

Brandeis University
Mathematics Department

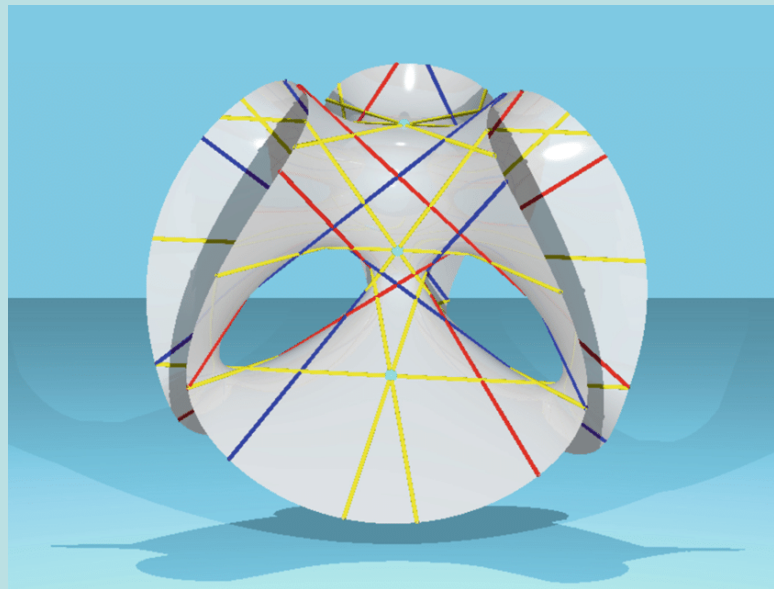
Undergraduate Curriculum and Orientation Event

Tuesday, October 25th, 2022

Introductions

Chair of Mathematics

Olivier Bernardi





Prof. Olivier Bernardi, Chair

1:00pm-1:15pm

Introductions and Initiatives

**Catherine Broderick (Admin), Kiyoshi Igusa (Prof),
Tyler Maunu (Applied Math Prof), Keith Merrill (Prof), Lucca Raabe (UDR)**

**Prof. Rebecca Torrey, Elementary Mathematics Coordinator
Spring Course Offerings and Climate-focused courses**

1:15 – 1:25pm

Prof. An Huang, Undergraduate Advising Head

**Math Degree Programs, New Courses, Declaring a Major, Finding a Math Adviser
and Mathematics UDRs**

1:25 – 1:35pm

Ray Maresca

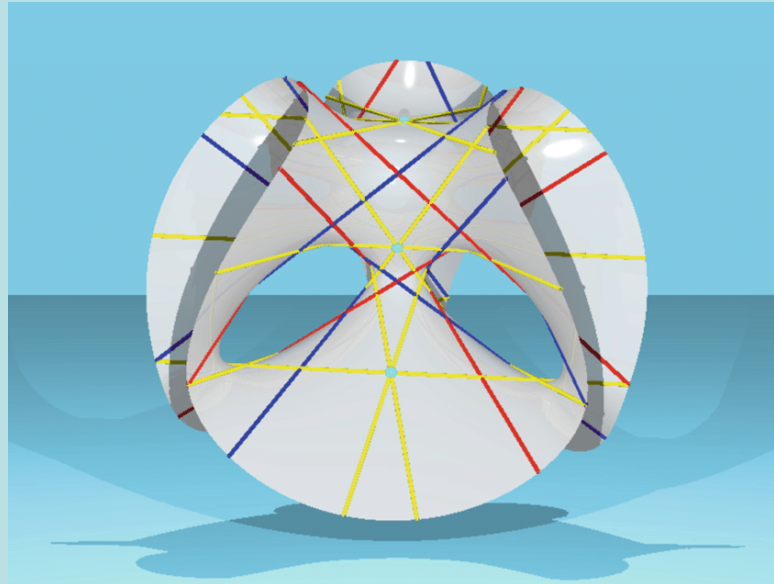
Presenting the new course: Math 48a “Quiver Representations”

1:35pm - 1:40pm

Q&A

1:40pm - 2:00pm

Initiatives with Prof. Bernardi





Initiatives:

Brandeis Mathematics Mentoring Program

- The mission of the Brandeis Mathematics Mentoring Program is to help students successfully navigate the undergraduate program in Mathematics at Brandeis, and make it as inclusive as possible.
<https://www.brandeis.edu/mathematics/undergraduate/mentor-program.html>
- The program launched last spring 2022. Apply to become a Mentor or Mentee in the fall for next spring's program.
- This mentoring program aims at creating a supportive relation between a mentee (typically a first year student interested in the minor/major in math or applied math) and a more experienced undergraduate student serving as their mentor (typically a junior or senior student majoring in math or applied math).



Initiatives:

Commitment to Diversity

- The Math Department is committed to fostering an inclusive community, bringing together individuals from diverse backgrounds to celebrate and expand the power of mathematical thinking. Regardless of our students' paths, they leave our Department with an enhanced ability to question, analyze and evaluate problems encountered throughout their lives.
- DEI Actions: <https://www.brandeis.edu/mathematics/dei/index.html>
- You may read our full statement at:
<https://www.brandeis.edu/mathematics/docs/diversity-statement.html>



Initiatives: Drop-in Tutoring

The Brandeis Math Department offers free drop-in tutoring for undergraduate math classes. Talking about math is one of the best ways to learn and to deepen your understanding. It can also be the most fun way to learn! So we invite you to enjoy this resource.

Just show up to Goldsmith 200 during any of the scheduled times; you don't need to have questions or prepare anything ahead of time. You can also just use it as a place to do your homework or studying, so that there are other people around if you get stuck or have questions as you work.

See the tutoring schedule on the next slide.



Initiatives: Drop-in Tutoring Schedule

Open to any students in Math classes numbered 0-99:

Mon, 6 - 8 pm

Tue, 4 - 6 pm

Wed, 6 - 8 pm

Only for students in Math 5a, 10a, and 10b:

Thu, 4 - 6 pm

Fri, 12 - 2 pm

Location: Goldsmith 200



Initiatives: Textbooks

- The Math Department keeps the current semester's textbooks in Goldsmith 200 for you to view.
- Textbooks are also placed on reserve in the library whenever possible.



Initiatives: Directed Reading Program

- Each spring, the Directed Reading Program (DRP) pairs undergraduate students with graduate student mentors to undertake independent study projects of various sizes and scopes over the course of the spring semester. The projects can take the form of reading and working through a mathematics text, reading research papers, or even doing research.
<https://www.brandeis.edu/mathematics/undergraduate/directed-reading-program.html>
- Any sophomore, junior, or senior who has taken 15A (Applied Linear Algebra) and 20A (Multi-Variable Calculus) is eligible to apply.
- No course credit given.



Initiatives: Opportunities for Outreach

See opportunities for “Outreach”:

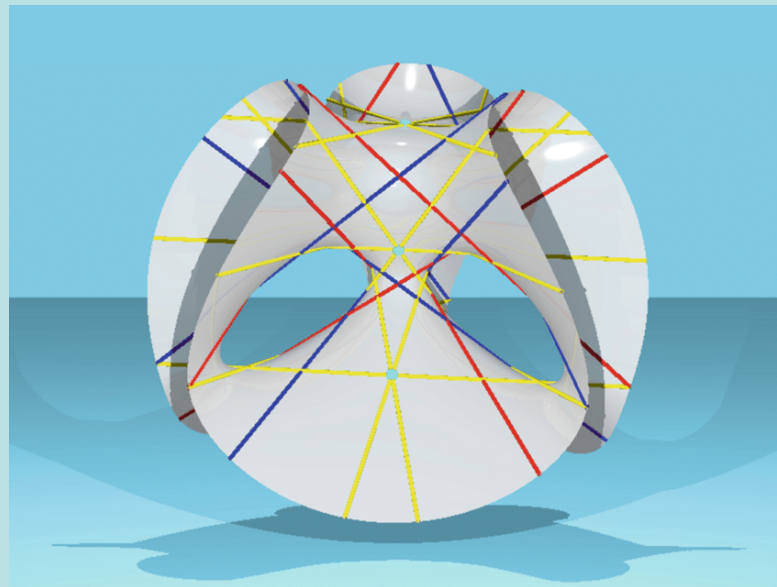
<https://www.brandeis.edu/mathematics/dei/outreach-dei.html>



Initiatives: Upcoming Events for You

- Faculty Research Talks (date to be determined)
- Undergraduate Barbeque with Math Faculty & Graduate Students (Spring)
- Senior Honors Research Thesis Defenses (Spring)
- Directed Reading Program (DRP) Student Presentations (Spring)

Course Offerings with Prof. Torrey





Courses: Spring 2023

(see “Notes” for listing of Pre-requisites and Rotation of Courses)

- Math 3a Explorations in Math: A Course for Educators (spring)
- Math 5a Pre-Calculus (fall, spring)
- Math 8a Intro. to Probability and Statistics (fall, spring) {qr/sn}
- **New!** Math 9b Math Puzzles and Games {sn}
- Math 10a Techniques of Calculus (a)(fall, spring) {sn}
- Math 10b Techniques of Calculus (b) (fall, spring) {sn}
- Math 15a Applied Linear Algebra (fall, spring) {sn}
- Math 16b Applied Linear Algebra Practicum (fall, spring) {dl, oc}
- Math 20a Multi-variable Calculus (fall, spring) {sn}
- Math 22b Honors Linear Algebra and Multi-variable Calculus II {sn}
- Math 23b Introduction to Proofs (fall, spring) {sn,wi}



Courses: Spring 2023 (con't)

(see “Notes” for listing of Pre-requisites and Rotation of Courses)

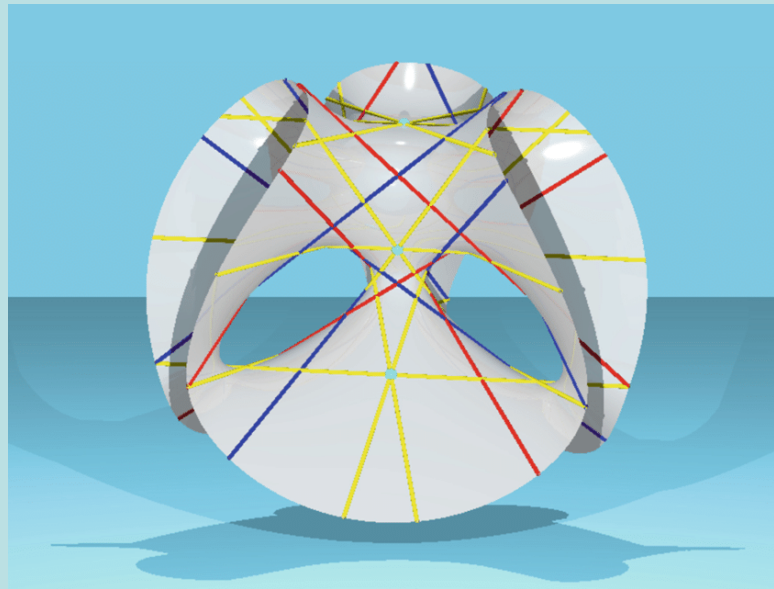
- Math 28b Introduction to Rings and Fields {sn}
- Math 36b Mathematical Statistics {sn, qr}
- Math 37a Differential Equations {sn}
- **New!** Math 48a Quiver Representations{sn}
- Math 91g (1/4 credit), Math 98b (4 credits), Math 99b (4 credits)
- Math 102a Introduction to Differential Geometry {sn}
- Math 115a Intro. to Complex Analysis {sn}
- Math 121a Mathematics for Natural Sciences {sn}
- **New!** MATH/MUS 121b Mathematics and Music
- Math 126a, Introduction to Stochastics Processes and Models {sn}



Climate-focused Courses

- **Math 10a Techniques of Calculus (a)**, with two sections on “Applications in Climate Data Analysis” Spring 2023 (tentative) and Fall 2023 (tentative)
- **Math 123a “Principles of Mathematical Modeling”** Focus on ecological applications. Tentatively offered Spring 2024 pending budgetary approval.

**Degree Programs, New Math
Courses, Declaring a Major, Finding
a Math Adviser and Math UDRs
Prof. Huang**





Degree Programs in Math

- Bachelor of Arts in Mathematics
- Bachelor of Science in Mathematics
- Bachelor of Science in Applied Mathematics
- Minor in Mathematics
- Teacher Preparation Track
- Combined BA/MA: A student must make an appointment with the Undergraduate Advising Head in the Department of Mathematics in order to add the BA/MA to his/her program. This must be done no later than May 1 preceding his/her final year of study on campus.



Degree Programs in Math (con't)

For degree requirements, review the University Bulletin <https://www.brandeis.edu/registrar/bulletin/provisional/courses/subjects/4700.html> or meet with your adviser, UAH, or the Mathematics Academic Administrator.

Note that a student can declare a Major in Mathematics or a Major in Applied Mathematics but not both.

A student may declare a minor in Mathematics but not in Applied Mathematics.



BA in Mathematics

As part of completing any math major, students must:

- Fulfill the writing intensive requirement by successfully completing one of the following: MATH 23b or MATH 47a.
- Fulfill the oral communication requirement by successfully completing: MATH 16b or MATH 40a.
- Fulfill the digital literacy requirement by successfully completing: MATH 16b, Math 40a, Math 122a, Math 124a, COSI 10a, COSI 12b, or COSI 21a.



BA in Mathematics

As part of completing the BA in Math major, students must complete these courses with at least a grade of C- :

- MATH 15a or 22a; MATH 20a or 22b.
- MATH 23b or exemption
- MATH 35a, 110a, or 115a.
- MATH 28a, 28b, or 100a.
- Four additional semester courses, either MATH courses numbered 27 or higher or cross-listed courses in Mathematics.
- No course taken pass/fail may count toward the major, honors, or the teacher preparation track



BS in Mathematics

As part of completing the BS in Mathematics, students must:

- Fulfill the writing intensive requirement by successfully completing one of the following: MATH 23b or MATH 47a.
- Fulfill the oral communication requirement by successfully completing: MATH 16b or MATH 40a.
- Fulfill the digital literacy requirement by successfully completing: MATH 16b, Math 40a, Math 122a, Math 124a, COSI 10a, COSI 12b, or COSI 21a.



BS in Mathematics

As part of completing the BS in Math major, students must complete these courses with at least a grade of C- :

- MATH 15a or 22a; MATH 20a or 22b.
- MATH 23b or exemption.
- MATH 35a, 110a, or 115a.
- MATH 28a, 28b, or 100a.
- Seven additional semester courses, either MATH courses numbered 27 or higher or cross-listed courses in Mathematics.
- No course taken pass/fail may count toward the major, honors, or the teacher preparation track



BS in Applied Mathematics

As part of completing the BS in Applied Math major, students must:

- Fulfill the writing intensive requirement by successfully completing one of the following: MATH 23b or MATH 47a.
- Fulfill the oral communication requirement by successfully completing: MATH 16b or MATH 40a.
- Fulfill the digital literacy requirement by successfully completing: MATH 16b, Math 40a, Math 122a, Math 124a, COSI 10a, COSI 12b, or COSI 21a.



BS in Applied Mathematics

As part of completing the BS in Applied Math major, students must complete courses with at least a grade of C-.

At least twelve semester courses are required, including the following:

- Three foundational courses: Math 15a or Math 22a, Math 20a or Math 22b, and Math 36a.
- Math 23b or an exemption.
- Math 36b or Math 40a.
- Two of the following analysis courses: Math 35a, Math 37a, Math 110a or Math 115a.
- Two of the following: Math 121a, Math 122a, Math 123a, Math 124a or Math 126a. (continue next slide)



BS in Applied Math (con't)

- One additional mathematics course number 27 or higher or a course cross-listed in Applied Mathematics.
- Two courses must be taken from another department from the following list: BCHM 102a, BCHM 104a, BCHM 145a, CHEM 141a, CHEM 142a, CHEM 146b, COSI 21a, COSI 112a, COSI 123a, COSI 130a, COSI 177a, COSI 180a, ECON 80a, ECON 161a, ECON 181b, ECON 182a, ECON 184b, NBIO 136b, NPHY 115a, any PHYS course numbered 20 or higher, and QBIO 110a.
- No grade below a C- will be given credit toward the Bachelor of Science degree.
- No course taken credit/no credit may count towards the Bachelor of Science degree.



New Math Courses

- **MATH/MUS 121b:** “Math and Music”, taught by Profs. Jonathan Touboul (Mathematics) and Erin Gee (Music). Provide students with an introduction to the deep relationship between mathematics & music, present in depth topics that highlight the influence of symmetries, patterns, stochastic structures and geometrical analysis, and encourage students to explore those links in a creative project. Does not satisfy the School of Science requirement. Can count toward the minor. Can count toward the applied-math major as a cross-listed course (it cannot count toward the pure math major).
- **MATH 9b:** “Math Puzzles and Game,” an entry level class which can serve as an invitation to math for students with limited prior exposure to math. Satisfies the School of Science requirement.
- **Math 48a:** Graduate student Ray Maresca will introduce the new course “Quiver Representations.”



How to Declare a Mathematics Major

- Study all the requirements for the major in the University Bulletin:
<https://www.brandeis.edu/registrar/bulletin/provisional/courses/subjects/4700.html>
- Fill out a Major/Minor Declaration Worksheet with a complete course plan for the major:
<https://www.brandeis.edu/registrar/forms/major-minor.html>
- Schedule an appointment with the undergraduate advising head to declare the major. Bring the filled out worksheet to the appointment.



How to be Assigned a Math Faculty Advisor

- Go to the faculty list on the Math Department website, and pick a candidate professor that you would like to be your advisor. Note: faculty who are listed as “Instructors”, “Postdoctoral Associates/Fellows” or “Lecturers” do not generally act as advisors.
<https://www.brandeis.edu/mathematics/people/index.html>
- Discuss and decide on the advisor in the appointment with the UAH. Get the signature from the advisor on your Major/Minor Declaration Worksheet, and submit the worksheet, with the signature, to the UAH.

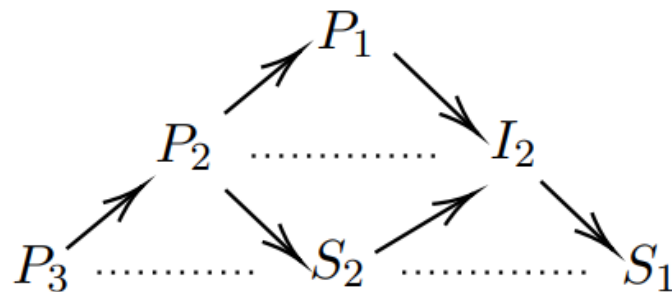


Undergraduate Department Representatives (UDRs)

- Nicole Meng is a senior who is triple majoring in Applied Mathematics, Computer Science, and Economics.
Contact: ziyimeng@brandeis.edu
- Lucca Raabe is a senior studying pure Math and Sociology, minoring in Social Justice/Social Policy.
Contact: luccaraabe@brandeis.edu

Quiver Representations

- Learn the fundamentals of Quivers and their Representations
- Use quivers to learn about 'graduate level' about topics like categories, path algebras, and homological algebra.
- Use quivers to learn some common techniques in mathematical problem solving.



An Auslander-Reiten Quiver of Type A_3



Questions and Answers



Notes Section

- 1) Course Pre-Requisites
- 2) Senior Honors Research
- 3) Foundational Literacy Requirements
- 4) Rotation of Courses
- 5) Research: How to Guide



Course Pre-requisites

Where do I find course pre-requisites and full course descriptions?

You will find course pre-requisites and descriptions in the [University Bulletin](#).

Math 3A Explorations in Math: A course for educators {sn}.

Permission of instructor required. No prerequisites.

Math 5a Pre-calculus

Does not satisfy the School of Science requirement. Students may not take MATH 5a if they have received a satisfactory grade in any math class numbered 10 or higher.

Math 8a Introduction to Probability and Statistics [qr sn]

Does not require calculus; only high school algebra and graphing of functions.

Math 9b Math Puzzles and Games {sn}

Pre-requisite: Math 5a

Math 10a Techniques in Calculus {sn}.

Prerequisite: Students may not take MATH 10a if they have received a satisfactory grade in MATH 10b or MATH 20a.

Math 10b Techniques in Calculus {sn}.

Prerequisite: A satisfactory grade of C- or higher in MATH 10a or placement by examination.



Course Pre-requisites (con't)

Math 15a Linear Algebra [sn]

Prerequisites: MATH 5a and permission of the instructor, placement by examination, or any mathematics course numbered 10 or above. Students may take MATH 15a or 22a for credit, but not both.

MATH 16b Applied Linear Algebra Practicum [dl oc]. Yields ½ credit.

Prerequisite: MATH 15a or MATH 22a.

Math 20a Multi-variable Calculus [sn]

Prerequisites: MATH 10a and b and MATH 15a, or placement by examination.

Math 22a Honors Linear Algebra and Multi-variable Calculus, Part I [sn]

Prerequisite: MATH 22 placement exam and permission of the instructor.

Math 22b Honors Linear Algebra and Multi-variable Calculus, Part II [sn]

Prerequisite: Math 22a or permission of instructor

Math 23b Introduction to Proofs {sn,wi}

Prerequisites: MATH 15a, 20a, or 22a, or permission of the instructor.

Math 28a Introduction to Groups [sn]

Prerequisites: MATH 23b and either MATH 15a or 22a, or permission of the instructor. Students may take MATH 28a or 100a for credit, but not both



Course Pre-requisites (con't)

Math 28b Introduction to Rings and Fields [sn]

Prerequisites: MATH 23b and either MATH 15a, 22a, or permission of the instructor. Students may take MATH 28b or 100b for credit, but not both.

Math 31a Abstract Linear Algebra [sn]

Prerequisites: MATH 23b or equivalent.

MATH 35a Advanced Calculus and Fourier Analysis [sn]

Prerequisites: MATH 15a or 22a and MATH 20a or 22b

MATH 36a Probability [qr sn]

Prerequisite: MATH 20a or 22b

MATH 36b Mathematical Statistics[qr sn]

Prerequisite: MATH 36a or permission of the instructor.

MATH 37a Differential Equations[sn]

Prerequisites: MATH 15a or 22a and MATH 20a or 22b.

MATH 39a Introduction to Combinatorics[sn]

Prerequisite: COSI 29a or MATH 23b, or permission of the instructor.

MATH 40a Introduction to Applied Mathematics[oc, dl, sn]

Prerequisites: MATH 15a or MATH 22a and MATH 20a or MATH 22b.

MATH 47a Introduction to Mathematical Research[sn wi]

Prerequisites: MATH 23b or permission of the instructor



Course Pre-requisites (con't)

Math 48a Representations of Quivers

Prerequisites: Math 15a and Math 23b, equivalent credit or instructor's permission are required. Math 28a(b) are recommended but not required.

MATH 100a Introduction to Algebra, Part I [sn]

Prerequisite: MATH 23b and MATH 15a or 22a, or permission of the instructor. Students may take MATH 28a or 100a for credit, but not both.

MATH 100b Introduction to Algebra, Part II [sn]

Prerequisite: MATH 100a or permission of the instructor. Students may take MATH 28b or 100b for credit, but not both.

MATH 102a Introduction to Differential Geometry [sn]

Prerequisites: MATH 23b and either MATH 20a or 22b or permission of the instructor.

MATH 104a Introduction to Topology [sn]

Prerequisites: MATH 15a or 22a and MATH 20a or 22b, and MATH 23b, or permission of the instructor.

MATH 108b Introduction to Number Theory [sn]

Prerequisites: MATH 23b and MATH 15a or 22a, or permission of the instructor.

MATH 110a Introduction to Real Analysis, Part I [sn]

Prerequisites: MATH 15a or 22a and MATH 20a or 22b, and MATH 23b, or permission of the instructor.

MATH 110b Introduction to Real Analysis, Part II [sn]

Prerequisite: MATH 110a or permission of the instructor.



Course Pre-requisites (con't)

MATH 115a Introduction to Complex Analysis [sn]

Prerequisites: MATH 15a or 22a and MATH 20a or 22b, and MATH 23b or permission of the instructor.

MATH 121a Mathematics for Natural Sciences [sn]

Prerequisites: MATH 15a or MATH 22a and MATH 20a or MATH 22b.

MATH/MUS 121b Mathematics and Music

Prerequisites: None. Does not satisfy the School of Science requirement.

MATH 122a Numerical Methods and Big Data [sn, dl]

Prerequisites: MATH 15a or MATH 22a and MATH 20a or MATH 22b, and basic proficiency with a programming language such as Python or Matlab.

MATH 123a Principles of Mathematical Modeling [sn]

Prerequisites: MATH 15a or MATH 22a, MATH 20a or MATH 22b, and MATH 37a.

MATH 124a Optimization [sn, dl]

Prerequisites: MATH 15a or MATH 22a, MATH 20a or MATH 22b, MATH 23b, and basic proficiency with a programming language such as Python or Matlab, or permission of the instructor.



Senior Honors Research, Math 99a/b

For complete listing of rules for Senior Honors Research, go to the Math website:
<https://www.brandeis.edu/mathematics/undergraduate/senior-honors-thesis.html>.

- The honors program is a two-semester sequence (Math 99a, "Senior Research" in fall, followed by Math 99b, "Senior Research" in spring) during which senior mathematics majors carry out independent research and the writing and oral presentation of a senior thesis.
- Only students who major in the BS in Mathematics or BS in Applied Math may choose the option of writing a thesis in order to be considered for Honors, High Honors or Highest Honors in mathematics.

Foundational Literacy Requirements

These courses in Math currently fulfill the University's [Quantitative Reasoning Requirement](#)):

Math 8a "Introduction to Probability and Statistics"

Math 36a "Probability"

Math 36b "Mathematical Statistics"

Math 231a "Advanced Bifurcation Analysis in Dynamical Systems" (graduate course)

As part of completing any math major, students must:

- Fulfill the writing intensive requirement by successfully completing one of the following: MATH 23b or MATH 47a.
- Fulfill the oral communication requirement by successfully completing: MATH 16b or MATH 40a.
- Fulfill the digital literacy requirement by successfully completing: MATH 16b, Math 40a, Math 122a, Math 124a, COSI 10a, COSI 12b, or COSI 21a.

Rotation of Courses:

Math Courses offered **EVERY** year.

Note: The actual rotation of classes may vary slightly due to instructor availability and budgetary constraints (and are always conditional on approval by the dean).

Math 3a	Explorations in Math		every spring
Math 5a	Precalculus Mathematics	every fall	every spring
Math 8a	Intro to Prob+Stat without Calc	every fall	every spring
Math 9b	Math Puzzles and Games		every spring
Math 10a	Techniques of Calculus (a)	every fall	every spring
Math 10b	Techniques of Calculus (b)	every fall	every spring
Math 15a	Applied Linear Algebra	every fall	every spring
Math 16b	Applied Linear Algebra Practicum	every fall	every spring
Math 20a	Multi-variable Calculus	every fall	every spring
Math 22a	Honors Lin Algebra & Multi-variable Calculus, I	every fall	
Math 22b	Honors Lin Algebra & Multi-variable Calculus, II		every spring
Math 23b	Introduction to Proofs	every fall	every spring
Math 31a	Abstract Linear Algebra	every fall	
Math 35a	Advanced Calculus and Fourier Analysis	every fall	
Math 36a	Probability	every fall	
Math 36b	Mathematical Statistics		every spring
Math 37a	Differential Equations		every spring
Math 40a	Intro to Applied Mathematics	every fall	
Math 47a	Introduction to Mathematical Research	every fall	
Math 48a	Representation of Quivers		one-time course offering, Spring 2023
Math 100a	Introduction to Algebra, Part I	every fall	
Math 110a	Intro to Real Analysis, Part I	every fall	
Math 115a	Introduction to Complex Analysis		every spring

Rotation of Courses:

Math Courses offered every **OTHER** year.

Note: The actual rotation of classes may vary slightly due to instructor availability and budgetary constraints (and are always conditional on approval by the dean).

Course Number	Course Name	Fall rotation, alternating years	Spring rotation, alternating years
Math 28a	Introduction to Groups		spring of even years (Spring 2024)
Math 28b	Intro to Rings and Fields		spring of odd years (Spring 2023)
Math 39a	Intro to Combinatorics	fall of odd years (Fall 2023)	
Math 100b	Intro to Algebra II		spring of even years (Spring 2024)
Math 102a	Introduction to Differential Geometry		spring of odd years (Spring 2023)
Math 104a	Intro to Topology	fall of odd years (Fall 2023)	
Math 108b	Introduction to Number Theory	fall of even years (Fall of 2024)	
Math 110b	Intro to Real Analysis II		spring of even years (Spring 2024)
Math 121a	Mathematics for Natural Sciences		spring of odd years (Spring 2023)
Math/Mus 121b	Mathematics and Music		Spring 2023 (rotation to be decided)
Math 122a	Numerical Methods and Big Data	fall of odd years (Fall 2023)	
Math 123a	Principles of Mathematical Modeling		spring of even years (Spring 2024)
Math 124a	Convex optimization	fall of even years (Fall of 2024)	
Math 126a	Intro to Stochastic Processes and Models		spring of odd years (Spring 2023)



Guide to Research

- Ask a faculty member in the math department if they have any projects that you can help with. Not sure how to approach a faculty member or what to ask for? Sign up for Research 101 workshops that can guide you (next ones are November 18th and December 8th): <https://www.brandeis.edu/undergraduate-research/index.html>
- Apply for the Math Department's [Directed Reading Program](#), spring semesters. You will work one-on-one with an advanced graduate student in the math department. Any sophomore, junior, or senior who has taken 15A (Applied Linear Algebra) and 20A (Multi-Variable Calculus) is eligible to apply. First-years who have seen this material are considered on a case-by-case basis.
- Create a Forager One Account: <https://foragerone.com/auth/get-started>. Find the faculty members who are doing research at Brandeis.
- In your senior year, consider pursuing [Senior Honors Research](#) (Math 99a/b).
- To receive academic credit for work with a faculty member, register for Math 91g "Intro to Research Practice" (1/4 credit) or Math 98a/b "Independent Research" (4 credits), with the faculty member's approval.



Guide to Research (links)

Off-Campus, including Research Experiences for Undergraduates (REUs)

- **Mathematical Sciences:** https://www.nsf.gov/crssprgm/reu/list_result.jsp?unitid=5044
- **REU's:** <https://www.maa.org/member-communities/students/undergraduate-research/research-experiences-for-undergraduates>
- **STEM:** <https://www.pathwaystoscience.org/undergrads.aspx>

Undergraduate Research and Creative Collaborations (URCC) at Brandeis

- <https://www.brandeis.edu/undergraduate-research/index.html>

Division of Science

- <https://www.brandeis.edu/science/undergraduate-research/surf.html>