



MathILy-Er 2016 Final Report

Preface

This was the second year of MathILy-Er, and the program was a rousing success. The students were extremely strong, the campus was excellent, and we discovered way more mathematics than we had ever expected.

Program Preparations

Promotions

Emails: Individual emails were sent to promising applicants from 2015 inviting them to apply for 2016. MathILy-Er 2015 participants were emailed as a group notifying them when the EAR became available.

Webpage hits: Over the last year, MathILy-Er-specific pages accounted for about 12% of traffic on mathily.org.

Impacts: About 57% of applicants found {MathILy, MathILy-Er} on a summer program list, 28% from a web search, 21% from a parent or guardian, 19% from a teacher, and 3% from a flier. These percentages are consistent with those for the 2015 season. About 3.5% of applicants said they heard about {MathILy, MathILy-Er} from a friend who had attended.

Applications

Statistics: Seventy-seven of the 120 completed applications were forwarded for MathILy-Er consideration, and of those 30 were admitted and 17 attended. That's an admissions rate of 39% and a yield of 57%.

Demographics: Not-as-Short Forms originated from at least 26 US states and 12 foreign countries (representing mostly North America, Europe, and Asia).

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

| Percentage | Female | East Asian | South Asian | Latin@ | Other of color |
|-------------|--------|------------|-------------|--------|----------------|
| Short Forms | 34% | 37% | 19% | 3% | 2% |
| EARs | 28% | 41% | 11% | 1% | 3% |
| Attending | 35% | 59% | 6% | 0% | 18% |

Financial Aid: We were awarded an AMS Epsilon Fund grant for \$8,250 (to be used for financial aid). Additionally, the Mathematical Staircase, Inc. Board also allocated up to \$5,000 from cash reserves for financial aid purposes. We awarded \$11,600 in need-based financial aid to MathILy-Er participants; some admitted students who did not participate in MathILy-Er also qualified for financial aid.

Personnel

Academic: There were two Lead Instructors, Dr. Jonah Ostroff (University of Washington, Ph.D. Brandeis University 2013) and Dr. Alice Mark (Arizona State University, Ph.D. University of Texas at Austin 2015), with Alice teaching for only the first three weeks. There were two Apprentice Instructors, Kate Borst (Carnegie Mellon University) and Michael Daellenbach (Lewis and Clark College).

Administrative: The Director was Dr. Jonah Ostroff. 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 Arianne Hermida (undergraduate, University of Washington).

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 Smith College

[Mr. James Cocoros](#), mathematics faculty at Stuyvesant High School

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

[Dr. Carol E. Fan](#), operations researcher (currently at the Gap)

[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](#), mathematics faculty at the Overlake School

[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, from west to east: California, Missouri, Florida, Virginia, Maryland, Pennsylvania, New York, Rhode Island

Countries outside the United States: China

Gender breakdown: 11 male students, 6 female students.

Ages: Three 14-year olds, one of whom turned 15 during the program; four 15-year olds; three 16-year olds, one of whom turned 17 during the program; 5 17-year olds.

Academic backgrounds: Four students had already taken calculus.

What Happened at MathILy-Er 2016?

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 (not including mathematical conversations held

outside of class). Weekends varied, but Saturdays usually consisted of 4 hours of morning class 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 focused-topic class, 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 seventeen students were split into two root classes (one taught by each LI). The material in the Root Class included matrix algebra and ring theory, enumerative combinatorics, graph theory, and combinatorial game theory. All of this 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 set of ten courses. The courses offered were as follows: A Tour of Turing, Cryptography and Number Theory, Surface-Level Understanding (a class about surfaces), Let's Talk About SET[®], Hyperplane Arrangements, Forbidden Colorings, Quaternions and Octonions, Coding, Non-Euclidean Geometry, and Generating Functions. Each student was placed into five of these classes according to their expressed preferences. A majority of these classes used combinatorial and graph theoretic material from the Root curriculum.

Branch Class: There was again one Branch class, on the topic of mathematical politics: social choice procedures, apportionment, weighted voting systems, and fair division. The instructors were pleased by the students' progress, especially in the area of social choice and apportionment.

Pedagogy: All classes were conducted through inquiry-based learning, with students writing on the board throughout most of the morning class, and almost zero time spent with instructors presenting at the front of the room.

Feedback: Students received feedback in several ways. Class presentations were met with instant verbal feedback from instructors and students, both for mathematical correctness and style. Students received written comments on their problem session work at the beginning of the following morning class. Near the end of Root and Branch classes, students wrote self-evaluations on their progress at MathILy-Er. Finally, individual interviews were held with the students at three points throughout the summer.

Daily Gathers: Each instructor gave several Daily Gathers. The Daily Gather time slot was occasionally used for other activities, such as a Sage tutorial, a mathematics spelling bee, and math movies. The remaining Daily Gathers were interactive presentations by visiting mathematicians, including the Willamette mathematics REU.

Extracurriculars

Life Seminars: Three Life Seminars were held on weekend afternoons. Each of these was an unstructured 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 explored the Salem Farmers Market and nearby Riverside Park. Other activities included a day-long trip to Portland and a

celebration of Approximate Pi Day.

Non-program-wide activities: Student recreational activities included running, tennis, piano, and Pokémon GO. Students often played board and video games and watched movies in the lounge.

Administrative matters:

Facilities at the Willamette: Students and staff both agreed that the Willamette campus was excellent. The classrooms were comfortable and perfect for group work, and the dormitory was well-equipped.

Salem: Salem was a fine location for MathILy-Er. There were a lot of options for food and recreation, but the town was small enough that students could safely leave campus in groups for shopping, eating, and Pokémon hunting. However, travel to Salem was expensive and inconvenient for most participants and visitors.

Post-Processing

Post-program staff meeting: On Saturday evening, the staff met to discuss various aspects of the summer.

We were very happy with the Root curriculum. We felt that Sage was better integrated into the curriculum this year, but next year our Sage tutorial should come earlier in the program.

Collectively, we felt that the students showed a promising amount of growth, and that most would be ready to attend MathILy should the apply in the following summer.

Finances summary: The income from student fees was \$66,651 and donations for financial aid were \$8,500, for total MathILy-Er income of \$75,151.

Administrative expenses (insurance, fliers, etc.) totaled approximately \$1935.

Total wages (instructors, PRiME, Minion, Director) were approximately \$24,890.

Travel costs (Daily Gather speakers, instructors) were approximately \$1419.

Program expenses (supplies, program outings) were approximately \$1335.

The charges from Willamette were approximately \$44,287 for food, housing, and copying costs.

Thus, the total expenses are approximately \$73,866.