



2024 Summer Camp for Women Undergraduate Students in Mathematical and Information Sciences: Event Report



# Introduction

The "Summer Camp for Women Undergraduate Students in Mathematical and Information Sciences" was held on September 9–11 (Monday-Wednesday), 2024, at the Inter-University Seminar House in Hachioji City, Tokyo. Participants in this three-day Summer Camp were women undergraduates studying mathematical and information science at universities throughout Japan. These young women were joined by graduate students in these fields as well as others, including professors and researchers. The goal was to provide an opportunity for attendees to consider their future careers. The Camp was an invaluable chance for the undergraduates to discuss their studies, research, and futures with the graduate students and professionals, to form more concrete images of their intended paths.

This program was supported by donations received by RIKEN during fiscal year (FY) 2023.

**Event Name:** Summer Camp for Female Undergraduate Students in Mathematical and Information Sciences **Organizers:** RIKEN Center for Advanced Intelligence Project (AIP), School of Science at Tokyo Institute of Technology **\***, Graduate School of Mathematical Sciences at The University of Tokyo, Department of Mathematical Sciences at Keio University

Date: September 9 (Monday) through September 11 (Wednesday), 2024

Site: Inter-University Seminar House in Hachioji City, Tokyo

The following report on the daily events was made by Kana Ito, a third-year doctoral student in the School of Computing at the Tokyo Institute of Technology\*, and Itsuki Nakamura, a first-year master's degree student in the Graduate Program in Mathematics and Computer Science at Tsuda University.

\* This name was changed from October 2024 to the Institute of Science Tokyo. This report will use the former name (with asterisk each time).



Group photograph of Camp participants (Day 1)

# Day 1: September 9 (Monday)

#### \*13:00 Opening Greetings

Camp attendees were greeted by, respectively, Masashi Sugiyama, Director of the RIKEN Center for Advanced Intelligence Program (hereinafter, "RIKEN AIP"), Kengo Hirachi, Dean of the Graduate School of Mathematical Sciences at The University of Tokyo, and Yuri Yatagawa, Associate Professor at the School of Science at Tokyo Institute of Technology\*. Prof. Sugiyama spoke on the theme, "Why is there a demand for AI researchers and women researchers?" Prof. Hirachi's message was: "Your attendance here at this Camp is one step forward for all of you. However, we hope that you take this opportunity to advance even two or three steps forward!" Dr. Yatagawa spoke of her personal experiences, and encouraged all in attendance to become "Friends and colleagues, and to continue to communicate and study with each other even after the Camp is completed."

#### \*13:15 Self-Introductions

The Professors and other dignitaries introduced themselves, followed by the graduate student mentors, and the undergraduate participants. Although this was a simple introduction, of each individual's name and a few words after, participants could feel that they were all a part of an important event, sharing the same goals.

#### \*13:55 Ice-Breaker Game

A game was performed using dice. The aim was to gain the highest score according to the game rules. Four to six person groups were formed of the undergraduate and graduate students, respectively, and heated debate followed. This debate was based on correct knowledge, especially given that participants had gained a firm understanding of probability in their high school and university years.

#### \*14:25 Explanation of undergraduate scheduling and basic information regarding graduate school

The first speaker was Natsumi Oyamaguchi, Associate Professor in the Faculty of Science Division 1 of Tokyo University of Science. She spoke about finding work as an undergraduate, advancement to graduate school, life at graduate school, differences between a graduate school of teacher education and a graduate school of a specific specialty. She also introduced various organizations that provide counseling and other services. She emphasized that "making mathematics 'fully yours' and a natural part of your thinking will help you to reconstruct and further bolster theories." Among her useful advice was also that "the study of abstract theory will enable you to take a small area and apply it over a broad range."

#### \*15:05 Explanation of basic information regarding advancement to graduate school, employment searches, and future career

Kenichi Bannai, Professor in the Department of Mathematical Science at Keio University (and Team Leader of the Mathematical Sciences Team, RIKEN AIP), lectured on various key topics. These included the depth of differences between men and women in the mathematics and information science fields, unconscious bias regarding the post-doctorate career path, and information about scholarships and other economic assistance. Regarding the path after completing graduate school, there seems to be a conception in Japan that "there is little demand in the job market for Ph.D. holders," but Prof. Bannai offered contrary evidence based on the results of surveys conducted by the Keidanren (Japan Business Federation). In terms of scholarships and financial assistance, most graduate school students (including the authors of this report) have little information, and we were pleased to learn of the different types of assistance available. We felt the importance of our freedom to choose our future careers and having appropriate information at the appropriate times. We hope that this kind of information can be more widely disseminated among undergraduates and graduates alike, to ensure everyone can learn about such things before it is too late!

#### \*15:30 Career Lectures (1): Professors and Other Professionals

The professors and researchers below spoke of their graduate work and life as graduate students. These professionals introduced themselves to the Camp undergraduate participants, and spoke of their research fields, with an overview of their life as graduate students, and their work after finishing graduate school. The lecturers and their contents are as follows.

#### 1.15:30 Yuka Kotorii (Associate Professor in the Graduate School of Advanced Science and Engineering, Hiroshima University)

Dr. Kotorii had six and a half years experiences as a postdoc. She spoke of her graduate school era, her postdoc experiences, and her personal life. It is a rare opportunity for us to hear about the private life of professors! Combined with the academic aspects of her speech, we all felt that Dr. Kotorii was an excellent role model for us to look up to.

\*Postdoc: "Postdoctoral." Refers to a person engaged in research work after having received a Ph.D.

#### 2. 15:50 Rika Akiyama (NTT Social Informatics Laboratories)

During her undergraduate years, Dr. Akiyama majored in variational calculus of energy-related functions (differential geometry field). Currently, she is engaged in research on post-quantum cryptography theory and implementation (algebra and applied mathematics fields). In her speech, Dr. Akiyama introduced us to a variety of work styles and choices.

#### 3. 16:10 Kazumi Kumagai (Postdoctoral Researcher, RIKEN AIP)

For her doctoral thesis, Dr. Kumagai performed research on communication robots (as related to human emotions). Today, she gave a rich and useful speech regarding the theme, "How can we transform our experiences as youth and our academic learning into benefits for the larger society?"

#### 4. 16:30 Soma Purkait (Special Associate Professor, Department of Mathematics, Tokyo Institute of Technology\*)

Dr. Purkait spoke of a variety of issues, including her native country, India, her own background, studying abroad, and her own specialty of number theory. She also talked about graduate school scholarship systems in the United Kingdom, North America, and France. Many participants were able to broaden their personal views as a result of the experiences and information she shared.

#### \*17:05 Panel Discussion (1): Professors and Other Professionals

In Panel Discussion (1), the following Professors and Researchers offered their ideas and opinions in response to audience questions.

#### Panelists:

- Yuka Kotorii (Associate Professor, Graduate School of Advanced Science and Engineering, Hiroshima University)
- Rika Akiyama (NTT Social Informatics Laboratories)
- Kazumi Kumagai (Postdoctoral Researcher, RIKEN AIP)
- Soma Purkait (Special Associate Professor, Department of Mathematics, Tokyo Institute of Technology\*
- Ayaka Sakata (The Institute of Statistical Mathematics)
- Tomoko Takemura (Associate Professor, Department of Physics and Mathematics, Faculty of Science, Nara Women's University)
- Yuri Imamura (Associate Professor, Department of Business Economics, School of Management, Tokyo University of Science)

#### Questions (discussion themes) included the following:

- Work-life balance (personal life, including life events, and work/research)
- "I recently made an X (previously, Twitter) account for exchanges regarding mathematics. Recently I have seen some strong comments regarding quotas for women in entrance examinations. These have made me confused. Could you please give me some advice as how to respond to and interact with the opinions out there?"
- "I am not sure if I am fully engaged properly in my research. I would like to ask our panelists if they were considering their future research paths, even in their undergraduate vears?"

#### \*19:20 Groupwork (1)

Groups of roughly seven persons (four undergraduates, two graduates, and one professor or other professional) were formed. Within each group, on the basis of individual experiences, opinions and ideas were exchanged about fields of interest as well as consideration of future career paths, etc.

- \* First half: Discussion about interests and curiosity about mathematics and information science. Many of the participants had clear and specific themes and fields of interest, and there was sharing of "aha" moments and other key experiences. Many of the undergraduates expressed their renewed interest in topics about which the lecturers and panelists had addressed.
- \* Latter half: Discussion focused on career intentions after graduating from university or graduate school. Many of the undergraduates and graduates felt unspecified anxieties about pursuing a Ph.D. Very many expressed, however, that the lectures heard here on Day 1 had helped to alleviate some of these fears. Some undergraduates said that they now were considering not only becoming university professors, but also the path of a researcher at a private company or institution.

#### \*21:00 Nighttime Seminar / Personal Interviews (voluntary participation)

Many of the undergraduates spent time looking at the mathematics and information textbooks brought by the graduate students, professors, and professionals. Personal interviews were also held, with graduate students, professors, and professionals serving as mentor, responding to the questions of undergraduates about mathematics and information sciences, and consulting with them about issues of concern. The responses were free and open, and there was much laughter and enjoyment.





#### \*09:00 Opening

The second day began with greetings from Prof. Kotaro Yamada, Dean of the School of Science at Tokyo Institute of Technology\* and mathematics professor. Prof. Yamada first introduced the launch in October 2024 of the Institute of Science Tokyo (formed from the merger of the Tokyo Institute of Technology with Tokyo Medical and Dental University). Then the professor spoke of his specialist field, differential geometry, providing a simple introduction while also emphasizing its difference from phase geometry. He also briefly introduced his own books, as well as some of the papers written by his students. Prof. Yamada wove humor into his speech, enabling everyone to start the morning with smiles and laughter. This was followed by self-introductions from each of the professors and professionals who had joined the Camp here on Day 2.

#### \*09:05 Career Lectures (2) (Graduate Students)

The graduate students below each spoke on the topic of "My research in graduate school, and life in graduate school." They introduced themselves and their area of research, provided an overview of daily life in graduate school, and spoke of their intended paths after completion. Each of the speakers is introduced in more detail below.

#### 1. 09:05 Itsuki Nakamura (Master's course, 1st year; Graduate Program in Mathematics and Computer Science, Tsuda University)

Ms. Nakamura provided a simple explanation of her specialist field, algebraic number theory (local class field theory), and of the Iwasawa Theory which she intends to study next. She summarized her daily life as an undergraduate and graduate student, with some words of advice about the graduate school entrance exam. She is thinking about various career paths after she finishes graduate school, such as to work as a researcher, educator, and to perform proof-reading and editing work for mathematics-related books. She stated that she first came across the Iwasawa Theory when she was in fifth grade of elementary school, as well as how she first had a look at the research lab of her current advisor professor when she was a second-year undergraduate student. More than a few participants expressed their surprise at her anecdotes.

#### 2. 09:25 Haruko Matsuzawa (Master's course, 1st year; Graduate School of Science, Osaka Metropolitan University)

Ms. Matsuzawa spoke first of how she introduced linear algebra into her field of specialization, moduli space theory, which led to her explanation of geometric invariant theory. She went into detail about her specialty field. Thereafter, using her yearly schedule, she explained how she transitioned from a fourth-year undergraduate to a first-year Master's student.

#### 3. 09:45 Kotomi Ochiai (Master's course, 2nd year; School of Science at Tokyo Institute of Technology\*)

Ms. Ochiai made a simple explanation of the definitions and expressions of Lie algebra, and of toroidal Lie algebra. Next, she gave an overview of her life as a first year Master's student, speaking of her daily workflow, and her yearly schedule. She urged students to be careful about neglecting their research time by trying to participate in too many job searching activities as summer interns, etc., especially if they were considering proceeding on to a doctoral course. Her message was to ask questions of as many persons as possible about their future, and to avidly engage in the kind of work they enjoy best.

#### 4. 10:05 Mizuki Takahashi (Doctoral course, 1st year; Graduate School of Science and Technology, University of Tsukuba)

Ms. Takahashi explained definitions and expressions in Lie algebra, a field approximate to that of Ms. Ochiai, the previous speaker. She also spoke about affine Lie algebra and quantum groups. Using a pie chart, she introduced her daily work flow in graduate school. She also talked about her school life from her fourth university year up through the second year of her Master's study. We were impressed how, in the midst of a busy schedule which included dividing up housework with her married partner, she was proactively striving to increase the number of hours she dedicates to research.

#### 5. 10:25 Emu Kondo (Doctoral course, 3rd year; Graduate School of Humanities and Sciences, Nara Women's University)

Ms. Kondo introduced her research theme of weighted Hardy inequalities for non-increasing functions. Next, she talked about daily life and overall schedule as she proceeded from her second year in her Master's course up to her third year as a doctoral student. She plans to find employment after she receives her Ph.D., and talked in detail of her job-search activities. She emphasized not to be so set on a certain job type, but rather to search broadly for companies where one can use their mathematical learning and skills. Her message about academic and career progress was to be sure to talk with and listen to the advice of key people when troubled, and then to act.

### \*11:00 Poster presentations by graduate students

The following graduate students displayed on a A0-size poster their study and research contents, and provided explanations to the Camp participants. The names of poster creators and their titles are listed below.

- Manasa Nagatsu (Master's course, 1st year; Graduate School of Science, Kyoto University) Eigenvalue distribution of the Wigner matrix
- Nao Moriyama (Master's course, 1st year; Graduate School of Science, Kyoto University) Fundamentals of algebraic geometry
- Momoka Tashiro (Master's course, 1st year; Graduate School of Science, Nagoya University) Regarding the bankruptcy problem in actuarial science
- Eri Maeda (Master's course, 1st year; Graduate School of Natural Science & Technology, Kanazawa University) Are the Baire category theorem and the axiom of choice equivalent?
- Ayu Deguchi (Master's course, 1st year; Graduate School of Informatics, Nagoya University) Constellation theorem
- Futaba Sato (Master's course, 2nd year; Graduate School of Mathematical Sciences, The University of Tokyo) Quantum groups as viewed from the perspective of theory of operator algebras
- Jiabao Yang (Master's course, 2nd year; Graduate School of Engineering, Musashino University) Stability analysis of linear multistep methods for continuous optimization problems
- Chiaki Shimizu (Master's course, 2nd year; Graduate School of Engineering, Musashino University) Numerical solution of a nonlinear Klein-Gordon equation system
- · Ayumi Ukai (Doctoral course, 1st year; Graduate School of Science, Nagoya University) Ground state approximation with spectral gap and area law
- Mirano Miyayama (Doctoral course, 2nd year; Graduate School of Humanities and Science, Ochanomizu University) Extraction of facial features of aged
  persons with mild cognitive impairment and investigation of related neural basis
- Koto Imai (Doctoral course, 3rd year; Graduate School of Mathematical Sciences, The University of Tokyo) Branch filtration of non-abelian Galois groups of isomorphic local fields
- Kana Ito (Doctoral course, 3rd year; School of Computing, Tokyo Institute of Technology\*) RR type identities denoted by HL polynomials and their arithmetic properties



Graduate student poster presentations (photo above and at top right)



# Group photograph of Camp participants (Day 2)

#### \*13:20 Team-Building Training

Participants were divided into teams, where they performed the "marshmallow challenge," a training activity used to teach lessons in collaboration.

#### \*14:00 Panel Discussion (2) (Graduate Students)

Panel Discussion (2) was led by the following seven graduate students, who spoke to all Camp attendees on similar themes.



#### Panelists:

- · Itsuki Nakamura (Master's course, 1st year; Graduate Program in Mathematics and Computer Science, Tsuda University)
- Haruko Matsuzawa (Master's course, 1st year; Graduate School of Science, Osaka Metropolitan University)
- Kotomi Ochiai (Master's course, 2nd year; School of Science at Tokyo Institute of Technology\*)
- Mizuki Takahashi (Doctoral course, 1st year; Graduate School of Science and Technology, University of Tsukuba)
- Emu Kondo (Doctoral course, 3rd year; Graduate School of Humanities and Sciences, Nara Women's University)
- Kana Ito (Doctoral course, 3rd year; School of Computing, Tokyo Institute of Technology\*)
- Mirano Miyayama (Doctoral course, 2nd year; Graduate School of Humanities and Science, Ochanomizu University)

Discussion themes included the following

- \* Merits and demerits of attending graduate school at a women's university, a co-ed university, one's own university, another university.
- \* Challenging experiences that are unique to women.
- \* Whether or not one should worry about standard scores and deviation (acceptance) rates for entrance exams.
- \* How to initiate contact with a university professor.

#### \*14:55 Lecture on information collection during university and graduate school life

Yuri Imamura, Associate Professor in the Department of Business Economics at the School of Management, Tokyo University of Science) presented the afternoon lecture. She talked about how one may choose a research lab and a career, how to advance to a different university for graduate school, as well as various items about studying abroad, etc. When choosing a research lab, it is important to consider the current state of the field, to investigate its future prospects, to confirm your compatibility with the lab, and, if possible, to make contact with a senior person in the lab. As for entering a graduate school at a different university, one should have a face-to-face interview with teaching staff, get a feel for the atmosphere and environment of the university, etc. Dr. Imamura also recommended various ways to obtain information. This includes building a mailing list with persons from different fields, finding research groups that can serve as information sources for your chosen research theme (such groups include the Oka Seminar for Women, the Women of Mathematics group meeting, the Research Meeting of Women in Number Theory in Japan, the Networking Event for young researchers in mathematics and mathematical sciences, etc.). As for finding academic papers, many of the undergraduates heard for the first time of the arXiv and MathSciNet websites and services. Dr. Imamura communicated the importance of broad-ranging exchanges and information sharing with diverse people globally, also in an effort to close the information gap that exists in the world.

#### \*15:20 Groupwork (2)

Just as on Day 1, groups of basically seven persons (four undergraduates, two graduates, and one professor or other professional) were formed. Within each group, discussions covered the two themes listed below, with each participant speaking of their own experiences.

- \* First half: Participants spoke of their previous images of what research work and graduate school would be like. The majority of the undergraduates had the image that they would be thinking about their schoolwork, and stuck indoors reading academic papers. Meanwhile, graduate students as well as the professors and professions spoke of how things had been much for difficult than they had imagined, and how they had struggled more than they thought they would. Many thought, however, that one's affinity for and compatibility with their professor is important.
- \* Latter half: Group members shared their experiences of problems and worries in their daily private lives. Undergraduates spoke of their difficulties in balancing their school work with their private lives (including circle/club memberships, part-time jobs, housework, etc.). Some spoke of their anxieties about living alone, while others that they had no opportunities to meet with and speak to their professors. Others spoke of the difficulties of speaking with their male fellow students. The graduates, professors, and professionals raised problems about financial insecurities as well as mental health issues, etc. Ways of resolving these issues were discussed, and included such things as proactively engaging with one's problems, as well as broadening one's social networks and obtaining information.



#### \*19:20 Poster Creation (by Undergraduates)

Groups were formed mainly of four undergraduates and two graduate students each, and the undergraduate students created A3-size posters on the theme of "Introducing my future university and graduate school life, and topics of personal interest in mathematics and information." The undergraduates received advice and suggestions from the professors, professionals, and graduate students in attendance. It was nice to see how these persons gave support to the undergraduates, who were hard at work. Some wrote quickly and fluently, while others stopped to think and reflect before they could move on.

#### \*21:00 Nighttime Seminar / Personal Interviews (voluntary participation)

Just as on the previous night, a seminar was held where all could discuss freely about mathematics, future pathways, etc. Personal interviews were also held, where consulting faculty and professionals could share their advice to individual students. The times of the personal interviews and the advisors were as follows.

#### Personal interviews: (1) From 21:00 (2) From 22:00

Advisors (Professors and other professionals) (1) Rei Kawakami (Department of Systems and Control Engineering, Tokyo Institute of Technology\*) (2) Yukiko Sakai (College of Liberal Arts and Sciences, Kitasato University)

Graduate students (1) Haruko Matsuzawa, Kotomi Ochiai, Nao Moriyama (2) Chiaki Shimizu, Kana Ito (the affiliations, etc., of each of these individuals are detailed earlier in this Report)

The undergraduates spent time looking at the mathematics and information textbooks brought by the graduate students, professors, and professionals, and lively discussions about mathematical topics flourished. Undergraduate student consultations included the topics of the fields of mathematics they should study next, and regarding which university would be best for them to apply to. Graduate students asked about whether they should proceed on to the doctoral course, etc. Meanwhile, ideas for an upcoming excursion were collected from the entire group.

#### \* 09:00 Opening / Poster Presentations by Undergraduates

Undergraduates presented their posters which they had made on Day 2. Groups of approximately seven persons each were formed for the first and latter half of the presentations. They also spoke of the things they thought about the Summer Camp. Certainly, it was no easy task to create posters for an hour or two on the second night, and then to present them the following morning (Day 3). Nevertheless, most of the undergraduates progressed smoothly in their work, self-aware of the changes that the Camp had made in them, and able to put their thoughts into words, edit and arrange them for presentation, and then communicate them to their fellows at the camp. These efforts impressed us who listened carefully to their presentations. A list of the statements made by the undergraduates in their presentations follows below.

- "When I go to graduate school, I am going to be active in various research and study groups."
- "I want to do my doctorate work abroad."
- "Looking at the textbooks presented in our nighttime seminars, I found some areas of interest that I intent to study further."
- "At this Camp, I found an interest in number theory that I didn't have before, and I plan to study this more."
- "One of the senior persons here introduced the basics of algebraic geometry in her poster presentation, which was quite interesting."
- "I had some worries before I came to the Camp, but it ended up to be a very fun experience. None of the things I had worried about actually happened—instead, things were about ten times more enjoyable than I had imagined."
- "I learned many things at this Camp, and it is enjoyable to think about what I am going to do after the Camp, too."



#### \*11:00 Groupwork (3)

For groupwork on Day 3, groups were made of approximately seven persons each. Together, each group discussed their impressions of the Camp.

#### Comments from the undergraduates included the following.

- "I had been worried about deciding about my future path, but I was able to get a lot of good advice about this."
- "I was able to share communication information with fellow participants, including my seniors in academic and professional life."
- "My major is not mathematics. Still, everyone patiently responded to my questions in a very easy-to-understand way. I felt that mathematics is also an interesting realm."
- "I was surprised to see that many persons still at school were already married, and it appears that there may be no prejudice about that. The Camp also help to lower my mental 'hurdles' about a Ph.D. course. All of this helped to broaden my perspectives."

Comments from the graduate students, professors, and other professionals included the following.

- "I could hear from people in a variety of fields and endeavors."
- "I am so glad to have been able to share my own experiences with others."
- "I have renewed motivation and desire to engage in my studies and research."

#### \*11:40 Closing

During this closing session, first, prizes were distributed for the Ice-Breaker Game and the Team-Building Training. Then, closing remarks were made by members of the Steering Committee, Prof. Kenichi Bannai and Dr. Yuri Yatagawa. The following statements were particularly impressive: "You don't have to wait for a famous person or a person in authority to initiate things. As soon as you feel the need in your own research or worksite, that's when you should take action," and "The important thing is for you to start acting, without always waiting for the go-ahead of a boss or superior."





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