



MathILy-Er 2022 Final Report

Preface

This was the eighth year of MathILy-Er. It was also the year that we happily were able to return to having the program in person. This year we were very happy to be able to have the program so close to MathILy.

Program Preparations

Promotions:

Emails: Individual emails were sent to promising applicants from 2021 inviting them to apply for 2022. {MathILy, MathILy-Er} 2021 participants were emailed as two groups notifying them when the EAR became available.

Webpage hits: Over the year we had 125,000 hits, with a low of about 5,000 in August 2021 steadily increasing to a peak of 17,000 in March 2022.

Impacts: 55% of applicants found {MathILy, MathILy-Er} on a summer program list, 32% found {MathILy, MathILy-Er} via a web search, 22% were alerted by a parent or guardian, 13% were informed by a teacher, 10% applied in a previous year, 10% heard of it from an alumn, and 1% found or were handed a {MathILy, MathILy-Er} flier (despite us not sending out fliers this year). About 5% of applicants said they heard about {MathILy, MathILy-Er} from a friend (18) or relative (5) who had attended or applied, and of these students, 8 were admitted to MathILy and 5 were admitted to MathILy-Er.

Applications:

Statistics: There were 388 completed applications. Of these, 46 were admitted to MathILy-Er. Of the 46 admitted students, 31 chose to attend. Thus, our current yield rate is roughly 67%.

The data in the following table was measured where possible and approximated otherwise.

Percentage	Female	NB/trans	East Asian	South Asian	Latinx	Middle Eastern	Black and Indigenous
Short Forms	34%	>1%	37%	26%	4%	8%	2%
EARs	37%	1%	49%	19%	3%	2%	1%
Attending	45%	3%	39%	22%	10%	0%	3%

Financial Aid: We awarded \$5850 in financial aid to MathILy-Er participants (\$4850 to domestic students and \$1000 to an international student). We met the level of demonstrated need for all admitted students who applied for financial aid.

Personnel

Academic: There were three Lead Instructors (LIs), Dr. Alice Mark (Senior Lecturer at Vanderbilt University, Ph.D. University of Texas at Austin, 2015), Dr. Brian Freidin (Assistant Professor at Auburn University, Ph.D. Brown University, 2018), and Dr. Aaron Fenyes (Instructor in Mathematics at Phillips Exeter Academy, Ph.D. University of Texas at Austin, 2016). There was one Instructor, Tom Mainiero (Assistant Professor of Math and CS at St. Joseph's University of New York, Ph.D. University of Texas at Austin, 2015, Physics), teaching only during the third week. There were four Apprentice Instructors (AIs), Corrine Yap (graduate student at Rutgers University), Kimball Strong (graduate student at Cornell University), Max Everett (graduate student at the CUNY Graduate Center), and Rory Erlich (undergraduate math major at Tufts University).

Administrative: The Director was Dr. Alice Mark. The {MathILy, MathILy-Er} Minion was Madison Stuart (Smith College B.A. 2006 in Mathematics and German; graduate work in information science at the University of Michigan). The Protector and Responder in the MathILy-Er Environment (PRiME) was Jennifer Diamond (undergraduate math major at Westfield State University). The Protector and Responder in the MathILy-Er Environment, Facilitator of Academics and CriTiquer of wRiting (PRiME FAC-ToR) was Audrey Baumheckel (graduating math major and beginning masters student at Fresno State University).

Advisory Amalgam: These individuals gave advice on academic and practical aspects of MathILy-Er.

[Dr. Douglas J. Shaw](#), mathematics faculty at University of Northern Iowa

[Dr. Ruth Haas](#), mathematics faculty at University of Hawaii

[James Cocoros](#), mathematics faculty at Hunter High School

[Dr. Dylan Shepardson](#), mathematics faculty at Mount Holyoke College

[Dr. Carol E. Fan](#), operations researcher (currently Operations Data Science Lead at Apple)

[Dan Zaharopol](#), Executive Director of [BEAM](#)

[Dr. James Tanton](#), mathematician, currently Ambassador for the [MAA](#)

[Dr. Joshua Greene](#), mathematics faculty at Boston College

[Dr. Emily Peters](#), mathematics faculty at Loyola University Chicago

[Wing L. Mui](#), Seattle-area artist and mathematics teacher

[Dr. Thomas Hull](#), mathematics faculty at Western New England University

[Dr. Josh Laison](#), mathematics faculty at Willamette University

Student Demographics:

States represented by MathILy-Er students, in order from most to least number of students: California, New York, Maryland, North Carolina, Texas, Florida, Georgia, Illinois, Louisiana, Massachusetts, Oregon, Pennsylvania, Tennessee, Washington.

Countries outside the US: Canada, India, Spain, South Korea.

Gender breakdown: 14 female, 16 male, 1 nonbinary.

Age: There were two 13-year-olds, one 14-year-olds, thirteen 15-year-olds, ten 16-year-olds, and five 17-year-olds. Two student birthdays fell during the program.

Academic Background: 17 students had taken some Calculus before the start of the program; 1 had taken some Linear Algebra; 7 had not yet taken Precalc.

What Happened at MathILy-Er 2022?

Academics

Classes: Each weekday we had 4 hours of morning class, 1 hour of Daily Gather, and 3 hours of evening problem session, for at least 8 contact hours per day. Weekends varied, but Saturdays usually consisted of 4 hours of morning class and between 1 and 2 hours of Life Seminar.

The basic curricular structure was two weeks of core curriculum, called Root Class (after the Root of a graph theoretic tree, and after the idea that the material strengthens student grounding much as the roots of a tree do), followed by one week of short topical classes, called the Week of Chaos, followed by two weeks of a focused topic, called Branch Class (after branches of mathematics, and after the idea that tree branches grow from a strong trunk nourished by roots).

Root Class: The 31 students were split into two root classes, each taught by one LI and one or two AIs. The PRiME FACToR also assisted in one of the classes. The material in Root Class included Farey and Stern-Brocot sequences, linear algebra over \mathbf{F}_2 , enumerative combinatorics, graph theory, combinatorial game theory, and disease modeling. Students also learned and practiced various proof techniques. All the material was treated with full proofs given by the students.

Week of Chaos: Students indicated which of 30 potential topics they would be excited to learn about. Instructors compiled these favorites into a list of eighteen courses. The courses offered were as follows: Gen-too Functions (Generating Functions), Quackternions and Ducktonions, Wind Up Birds (Turing Machines), The Many Meanders of Masha Meowinovich (Random Walks), Cardinals and Orioles, Flying in Circles (Homotopy), Rock Dove the Vote, Angry Birds (Fair Division), That's Numberwing! (Algebraic Number Fields), Surreal Numbers: A Play in Five Acts, Juggling, Codebirds (Cryptography), Bird of a Feather (SET), Glass Buildings are a Hazard for Birds (Reflection Groups), Erdős Magic (Probabilistic Proof), Big Bird's Great Neurotic Adventure (the Circle Dynamical System), Bird Den of Proof (Methods of Proof), and Fibirdnacci's Friends.

Branch Class: During the last two weeks of the program, students took one of two Branch classes. The courses were Markov Algorithms and Non-Euclidean Geometry. Students were given the opportunity to indicate which class they preferred, and were placed based on preference. The Geometry class has been taught every year since 2017, but the Algorithms class was new this year.

Pedagogy: All classes were conducted through inquiry-based learning, with students writing on the board and working in groups throughout most of the morning class and collaboratively working on a problem set and writing up proofs during the evening class.

Feedback: Students received feedback in several ways. Class presentations were often met with feedback from instructors and students, both for mathematical correctness and style. Students received written comments on their problem session work, always on the following day. Near the end of Root and Branch classes, students wrote introspective self-evaluations on their progress at MathILy-Er. Then, individual interviews were held with the students to discuss what they had written, as well as other areas for improvement.

Daily Gathers: The instructors each gave at least one Daily Gather. The Daily Gather time slot was occasionally used for showing math movies. The remaining Daily Gathers were interactive presentations by guest mathematicians, most of whom were visitors from MathILy.

Extracurriculars

Life Seminars: Life Seminars were held on four weekends. Each was a mostly unstructured one- to two-hour period where students could ask the staff about applying and going to college, work as a mathematician, and general practical matters of life and adulthood.

Other program-wide activities: At the end of the first week, students and staff walked to a park across the road. At the end of the third week, there was a trip to a nearby ice cream shop. Towards the end of the program, there was an informal talent show.

We ordered MathILy-Er t-shirts for everyone. Several students collaborated with the PRiMEs and Minion to come up with a design featuring things from Root class, inside jokes, and student doodles.

Each week, students wrote and edited content for the Record of Mathematics. Students wrote summaries of classes and other program happenings as well as fun and silly observational pieces about life at the program, and drew elaborately detailed covers.

Non-program-wide activities: Student recreational activities included soccer, frisbee, volleyball, and running, as well as a variety of board and card games.

Administrative Matters

Cabrini Campus and Facilities: The best thing about Cabrini was its proximity to Bryn Mawr, and how easy it was for MathILy and MathILy-Er staff to visit each other's programs. The Cabrini campus itself had some nice features, including its small size, and the layout of our dorm.

Covid-19 Protocols: All students and staff took rapid tests on arrival. Everyone wore masks everywhere indoors on campus for the first week of the program. After a week, tests were offered again, and anyone who presented a negative result could unmask in the dorm and in our classrooms. We all continued to wear masks in all indoor spaces besides our dorm and classrooms throughout the summer.

Post-Processing

Post-program staff meetings: The post-processing meeting was held after the last car returned from dropping students off at the airport. We met for an hour, broke for dinner, and then continued the meeting after dinner until we were done.

We all agreed that being close to MathILy was a major positive.

Finances Summary: The income from student fees (some discounted) was \$147,830.

No donations were earmarked for financial aid.

Our Epsilon Grant award was \$3,000.

Total MathILy-Er income: \$150,830.

Administrative expenses (insurance, fliers, etc.) totaled approximately \$3065.

Total wages (instructors, PRiME, Minion, Director) were approximately \$42,605.

Wage-related administrative costs (payroll taxes, etc.) were \$591.

Travel costs (visitors, instructors) were \$2942.

No students receiving financial aid needed travel support.

Program expenses (supplies) were approximately \$3015.

Site expenses from Cabrini University were \$95,405.

Total MathILy-Er expenses: \$147,623.

The net revenue of approximately \$3207 arose from a staff member refusing to provide us with correct bank information, and from having one less staff member during Week of Chaos than hoped for.