



MathILy-Er 2024 Final Report

Preface

This was the tenth year of MathILy-Er and the first year with Corrine as director. We celebrated with a 10th Birthday Party celebration and had our first summer at a Philadelphia-area campus that we would be happy to return to. We also had excellent students who grew a lot in their mathematical thinking and writing abilities.

Program Preparations

Promotions

Electronic: Individual emails were sent to prior participants and promising applicants. Web traffic varied from 5,900–17,300 hits/month, with about one-third of the traffic from abroad. The second-most popular page (after the MathILy home page) is Discrete Mathematics in the Real World, accounting for about 28% of website visits.

Print: sarah-marie handed out about 50 fliers at the Harvard-MIT Math Tournament (HMMT), and the Minion sent about 800 fliers to other contests.

Other Activities: We held a {MathILy, MathILy-Er, MathILy-EST} Yearly Gather at the Joint Mathematics Meetings, where at least 110 participants team-solved a Jonah-designed seven-part puzzle with a meta-puzzle using the solutions to the prior seven parts. At HMMT February sarah-marie gave an Education Event on Tetris-y Tilings, with 65–70 attendees split across two adjacent rooms (she ran back and forth). In late March she offered an Art of Problem Solving Math Jam (about 60 participants) on Foury, Fourier, Fouriest Numbers that included a {MathILy, MathILy-Er} Q&A.

Applications and Admissions

Statistics: We received 2052 Short Forms, 833 Not-as-Short Forms, 746 EARs, and 675 completed applications. We admitted 39 students, for an admissions rate of under 6%. Of these, 30 chose to attend. Thus, our current yield rate is roughly 77% (an increase from last year).

Demographics: Applicants originated from at least 40 US states and 46 foreign countries. This data comes from the 833 Not-as-Short Forms (representing North/South America, Western/Eastern Europe, East/Central/Southeast Asia, North/West/East Africa, and the Middle East). The data in the following table was measured where possible and approximated otherwise.

Percentage	Female	NB	East Asian	South Asian	Latinx	Middle Eastern	Black and Indigenous
Short Forms	28%	3%	47%	21%	4%	6%	2%
EARs	29%	2%	58%	14%	3%	2%	1%
Attending	40%	7%	50%	10%	7%	0%	7%

Financial Aid: We awarded \$26,050 in financial aid to MathILy-Er participants and used grants from Jane Street (\$10,800) and the AMS Epsilon Fund (\$15,000) for this purpose.

Personnel

Academic: Lead Instructors were Dr. Corrine Yap (Visiting Assistant Professor at Georgia Tech, Ph.D. Rutgers University, 2023) and Dr. Alice Mark (Senior Lecturer at Vanderbilt University, Ph.D. University of Texas at Austin, 2015). Apprentice Instructors were Kye Shi (graduate student at UCLA, MathILy 2015–16) and Cam Gavalier (graduate student at CUNY Graduate Center). Week of Chaos instructors were 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) and Karoline Dubin (graduate student at University of Illinois, Chicago).

Administrative: The Director-Er was Dr. Corrine Yap. The excellent {MathILy, MathILy-Er} Minion was again the ever-capable Madison Stuart (Smith College B.A. 2006 in Mathematics and German; graduate work in information science at the University of Michigan). The PRiME FACToRS were Taryn Trigler (MathILy-Er 2019, B.A. in Mathematics and Biomedical Engineering, Georgia Tech, beginning graduate student at Emory University in Biochemistry) and Noa Hunter (B.A. in Mathematics, Auburn University, beginning graduate student at Notre Dame in Mathematics). The PRiME FACToRS had academic roles as well.

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

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

[Dr. Ruth Haas](#), (retired) 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 Mathematician at Large with the [MAA](#)

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

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

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

[Dr. Thomas Hull](#), mathematics faculty at Franklin&Marshall College

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

Student Demographics

U.S. States and Districts represented by MathILy-Er students, roughly from east to west: Massachusetts, New Hampshire, New York, New Jersey, Florida, Pennsylvania, Virginia, District of Columbia, North Carolina, Illinois, Kansas, Arizona, Oregon, and California.

Countries outside of the U.S., roughly from east to west: Mexico, Philippines, China, Vietnam

Gender breakdown: 12 female, 16 male, 2 non-binary

Age: There were five 14-year-olds, fourteen 15-year-olds, seven 16-year-olds, and four 17-year-olds. Two student birthdays fell within the program.

Academic background: 16 students had taken some Calculus before the start of the program; 5 had taken some Number Theory; 2 had taken some Linear Algebra; 5 had not yet taken Precalc.

Previous summer programs: 5 attended MathPath, 5 attended AwesomeMath, 1 attended Epsilon, 1 attended G2 Math Program.

What Happened at MathILy-Er 2024?

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 1.5–2 hours of Life Seminar. Mathematical conversations also occurred outside of class.

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 30 students were split into two Root classes, one taught by Corrine and Cam with some assistance from Taryn, and the other taught by Alice and Kye with some assistance from Noa.

The material in Root Class included Farey and Stern-Brocot sequences, linear algebra over 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 39 potential topics they would be excited to learn about, from which instructors decided on a list of 18 classes offered. These were: Algebraists Anonymous (abstract algebra, Tom), All algorithms taste the same (complexity theory, Karoline), Big and Bigger (cardinality, Cam), Complaints in Noir Films (point-set topology, Alice), Counting to the Extreme (extremal combinatorics, Corrine and Taryn), Dr. Strangeword or: How I Learned to Stop Worrying and Love the Automata Bomb (finite state automata, Karoline), From Poof to Proof (proof-writing, Corrine), If it quacks like a duck and rotates like a duck... (quaternions, Alice), Knot Another Knot Joke (knot theory, Tom), Numberwang! (number theory, Cam), Roundabout Ronda's Ridiculously Remarkable Ritual (circle dynamical system, Tom), SET (mathematics of SET, Cam), That's so Real, honestly (surreal numbers, Kye), Through the Looking Glass (reflection groups, Alice and Noa), Through Thicc and Thinn (fractal dimension, Kye), Voting in the Isle of Dog (voting theory, Karoline), Werewolf Designs (combinatorial designs, Corrine), What is the shape of a sentence? (grammar and fractals, Kye). Student preferences guided placement of each student into 5 classes. 11/18 of these classes used specific material from the Root curriculum, and each main topic in the Root curriculum was used in at least one class.

Branch Class: During the last two weeks of the program, students took one of two Branch classes. The courses were What to Expect When You're Expecting the Unexpected (discrete probability) taught by Corrine and Kye with assistance from Noa, and The Geometry of Our Dreams (non-Euclidean

geometry) taught by Alice and Cam with assistance from Taryn. Both Branch classes used linear algebra and Sage.

Pedagogy: All classes were conducted through inquiry-based learning, with time split between instructor-led discussion, work in groups at the board, and student presentations. Students were assigned to take comprehensive notes for future class reference, which were reviewed by an instructor and then copied and distributed to the class.

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

Daily Gatherers: The instructors gave one Daily Gather each. Math Movies were shown during the Daily Gather time once per week in four of the weeks. The remaining Daily Gatherers were given by visiting mathematicians, four of whom were from {MathILy, MathILy-EST} and the remaining eight of whom were external visitors.

Extracurriculars

Life Seminars: Five Life Seminars were held over the weekends, each with a general theme but with a lot of time for open questions. The first was on miscellaneous life matters, such as writing emails and imposter syndrome. The second focused on college, the fourth on mathematical careers, and the fifth on applying to MathILy. The third was a special alumni panel held for MathILy-Er's 10th Birthday Celebration.

All-program activities: On the first Saturday afternoon, the entire program walked to a small park in Glenside to play orthogonal questions and eat watermelon. On the Saturday ending Week of Chaos, we celebrated this summer being the 10th MathILy-Er with a party open to all alumni, former staff, and former visitors to MathILy-Er; events included a special alumni life seminar, Jonah-written puzzles, MathILy-Er trivia, and cake. The following day, we walked to Dreams Ice Cream in Glenside to celebrate National Ice Cream Day.

Social activities: The games One Night: Ultimate Werewolf and Avalon were popular this year. Several students and one staff member used the pool table in the dorm lounge. A piano in the dorm lounge was used for piano practice and also for accompanying spontaneous karaoke, mainly the songs "Taylor the Latte Boy" and "Dreamer." The TV in the lounge was used for several weekend movie screenings. A staff member ran a mile every day and was usually joined by several students. During Week of Chaos, Corrine read Bedtime Cat Poems. On the Saturday of the fourth week, students hosted a talent show. Students sang, danced, juggled, rapped, acted out a scene from a satiric YouTube series, held a toilet-drawing contest, made a soundscape of weird body noises, and drew perfect circles. A staff member held social dancing lessons.

Administrative Matters

Campus Location: Glenside is a suburb of Philadelphia. The town is walkable and safe, and the SEPTA station is a 20-minute walk or a 5-minute drive from the Arcadia campus. There are several grocery stores nearby, including a Produce Junction that students and staff liked to visit to purchase fruit. Bryn Mawr College is a 35-minute drive away, which made visits between campuses possible but less convenient than last year.

Facilities at Arcadia: The campus itself was small and easy to navigate. We were assigned our own dormitory with air-conditioned rooms. Everyone's favorite aspect of the dorm was the lounge, which was large enough to have many social activities happening at the same time. We also liked our classrooms in Boyer; all had at least one wall of floor-to-ceiling whiteboards and two had several whiteboard desks on wheels. Our floors of the building were mostly unoccupied by anyone but us. The dining hall staff members were all very friendly and super accommodating to our group, particularly with respect to dietary restrictions.

COVID-19 Protocols: All students and staff took rapid tests on arrival and every day for the first five days. In the meantime, we remained unmasked around each other. The only place on campus where we regularly encountered people from outside our program was the dining hall, and we masked there. We also ate all our meals outside or in a separate room next to the dining hall.

Post-Processing

Post-program staff meetings: After the official end of the program, the staff met to discuss and evaluate various aspects of the program. We will update some of the staff documentation and curriculum documents based on this discussion.

Finances summary:

The income from student fees (some discounted) was \$132,953.

Donations from Jane Street for financial aid and visitor travel were \$13,300.

Our Epsilon Grant award was \$15,000.

Total MathILy-Er income: \$161,253.

Administrative expenses (insurance, fliers, etc.) totaled approximately \$2,645.

Total wages (instructors, PRiMEs, Minion, Directors) were approximately \$46,443.

Wage-related administrative costs (payroll taxes, etc.) were \$1465.

Travel costs (visitors, instructors) were \$4,704.

Program expenses (supplies) were approximately \$2,737.

Site expenses from Arcadia University were \$86,997.

Total MathILy-Er expenses: \$144,991.

The net revenue of approximately \$16,262 was primarily from lower-than-budgeted (and lower-than-expected) site expenses and from not needing a PRiME (because we had two PRiME FACToRs).