems, free abelian groups, free groups, PIDs and UFDs. Prerequisite: MATH 203. Some students also find it helpful to have taken a proof oriented course such as MATH 206 before enrolling in this course. *Cheng, Melvin: Fall 2017*

**MATH B304 Abstract Algebra II**

A continuation of Abstract Algebra I. Vector spaces and linear algebra, field extensions, algebraic and transcendental extensions, finite fields, fields of fractions, field automorphisms, the isomorphism extension theorem, splitting fields, separable and inseparable extensions, algebraic closures, and Galois theory. Also, if not covered in Abstract Algebra I: group actions and Sylow theorems, free abelian groups, free groups, PIDs and UFDs. Possible additional topics: finitely generated modules over a PID and canonical forms of matrices. Prerequisite: MATH 303. *Melvin: Spring 2018*

**MATH B308 Applied Mathematics I**

This course will provide a general introduction to methods and modeling in applied mathematics. A variety of mathematical tools will be used to develop and study a wide range of models, including deterministic, discrete, and stochastic methods. Additional emphasis will be placed on techniques for analyzing mathematical models, including phase plane methods, stability analysis, dimensional analysis, bifurcation theory, and computer simulations. Applications to biology, physics, chemistry, engineering, and the social sciences may be discussed. Prerequisite: Math 203 or equivalent, or permission from instructor. *Not offered in 2017–2018*

**MATH B310 Mathematics of Financial Derivatives**

An introduction to the mathematics utilized in the pricing models of derivative instruments. Topics to be covered may include Arbitrage Theorem, pricing derivatives, Wiener and Poisson processes, martingales and martingale representations, Ito's Lemma, Black-Scholes partial differentiation equation, Girsanov Theorem and Feynman-Kac Formula. Prerequisite: MATH 201 or permission of instructor. *Not offered in 2017–2018*

**MATH B311 Partial Differential Equations**

Heat and wave equations on bounded and unbounded domains, Laplace's equation, Fourier series and the Fourier transform, qualitative behavior of solutions, computational methods. Applications to the physical and life sciences. Prerequisite: MATH 301 or permission of instructor. *Not offered in 2017–2018*

**MATH B312 Topology**

General topology (topological spaces, continuity, compactness, connectedness, quotient spaces), the fundamental group and covering spaces, introduction to geometric topology (classification of surfaces, manifolds). Typically offered yearly in alternation with Haverford. Corequisite: MATH 301, MATH 303, or permission of instructor. *Not offered in 2017–2018*

**MATH B315 Geometry**

Differential geometry of curves and surfaces in three-dimensional space. The concepts of curvature and torsion of curves, and of Gaussian curvature of surfaces, will be developed using Frenet frames and shape operators. Prerequisite: MATH 201. *Not offered in 2017–2018*

**MATH B322 Functions of Complex Variables**

Analytic functions, Cauchy's theorem, Laurent series, calculus of residues, conformal mappings, Möbius transformations. Prerequisite: MATH 301 or permission of instructor. *Traynor: Spring 2018*

**MATH B361 Harmonic Analysis and Wavelets**

A first introduction to harmonic analysis and wavelets. Topics to be covered include Fourier series on the circle, Fourier transforms on the line and space, Discrete Wavelet Transform, Fast Wavelet Transform and filter-bank representation of wavelets. Prerequisite: MATH B203 or permission of instructor. *Not offered in 2017–2018*

**MATH B390 Number Theory**

Study of integers with an emphasis on their multiplicative structure and topics related to analysis, and a first course in analytic number theory. Core topics: divisibility and primes, arithmetic functions, average and extremal orders, techniques of analytic number theory, Riemann zeta function, prime number theorem, Dirichlet characters, L-functions. Possible additional topics may include approximations by rational numbers, geometry of numbers, algebraic numbers and class numbers, sums of squares, and the idea of modular forms. Prerequisite: MATH 201 and some familiarity with writing proofs (such as Math 206, Math 301/303 as a co-requisite), or permission of instructor. *Milićević: Fall 2017*

**MATH B395, B396 Research Seminar**

A research seminar for students involved in individual or small group research under the supervision of the instructor. With permission, the course may be repeated for credit. Prerequisite: Permission of instructor. *Staff: Fall 2017, Spring 2018*

**MATH B398, B399 Senior Conference**

A seminar for seniors majoring in mathematics. Topics vary from year to year. *Graham: Fall 2017; Graham, Milićević: Spring 2018*

**MATH B403 Supervised Work**

Independent research. *Staff*

GRADUATE COURSES :

**MATH B501 Graduate Analysis I**

In this course we will study the theory of measure and integration. Topics will include Lebesgue measure, measurable functions, the Lebesgue integral, the Riemann-Stieltjes integral, complex measures, differentiation of measures, product measures, and  $L^p$  spaces. *Not offered in 2017–2018*

**MATH B502: Graduate Analysis II**

This course is a continuation of Math 501. *Not offered in 2017–2018*

**MATH B503 Graduate Algebra I**

This is the first course in a two course sequence providing a standard introduction to algebra at the graduate level. Topics in the first semester will include categories, groups, rings, modules, and linear algebra. *Melvin: Fall 2017*

**MATH B504: Graduate Algebra II**

This course is a continuation of Math 503, the two courses providing a standard introduction to algebra at the graduate level. Topics in the second semester will include linear algebra, fields, Galois theory, and advanced group theory. *Melvin: Spring 2018*

**MATH B505 Graduate Topology I**

This is the first course of a 2 semester sequence, covering the basic notions of algebraic topology. The focus will be on homology theory, which will be introduced axiomatically (via the Eilenberg-Steenrod axioms) and then studied from a variety of points of view (simplicial, singular and cellular homology). The course will also treat cohomology theory and duality (on manifolds), and the elements of homotopy theory. *Not offered in 2017–2018*

**MATH B506 Graduate Topology II**

Math 505 and Math 506 offer an introduction to topology at the graduate level. These courses can be taken in either order. Math 506 focuses on differential topology. Topics covered include smooth manifolds, smooth maps, and differential forms. *Traynor: Fall 2017*

OTHER COURSE OFFERED THIS YEAR BY MATH PROFESSOR :

**ESEM Section 026 The Sound of Numbers**

Mathematics and music are just two of the many ways we respond to the world around us. Mathematics describes quantity and space, while music involves the appreciation of sound. Both math and music are intentional human creations. Like mathematicians, musicians describe concepts like “chords” that cannot be touched or seen. Like musicians, mathematicians speak of “beauty” or “elegance” in their case, of a particular equation, theorem, or proof. Both disciplines rely on precise notation.

In this course we explore the connections between math and music through class discussions and written assignments. We consider musical works from J. S. Bach, Phillip Glass, Ella Fitzgerald, Taylor Swift, Ghanaian drum circles, Flamenco artists, and others to illuminate mathematical concepts such as Fibonacci numbers, modular arithmetic, wave functions, equivalence relations, transformations, tilings, and more. The course emphasizes the appropriate use and citation of sources, and includes an explicit process of drafting, revision, and peer review. *Myers: Fall 2017*

APPENDIX: PATHWAYS THROUGH THE MATHEMATICS MAJOR

All programs of study in mathematics *must* be designed with the advice of a Math Major Advisor, and also – for double majors or majors in conjunction with a minor or concentration in another field – with an advisor from the second program. In addition, all programs *must* satisfy the

**Bryn Mawr College Distribution Requirement**

*One* semester course in *each* of the following four “Approaches to Inquiry”

**Critical Interpretation (CI)** – critically interpreting works, such as texts, objects, artistic creations and performances, through a process of close reading.

**Cross-Cultural Analysis (CC)** – analyzing the variety of societal systems and patterns of behavior across space.

**Inquiry into the Past (IP)** – inquiring into the development and transformation of human experience over time.

**Scientific Investigation (SI)** – understanding the natural world by testing hypotheses against observational evidence.

SAMPLE PROGRAMS

**Note:** In each sample program, distribution requirements and electives can be interchanged among the various semesters to accommodate the student’s desires.

A. MATH MAJOR: GENERAL PLAN

	Fall Semester	Spring Semester
<b>First year</b>	<b>Math 101: Calculus I</b> Emily Balch Seminar Foreign Language Distribution Requirement	<b>Math 102: Calculus II</b> Foreign Language Distribution Requirement Free Elective
<b>Second year</b>	<b>Math 201: Multivariable Calculus</b> Distribution Requirement Free Elective Free Elective	<b>Math 203: Linear Algebra</b> <b>Math 206: Transition to Higher Math</b> (as math elective) Distribution Requirement Free Elective
<b>Third year</b>	<b>Math 301: Real Analysis I</b> <b>Math 303: Abstract Algebra I</b> Free Elective Free Elective	<b>Math 302 or Math 304</b> <b>Math Elective (200 or 300 level)</b> Free Elective Free Elective
<b>Fourth year</b>	<b>Math 398: Senior Conference</b> <b>Math Elective (200 or 300 level)</b> Free Elective Free Elective	<b>Math Elective (200 or 300 level)</b> Free Elective Free Elective Free Elective

**Note:** If considering graduate study, enroll in as many 300-level math electives as possible.

Sample programs are also posted on our web site: <https://www.brynmawr.edu/math/sample-programs>

B. MATH MAJOR STARTING WITH CALCULUS II

	Fall Semester	Spring Semester
<b>First year</b>	<b>Math 102: Calculus II</b> Emily Balch Seminar Foreign Language Distribution Requirement	<b>Math 203: Linear Algebra</b> Foreign Language Distribution Requirement Free Elective
<b>Second year</b>	<b>Math 201: Multivariable Calculus</b> Distribution Requirement Free Elective Free Elective	<b>Math 206: Transition to Higher Math (as math elective)</b> <b>Math Elective (200 or 300 level)</b> Distribution Requirement Free Elective
<b>Third year</b>	<b>Math 301: Real Analysis I</b> <b>Math 303: Abstract Algebra I</b> Free Elective Free Elective	<b>Math 302 or Math 304</b> <b>Math Elective (200 or 300 level)</b> Free Elective Free Elective
<b>Fourth year</b>	<b>Math 398: Senior Conference</b> Free Elective Free Elective Free Elective	<b>Math Elective (200 or 300 level)</b> Free Elective Free Elective Free Elective

**Note:** A student following this program should consider doing research and/or honors in the senior year. Discuss this possibility with a Major Advisor early in the junior year. **If considering graduate study, enroll in as many 300-level math electives as possible and considering enrolling in our graduate courses.**

C. MATH MAJOR STARTING WITH MULTIVARIABLE CALCULUS

	Fall Semester	Spring Semester
<b>First year</b>	<b>Math 201: Multivariable Calculus</b> Emily Balch Seminar Foreign Language Distribution Requirement	<b>Math 203: Linear Algebra</b> <b>Math 206: Transition to Higher Math (as math elective)</b> Foreign Language Distribution Requirement
<b>Second year</b>	<b>Math 301: Real Analysis I</b> <b>Math 303: Abstract Algebra I</b> Distribution Requirement Free Elective	<b>Math 302 or Math 304</b> Distribution Requirement Free Elective Free Elective
<b>Third year</b>	<b>Math Elective (200 or 300 level)</b> Free Elective Free Elective Free Elective	<b>Math Elective (200 or 300 level)</b> Free Elective Free Elective Free Elective
<b>Fourth year</b>	<b>Math 398: Senior Conference</b> Free Elective Free Elective Free Elective	<b>Math Elective (200 or 300 level)</b> Free Elective Free Elective Free Elective

**Note:** A student following this program should consider doing research and/or honors in the senior year. Discuss this possibility with a Major Advisor early in the junior year. **If considering graduate study, enroll in as many 300-level math electives as possible and considering enrolling in our graduate courses.**

D. TAKING A SEMESTER ABROAD, STARTING WITH CALCULUS I

	Fall Semester	Spring Semester
<b>First year</b>	<b>Math 101: Calculus I</b> Emily Balch Seminar Foreign Language Distribution Requirement	<b>Math 102: Calculus II</b> Distribution Requirement Foreign Language Free Elective
<b>Second year</b>	<b>Math 201: Multivariable Calculus</b> Distribution Requirement Free Elective Free Elective	<b>Math 203: Linear Algebra</b> <b>Math 206: Transition to Higher Math (as math elective)</b> Distribution Requirement Free Elective
<b>Third year</b>	<b>Math 303 or Math 301</b> <b>Math Elective (200 or 300 level)</b> Free Elective Free Elective	SEMESTER AWAY (Free Electives)
<b>Fourth year</b>	<b>Math 301 or Math 303</b> <b>Math 398: Senior Conference</b> <b>Math Elective (200 or 300 level)</b> Free Elective	<b>Math 302 or Math 304</b> <b>Math Elective (200 or 300 level)</b> Free Elective Free Elective

**Note: Meeting with a Math Major Advisor as early as possible can increase the options available.**  
For complete information on study abroad, please consult <http://www.brynmawr.edu/studyabroad>.

E. TAKING A SEMESTER ABROAD, STARTING WITH CALCULUS II

	Fall Semester	Spring Semester
<b>First year</b>	<b>Math 102: Calculus II</b> Emily Balch Seminar Foreign Language Distribution Requirement	<b>Math 203: Linear Algebra</b> Distribution Requirement Foreign Language Free Elective
<b>Second year</b>	<b>Math 201: Multivariable Calculus</b> Distribution Requirement Free Elective Free Elective	<b>Math 206: Transition to Higher Math (as math elective)</b> <b>Math Elective (200 or 300 level)</b> Distribution Requirement Free Elective
<b>Third year</b>	<b>Math 303 or Math 301</b> <b>Math Elective (200 or 300 level)</b> Free Elective Free Elective	SEMESTER AWAY (Free Electives)
<b>Fourth year</b>	<b>Math 301 or Math 303</b> <b>Math 398: Senior Conference</b> Free Elective Free Elective	<b>Math 302 or Math 304</b> <b>Math Elective (200 or 300 level)</b> Free Elective Free Elective

**Note: Meeting with a Math Major Advisor as early as possible can increase the options available.**  
For complete information on study abroad, please consult <http://www.brynmawr.edu/studyabroad>.

F. MATH MAJOR IN THE AB/MA PROGRAM

	Fall Semester	Spring Semester
<b>First year</b>	<b>Math 201: Multivariable Calculus</b> Emily Balch Seminar Foreign Language Distribution Requirement	<b>Math 203: Linear Algebra</b> <b>Math Elective (200 or 300 level)</b> Foreign Language Distribution Requirement
<b>Second year</b>	<b>Math 301: Real Analysis I</b> <b>Math 303: Abstract Algebra I</b> Distribution Requirement Free Elective	<b>Math 302: Real Analysis II</b> <b>Math 304: Abstract Algebra II</b> Distribution Requirement Free Elective
<b>Third year</b>	<b>Graduate Math Course *</b> Free Elective** Free Elective Free Elective	<b>Graduate Math Course *</b> Free Elective** Free Elective Free Elective
<b>Fourth year</b>	<b>Graduate Math Course *</b> <b>Math 701 or 702 (Thesis)</b> <b>Math 398: Senior Conference</b> Free Elective	<b>Graduate Math Course *</b> <b>Math 701 or 702 (Thesis)</b> Free Elective Free Elective

**Note:** This plan assumes 4 transfer credits (such as AP, IB) toward the BMC degree.

\*Two Graduate Math courses may be advanced 300-level Math courses with additional work. Up to two graduate courses may be taken for both AB and MA credit.

\*\*It is highly recommended that a Math elective be chosen.

G. MATH MAJOR WITH A MINOR IN COMPUTER SCIENCE

	Fall Semester	Spring Semester
<b>First year</b>	<b>Math 101: Calculus I</b> <b>CMSC 110: Intro. Computer Science</b> Emily Balch Seminar Foreign Language	<b>Math 102: Calculus II</b> Distribution Requirement Distribution Requirement Foreign Language
<b>Second year</b>	<b>Math 201: Multivariable Calculus</b> <b>CMSC/Math 231: Discrete Math</b> (counts as math elective) Distribution Requirement Free Elective	<b>Math 203: Linear Algebra</b> <b>Math Elective (200 or 300 level)</b> <b>CMSC 206: Data Structures</b> Distribution Requirement
<b>Third year</b>	<b>Math 301: Real Analysis I</b> <b>Math 303: Abstract Algebra I</b> Free Elective Free Elective	<b>Math 302 or Math 304</b> <b>Math Elective (200 or 300 level)</b> <b>Computer Science Elective</b> Free Elective
<b>Fourth year</b>	<b>Math 398: Senior Conference</b> <b>Computer Science Elective</b> Free Elective Free Elective	<b>Math Elective (200 or 300 level)</b> <b>Computer Science Elective</b> Free Elective Free Elective

**Note:** Computer Science electives must include any two of CMSC 240, 245, 246, 330, 340, 345.

H. MATH MAJOR WITH TEACHING CERTIFICATION

	Fall Semester	Spring Semester
<b>First year</b>	<b>Math 101: Calculus I</b> Emily Balch Seminar Foreign Language Distribution Requirement	<b>Math 102: Calculus II</b> Foreign Language Distribution Requirement(English course) Free Elective
<b>Second year</b>	<b>Math 201: Multivariable Calculus</b> <b>Ed 200: Critical Issues in Education</b> <b>Psych 203: Educational Psychology</b> Distribution Requirement	<b>Math 203: Linear Algebra</b> <b>Math 206: Transition to Higher Math</b> (as math elective) Distribution Requirement Free Elective
<b>Third year</b>	<b>Math 301: Real Analysis I</b> <b>Math 303: Abstract Algebra I</b> <b>Ed 210 or 275 (at BMC or HVD)</b> Free Elective	<b>Math 302 or Math 304</b> <b>Math Elective (200 or 300 level)</b> <b>Math Elective (200 or 300 level)</b> Free Elective
<b>Fourth year</b>	<b>Math 398: Senior Conference</b> <b>Math Elective (200 or 300 level)</b> <b>Ed 210 or 275 (at BMC or HVD)</b> <b>Ed 301: Curriculum/Pedagogy Sem.</b>	<b>Ed 302: Practice Teaching Seminar</b> <b>Ed 303: Practice Teaching</b> (2 units of credit)

**Suggested math electives:** Probability: BMC 205 or HC 218; Discrete Math: BMC 231; Geometry: BMC 221 or HC 205b; Number Theory: BMC 290 or 390; History of Mathematics: BMC 295. Meeting with a math major advisor as early as possible can increase the available options.

I. MATH MAJOR WITH PRE-MEDICAL STUDIES

	Fall Semester	Spring Semester
<b>First year</b>	<b>Math 101: Calculus I</b> <b>Bio 110: Intro. Biology I</b> Emily Balch Seminar Foreign Language	<b>Math 102: Calculus II</b> <b>Bio 111: Intro. Biology II</b> Distribution Requirement (English) Foreign Language
<b>Second year</b>	<b>Math 201: Multivariable Calculus</b> <b>Chem 103: General Chemistry I</b> Distribution Requirement Distribution Requirement	<b>Math 203: Linear Algebra</b> <b>Math 206: Transition to Higher Math</b> (as math elective) <b>Chem 104: General Chemistry II</b> Distribution Requirement
<b>Third year</b>	<b>Math 301: Real Analysis I</b> <b>Math 303: Abstract Algebra I</b> <b>Chem 211: Organic Chemistry I</b> Free Elective	<b>Math 302 or Math 304</b> <b>Math Elective (200 or 300 level)</b> <b>Chem 212: Organic Chemistry II</b> Free Elective
<b>Fourth year</b>	<b>Math 398: Senior Conference</b> <b>Math Elective (200 or 300 level)</b> <b>Phys 101: Intro. Physics I</b> Free Elective	<b>Math Elective (200 or 300 level)</b> <b>Phys 102: Intro. Physics II</b> Free Elective Free Elective

**Note:** This plan allows the student to have a “glide year” after graduation, before entering medical school. It is entirely possible to design a program that permits the student to enter medical school immediately upon graduation from Bryn Mawr. See a Health Professions Advisor for details, and consult [www.brynmawr.edu/healthpro](http://www.brynmawr.edu/healthpro).

J. DOUBLE MAJOR IN MATHEMATICS AND PHYSICS

	Fall Semester	Spring Semester
First year	<b>Math 102: Calculus II</b> <b>Phys 121: Modeling the Physical World: Foundations &amp; Frontiers</b> Emily Balch Seminar Foreign Language	<b>Math 203: Linear Algebra</b> <b>Phys 122: Classical Mechanics</b> Foreign Language Distribution Requirement
Second year	<b>Math 201: Multivariable Calculus</b> <b>Phys 201: Electromagnetism</b> Distribution Requirement Free Elective	<b>Math 206: Transition to Higher Math (as math elective)</b> <b>Phys 214: Intro. Quantum Mechanics</b> Distribution Requirement Free Elective
Third year	<b>Math 301: Real Analysis I</b> <b>Math 303: Abstract Algebra I</b> <b>Phys 306: Mathematical Methods (counts as math elective)</b> Free Elective	<b>Math 302 or Math 304</b> <b>Math Elective (200 or 300 level)</b> <b>Phys 305 or 331</b> Free Elective
Fourth year	<b>Math 398: Senior Conference</b> <b>Physics Elective (300 level)</b> <b>Physics 398: Senior Seminar I</b> Free Elective	<b>Math Elective (200 or 300 level)</b> <b>Physics Elective (300 level)</b> Free Elective Free Elective

**Note: You must meet with major advisors in both departments.** Some suggested courses to fulfill remaining Math Electives are Math 311 (Partial Differential Equations), Math 312 (Topology) and Math 322 (Functions of Complex Variables), because these courses relate best to the field of Physics.

K. DOUBLE MAJOR IN MATHEMATICS AND COMPUTER SCIENCE

	Fall Semester	Spring Semester
First year	<b>Math 101: Calculus I</b> <b>CMSC 110: Intro. Computer Science</b> Emily Balch Seminar Foreign Language	<b>Math 102: Calculus II</b> <b>CMSC 206: Data Structures</b> Foreign Language Distribution Requirement
Second year	<b>Math 201: Multivariable Calculus</b> <b>CMSC/Math 231: Discrete Math (counts as math elective)</b> <b>CMSC 245 Princ. Progr. Languages</b> Distribution Requirement	<b>Math 203: Linear Algebra</b> <b>Math 206: Transition to Higher Math (as math elective)</b> <b>Computer Science Elective</b> Distribution Requirement
Third year	<b>Math 301 or Math 303</b> <b>CMSC 240: Princ. Comp. Org.</b> <b>Computer Science Elective</b> Distribution Requirement	<b>Math 302 or Math 304</b> <b>CMSC 330: Algorithms</b> <b>Computer Science Elective</b> Free Elective
Fourth year	<b>Math 303 or Math 301</b> <b>Math 398: Senior Conference</b> <b>CMSC 340 or CMSC 345 (counts as math elective)</b> <b>Computer Science Elective</b>	<b>Math Elective (200 or 300 level)</b> <b>Computer Science Elective</b> <b>CMSC 399: Senior Conference</b> Free Elective

**Note: You must meet with major advisors in both departments.** The following Computer Science courses double count for the major in Mathematics and the major in Computer Science: CMSC 231 (Discrete Mathematics), CMSC 340 (Analysis of Algorithms), and CMSC 345 (Theory of Computation).

L. DOUBLE MAJOR IN MATHEMATICS AND CHEMISTRY

	Fall Semester	Spring Semester
First year	<b>Math 101: Calculus I</b> <b>Chem 103: General Chemistry I</b> Emily Balch Seminar Foreign Language	<b>Math 102: Calculus II</b> <b>Chem 104: General Chemistry II</b> Foreign Language Distribution Requirement Distribution Requirement
Second year	<b>Math 201: Multivariable Calculus</b> <b>Chem 211: Organic Chemistry I</b> <b>Physics 121 or 101</b> Distribution Requirement	<b>Math 203: Linear Algebra</b> <b>Math 206: Transition to Higher Math</b> (as math elective) <b>Chem 212: Organic Chemistry II</b> <b>Physics 122 or 102</b>
Third year	<b>Math 301 or Math 303</b> <b>Chem 221: Physical Chemistry I</b> (counts as math elective) <b>Chem 242: Biological Chemistry</b> <b>Chem 251: Research Methodology I</b>	<b>Math 302 or Math 304</b> <b>Chem 222: Physical Chemistry II</b> <b>Chem 231: Inorganic Chemistry</b> <b>Chem 252: Research Methodology II</b>
Fourth year	<b>Math 301 or Math 303</b> <b>Math Elective (200 or 300 level)</b> <b>Chemistry Elective (300 level)</b> Free Elective	<b>Chemistry Elective (300 level)</b> <b>Math 399: Senior Conference</b> <b>Math Elective (200 or 300 level)</b> Free Elective

**Suggested Math Electives:** Math 210, Math 251 or Math 351, Math 312.

M. DOUBLE MAJOR IN MATHEMATICS AND GEOLOGY

	Fall Semester	Spring Semester
First year	<b>Math 101: Calculus I</b> <b>Geo 101: How the Earth Works</b> Emily Balch Seminar Foreign Language	<b>Math 102: Calculus II</b> <b>Geo 102 or Geo 103</b> Foreign Language Distribution Requirement
Second year	<b>Math 201: Multivariable Calculus</b> <b>Geo 202: Mineralogy and Crystal Chemistry</b> <b>Chem 103, Physics 101, or Physics 121</b> Distribution Requirement	<b>Math 203: Linear Algebra</b> <b>Math 206: Transition to Higher Math</b> (as math elective) <b>Chem 104, Physics 102, or Physics 122</b> Distribution Requirement
Third year	<b>Math 301 or Math 303</b> <b>Geo 203: Invertebrate Paleobiology</b> Free Elective Free Elective	<b>Math 302 or Math 304</b> <b>Geo 204: Structural Geology</b> <b>Geo 205: Sedimentary Materials &amp; Environments</b> Free Elective
Fourth year	<b>Math 303 or Math 301</b> <b>Math 398: Senior Conference</b> <b>Math Elective (200 or 300 level)</b> <b>Geology Elective (300 level)</b>	<b>Math Elective (200 or 300 level)</b> <b>Math Elective (200 or 300 level)</b> <b>Geo 399: Senior Capstone Seminar</b> Free Elective

**Note:** CMSC 110 (Introduction to Computer Science) is strongly recommended.

N. DOUBLE MAJOR IN MATHEMATICS AND SOCIOLOGY

	Fall Semester	Spring Semester
First year	Math 101: Calculus I Soc 102: Society, Culture, & Individ. Emily Balch Seminar Foreign Language	Math 102: Calculus II Foreign Language Distribution Requirement Distribution Requirement
Second year	Math 201: Multivariable Calculus Sociology Elective* Soc 265: Res. Design and Stat. Anal. Distribution Requirement	Math 203: Linear Algebra Math 206: Transition to Higher Math (as math elective) Distribution Requirement Free Elective
Third year	Math 301: Real Analysis I Math 303: Abstract Algebra I Soc 302: Social Theory Sociology Elective*	Math 302 or Math 304 Math Elective (200 or 300 level) Sociology 303: Junior Conference (Discipline-Based Intensive Writing) Sociology Elective*
Fourth year	Math 398: Senior Conference Soc 398: Senior Conference Math Elective (200 or 300 level) Sociology Elective*	Math Elective (200 or 300 level) Sociology Elective* Free Elective Free Elective

\* Of the 5 sociology electives, at least 1 must be at the 300-level, and 1 may be at the 100-level.

**Note:** Two of the math electives may count as *allied work* for the Sociology Major. To design your program, you must meet with a math major advisor, and with Faculty in the Sociology Department.

O. DOUBLE MAJOR IN MATHEMATICS AND ENGLISH

	Fall Semester	Spring Semester
First year	Math 101: Calculus I Emily Balch Seminar Foreign Language Distribution Requirement	Math 102: Calculus II English Elective (200 level)* Foreign Language Distribution Requirement
Second year	Math 201: Multivariable Calculus English Elective (200 level)* Distribution Requirement Free Elective	Math 203: Linear Algebra Math 206: Transition to Higher Math (as math elective) Eng 250: Methods of Literary Study Free Elective
Third year	Math 301: Real Analysis I Math 303: Abstract Algebra I English Elective (200 level)* English Elective (300 level)*	Math 302 or Math 304 Math Elective (200 or 300 level) English Elective (200 level)* English Elective (300 level)*
Fourth year	Math 398: Senior Conference Eng 398: Senior Seminar Math Elective (200 or 300 level) English Elective*	Math Elective (200 or 300 level) Eng 399: Senior Essay English Elective* Free Elective

\* Of the 8 English Electives, at least 3 must be at the 300-level (not counting English 398 or 399). You need to take two 200 level classes before taking English 250. English 250 should be completed either in the spring semester of sophomore year or the fall semester of junior year. **Note:** You must meet regularly with advisors in both departments and gain approval to double major.

P. MATH MAJOR WITH A MINOR IN ENVIRONMENTAL STUDIES

	Fall Semester	Spring Semester
First year	<b>Math 101: Calculus I</b> <b>EnvS 101: Intro. Env. Studies</b> Emily Balch Seminar Foreign Language	<b>Math 102: Calculus II</b> <b>Environmental Studies Elective*</b> Foreign Language Distribution Requirement
Second year	<b>Math 201: Multivariable Calculus</b> <b>Environmental Studies Elective*</b> Distribution Requirement Free Elective	<b>Math 203: Linear Algebra</b> <b>Math 206: Transition to Higher Math (as math elective)</b> <b>Environmental Studies Elective*</b> Distribution Requirement
Third year	<b>Math 301: Real Analysis I</b> <b>Math 303: Abstract Algebra I</b> <b>Environmental Studies Elective*</b> Free Elective	<b>Math 302 or Math 304</b> <b>Math Elective (200 or 300 level)</b> Free Elective Free Elective
Fourth year	<b>Math 398: Senior Conference</b> <b>Math Elective (200 or 300 level)</b> Free Elective Free Elective	<b>Math Elective (200 or 300 level)</b> <b>EnvS 397: Senior Seminar</b> Free Elective Free Elective

\* The Environmental Studies minor requires four electives beyond the introductory EnvS 101 and the capstone EnvS 397, any of which can be used to satisfy distribution requirements. Two of these must be chosen from the approved list in the natural sciences, math and engineering (many of which satisfy SI), and two from the approved list in the humanities and social sciences (many of which satisfy CI, CC or IP); see [www.brynmawr.edu/es/courses.html](http://www.brynmawr.edu/es/courses.html).

**Note:** Math 210 Differential Equations is *strongly* suggested as a Math Elective.

All programs of study **MUST** be designed with the advice of a Mathematics Major Advisor and the Bryn Mawr Co-Director of the Environmental Studies Program, Victor Donnay ([vdonnay@brynmawr.edu](mailto:vdonnay@brynmawr.edu)).

**Bryn Mawr College Distribution Requirement**

*One* semester course in *each* of the following four “Approaches to Inquiry”:

- Critical Interpretation (CI)** – critically interpreting works, such as texts, objects, artistic creations and performances, through a process of close reading.
- Cross-Cultural Analysis (CC)** – analyzing the variety of societal systems and patterns of behavior across space.
- Inquiry into the Past (IP)** – inquiring into the development and transformation of human experience over time.
- Scientific Investigation (SI)** – understanding the natural world by testing hypotheses against observational evidence.

Sample programs are also posted on our web site: <https://www.brynmawr.edu/math/sample-programs>