NC State Undergraduate Mathematics

Fall 2022

Newsletter

Sonia Kovalevsky Day 2022!

Contents

This past April, the Association for Women in Mathematics (AWM) held their annual Sonia Kovalevsky Day (SK Day), in honor of Sonia Kovalevsky - the first female mathematician to obtain her PhD. Schools across the nation hold SK Day to encourage young women to pursue mathematics.

The AWM Chapter at NC State held the first SK Day since the pandemic and it was a major success. Over 45 students from middle and high schools all across North Carolina joined in for a day of mathematics and coding workshops, lunch, prizes, and a special talk put on by keynote speaker Dr. Sabrina Hessinger Professor and Chair for the Department of Mathematical Sciences at Georgia Southern University and founder of Alliance for Women in STEM.

The AWM tentatively plans on holding the next SK Day in April 2023. If you are interested in participating, please join their email list:

1. Compose and email to: math-awm+subscribe@lists.ncsu.edu (no subject or text in body of the message is required)
2. You will receive an email "Join request"
3. Reply to the email: no need to change the subject or add any text

The Association for Women in Mathematics at NC State is a group dedicated to supporting women in our math department. We welcome anyone who supports the success of women in math. We hold casual lunch meetings on Fridays at 11:30am-12:30pm outside of SAS (weather-permitting). Come hang with us!

Newsletter contacts

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SUM Club

Where Are They Now?

Do you ever wonder where our graduates end up? Us too! We reached out to a few exemplary former students from the department to learn about where their NC State mathematics degree has landed them.

Andrew Daniel Marquis

Applied Mathematics (B.S.) - 2016

What are you doing now?

After graduating from NCSU I went to grad school at the University of Michigan where I studied how the constriction/dilation of blood vessels in the lungs affects oxygen uptake in the department of Molecular Integrative Physiology. I took a stab at doing wet laboratory work (cell culture, animal surgery, molecular assays, etc.), but came full circle back to what I'm good at and enjoy doing, which is mathematical modeling. The center of my dissertation was a multi-scale multi-physics model of lungs fluid mechanics, oxygen transport, and physiological regulatory mechanisms that I used to understand how the distribution of air flow and blood flow affects oxygen delivery into the blood stream. I defended my dissertation this year (February 2022) and I started my first real job this year as a Senior Scientist at a company called Applied BioMath. Applied BioMath is a contract research organization/consultancy, where we are hired by biotechnology and pharmaceutical companies to help inform strategic decision making, by developing and analyzing mathematical models of a client's drug/therapy. A major portion of the modeling we do is called pharmacokinetics, where you build a model to keep of track of how a drug is transported throughout the body, and ultimately is eliminated (metabolized by the liver, peed out through the kidneys, etc.). If a drug only accumulates in the body and is never eliminated, you're almost certainly going to have toxic side effects. These models can also be extended to represent how the drug engaging with it's target receptor/cell population affects a biological pathway and produces an efficacious response (alleviates symptoms, cures the disease). We work work on a wide range of projects spanning the drug discovery pipeline: from preclinical phase (doing experiments in cells, mice) to predict if a client's drug is even feasible to have an efficacious response in humans; to using preclinical data to predict a first-in-human dose for a clinical trial; to performing virtual clinical trials in order to de-risk the overall drug development process. The models we build are mostly in the form of large systems of ordinary differential equations (ODEs), and we encounter a variety of interesting/challenging math problems: fitting the model to multiple different types of data, trying to calibrate model parameters with sparse data sets, parameter unidentifiability, etc. What I'm most excited about right now is working on the bleeding-edge of cancer therapies. For example, many companies are developing antibody drug conjugates (ADCs), which is an antibody (large immune protein) with a drug payload (small molecule chemotherapy) conjugated to it. The idea is that the antibody is designed to bind to a specific protein only expressed in cancer cells. When the ADC binds to the cancer cell, it is internalized by the cell and the degradation of the antibody releases the chemotherapeutic drug payload inside the cancer cell. Simply put, it's targeted delivery of a poison. "Old school" chemotherapy is where we basically administer a nasty poison to a cancer patient and hope that it kills the cancer before it kills the patients. ADCs are really exciting in that we can deliver these poisons ONLY to the the cancer tissue, and limit exposure of these nasty poisons to healthy tissue. In practice, a patient will still experience some systemic exposure to the drug payload, and often times the receptor the antibody is designed to bind to is also expressed in healthy tissues, which really complicated the effectiveness of the ADC and potentially causes toxic side effects. The kind of modeling we do at Applied BioMath is very valuable to provide a mechanistic understanding of what properties of an ADC can a pharmaceutical/biotechnology company better design/engineer to maximize therapeutic potential while minimizing toxic side effects.

Where Are They Now?

How has your experience at NC State been helpful to your career?

NCSU in general has a profound reputation for giving folks an excellent education in mathematics/statistics. Simply having NCSU on my resume as opened up a lot of networking doors for me.

While a student at NCSU, I did undergraduate research under the mentorship of Dr. Mette Olufsen. This experience was incredibly influential for me to start shifting how I think about math in a classroom setting, to using math to understand and grapple with complex problems. Dr. O has a deep interest in cardiovascular fluid mechanics, which I have absolutely inherited. She also encouraged/pushed me to take some of the graduate-level courses in the Biomathematics program, where I learned the basics of analyzing system dynamics with a biological contexts. There are a lot of great courses I took during my time at NCSU, but these Biomathematics courses were fundamental to inspiring the kinds of research questions I continue to be interested in.

What advice do you have for current NC State students?

If you're trying to figure out what you want to do for a career, and/or how to make use of a math/applied math degree, my biggest advice would be to do informational interviews. Find someone who is working in a field/job that you're interested in, and ask if you can get coffee with them (or some informal chat) and ask them a few questions about their job. These kinds of interviews are NOT where you ask them for a job or internships. Instead, you ask them stuff like, what do you like about your job? What do you dislike about your job? How do you see the industry changing in the next 5-10 years? If I wanted to do your job, what can I do now to start preparing myself? The point of these informational interviews is to help you figure out what you do and do not want out of a job/career. In my experience, people are super willing to do this, and are very generous with giving you and honest perspective of the pros/cons of a given position/field. I did this toward the end of my time grad school, and this helped steer me away from careers I though was interested in, and allowed me to learn about different options I could do with my unique combination of degrees. I don't regret my path at all, but in hindsight I wish started doing information interviews while I was an undergraduate student. To meet people in careers that you're considering, you can reach out to alumni from NCSU, former students of your professors, and folks you meet at career fairs and similar events.

If you're interested in contacting Andrew, his email is drew.marquis@appliedbiomath.com

DO YOU KNOW A MATH DEPARTMENT GRADUATE WITH AN INTERESTING CAREER?

Nominate them for next semester's "Where are they now?" feature!

Email us at ncsusumclub@ncsu.edu with your nomination.

Where Are They Now?

Do you ever wonder where our graduates end up? Us too! We reached out to a few exemplary former students from the department to learn about where their NC State mathematics degree has landed them.

Jasmine Frantz

Mathematics (B.S.) - 2013
Mathematics Education (B.S.) - 2013

What are you doing now?

Currently, I am in my tenth year teaching. I am in my eighth year at Apex Friendship High School in Apex, NC - "the PEAK of good living." At Friendship I have taught everything from Math 1 to AP Calculus BC. This year I am teaching Honors Pre-Calculus and AP Calculus AB and BC. Outside of the classroom, I am the Mu Alpha Theta faculty advisor, a member of the school improvement team, intervention team, scholarship committee, and a proud supporter of all Apex Friendship sports teams.

How has your experience at NC State been helpful to your career?

My experience at NC State has been pivotal to my success as an educator. Being dual enrolled in the College of Education and the College of Physical and Mathematical Sciences (now College of Science), and my time with the Park Scholarship Program. Being dually enrolled allowed me to explore both pedagogy and mathematics. Having both degrees in mathematics and education has given me the foundation and confidence to teach courses like AP Calculus BC, mentor younger educators, have student teachers, collaborate with my fellow math teachers, and challenge my bright students. My time at NC State also allowed me to work with a wide variety of professors who positively impacted me. Building those relationships with classmates and professors challenged me to think about what type of educator that I wanted to be and the impact that I wanted to make. I am forever grateful for my education at NC State.

What advice do you have for current NC State students?

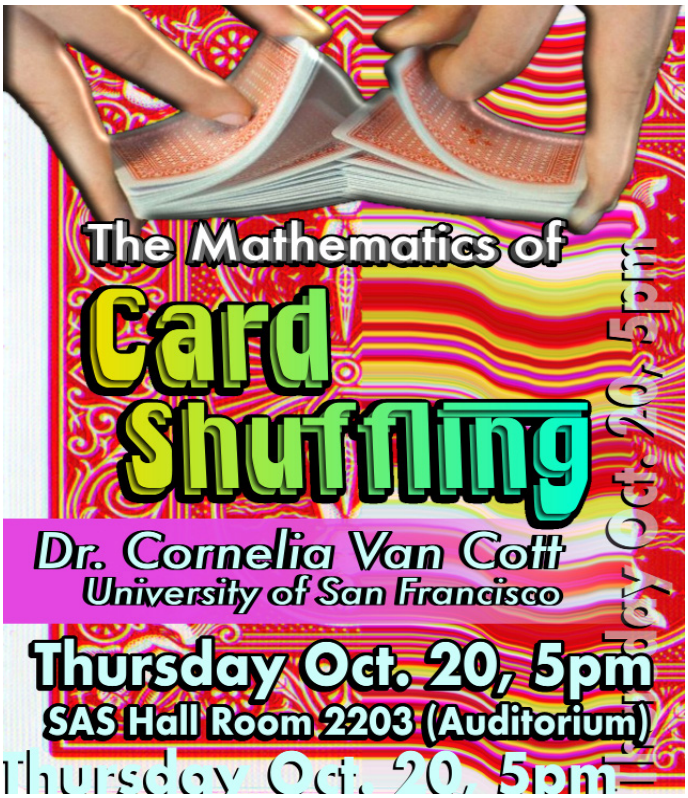
The advice that I have for current NC State students is to push yourself to explore new opportunities. Whether you explore by studying abroad, joining a new club, or by striking up a conversation with a classmate or professor, just do it! You never know where these experiences will take you.

Interested in contacting Jasmine? Her email is jasfrantz@gmail.com

Department Happenings

Tuesday October 18th, 6-7pm (SAS 2235): Math Grad Student panel; Listen to grad students talk about their experience and learn about what graduate school in mathematics really looks like!

Thursday, October 20th, 5-6pm (SAS 2203): Guest speaker Dr. Cornelia Van Cott:
The Mathematics of Card Shuffling



Saturday, October 22nd, (Time, Location TBD): Hike with Dr. Duca

Thursday, October 27th, 6-7pm (SAS 2202): Movie Night and Halloween celebration

Thursday, November 3rd, 6-7pm (Location TBD): Mathematics Alumni / Career Panel; Learn what NC State alumni are doing in industry or outside of academia. Come ask questions and learn about jobs math majors are getting hired for!

Thursday, November 10th, 6-7pm (SAS 2202): Powerpoint night

Thursday, November 17th, 6-7pm (SAS 2202): Mathematical Insights Night 2; Presentations by Etienne Phillips on Category Theory and the Yoneda Lemma as well as Andrew Farkas on Geometric Algebra

Thursday, December 1st. 6-7pm (SAS 2202): Relaxation time before finals

Friday from 11am-12pm (outside SAS): Association for Women in Mathematics Bagged Lunches!

Saturday from 11am-2pm (SAS 1218): Putnam competition problem solving session!

SUM Club

2021 Sum Club Integration Bee!

The Society for Undergraduate Mathematics (SUM Club) is a student organization for students with a passion for mathematics. We connect math undergrads and provide students with academic and professional development, leadership, and service opportunities. This is accomplished through social and outreach activities, presentations at meetings, career events, and other college- and university-wide involvement. Open to any student, math major or otherwise, we meet on the first and third Thursday of every month to get to know one another, do math puzzles, play games, learn together, and perform outreach. The club hosts undergraduates, graduate students, and professionals to share their experiences and knowledge. SUM Club supports the Raleigh community through participation in programs like Service Raleigh and Washington Elementary Math and Science Night. We hope to continue to create a strong undergraduate mathematics community. We would love to have more people involved! Email us at ncsusumclub@ncsu.edu with any questions or to be added to our email list.

MIC Club

The Mathematical Insights Club (MIC) aims to foster an environment where undergraduate students can delve deeper into the field of mathematics. We will discuss undergraduate research, interesting papers, and math history. MIC is a platform for students to share their math interests. Each month two students give a short informal presentation on something they have found interesting, whether it is their own research, a published article, a fun problem, or math history. Come to MIC and advance your ability to discuss mathematics and give your CV a boost! We hope to see you there!
mathematicalinsightsclub@ncsu.edu

Sports Analytics Club

The Sports Analytics Club at NC State is a student-run organization committed to the quantitative analysis of sports strategy and management. This club is open to all students and faculty members of NCSU. The club encourages and enables students to share ideas and complete research projects on any topic related to sports statistics. We meet weekly on Monday nights at 6:30 pm in SAS Hall room 1216.

Email **sportsanalytics@ncsu.edu** if you would like to join our email list.

Stat Club

If you are interested in statistics or related professions or just want to meet and socialize with other statistics lovers, come join Stat Club. The purpose of the club is to expose people to the endless applications of statistics and what a career in statistics really looks like by bringing in guest speakers from industry and academia. This is also a great way for members to network with industry professionals, NCSU faculty, and other statistics majors. Our meetings also consist of workshops to hone your marketability when applying for internships and opportunities. If you have any questions or want to be added to the mailing list please email us at statistics-club@ncsu.edu. We hope to see you all soon!

Study Abroad!

UPCOMING NOTEWORTHY DATES:

Summer 2023 Group Study Abroad: Applications due Nov. 30th (early action) or February 7, 2023 (regular deadline)

Walk-In Advising Hours: Wednesday 1-3pm in Holmes Hall and Thursday 1-3pm in the Global Engagement Hub (in Talley next to Wolfpack One Card Office)

Check out the math study abroad programs available:
https://studyabroad.ncsu.edu/math/

Advanced Mathematics Courses

MA 792-1 Special Topics: C/C++/Python for Mathematicians
Instructor: Erich Kaltofen
Prerequisite: some familiarity with computer programming is recommended.

The class covers the three widely used computer programming languages C, C++ and Python, with approximately the same number of lectures for each.

C and C++ are compilable programming languages. Programs are compiled into machine instructions rather than interpreted by another program. As such, they produce very fast programs and allow the programmer to directly access the computer's memory, which is important for large data. The memory models of C (malloc) and C++ (new) are discussed. Modular program design and the "make" command for selective re-compilation is introduced. The object-oriented semantics of C++ as an intuitive software design concept is explained, and object-oriented design in C via pointers to void is demonstrated. C++'s standard template library for programming with maps (dictionaries), which are the most common container data structures for data access, is shown to permit arbitrary container element types.

Python is widely used for rapidly prototyping programs, whose open-source packages cover a vast area of functionality. The language itself is C-sized (in comparison, C++'s ANSI standard definition is over 1000 pages) and the art of Python programming is to put imported packages to quick use. Examples such as scipy and the json data formatter are given.

Python can be operated interactively like Maple and Mathematica, for instance in a jupyter notebook in a web browser. Such interactive use is possible for an interpreted language.

Advanced Mathematics Courses

MA 798 Special Topics In Numerical Analysis: Inverse Problems

Instructor: Alen Alexanderian
Class times: MW, 1:30–2:45

This course provides an introduction to inverse problems that are governed by partial differential equations (PDEs) and methods for their numerical solution. In an inverse problem, we use observed data and a mathematical model to estimate unknown model parameters.
The focus will be on variational formulations, ill-posedness, regularization, discretization methods, and optimization algorithms for large-scale inverse problems. In addition to learning
about the theoretical aspects of inverse problems, the students will develop numerical
implementations to gain insight into the effect of measurement noise, regularization,
the choice of the parameter field, and the nature of the underlying PDE model on the
identifiability of the model parameters.

BMA 815: Writing Science Effectively: Principles and Practice

Instructor: Kevin Gross (kevin_gross@ncsu.edu)
Class times: W 3:00 – 4:50, in person (2 credits, S/U grading)

Are you eager to develop your skills as a writer in a small-group setting? If so, consider this workshop-style course that will study how to write effective scholarly prose. The backbone of the course will be a group study of Joseph M. Williams's classic handbook Style: Lessons in Clarity and Grace. This text offers practical, lucid guidance to help writers communicate complex ideas clearly. We will also study George Gopen's Reader Expectation Approach and intersperse occasional readings from other sources.

This is not a class on how to write a scientific paper. I expect students to know the basic format and mechanics of writing such a paper. Instead, this is a class about writing better sentences, better paragraphs, and better sections within the larger context of a scientific paper, or any other scholarly form. We will not take any one author's advice as inviolate. We will welcome diverse points of view.

The major topics are:

1. Usage, custom, and correctness
2. Writing clear sentences and paragraphs
3. Organizing paragraphs into whole sections clearly
4. Writing ethically and inclusively
5. Style and elegance in writing
6. Reader expectation theory

Though they do not rise to the level of major topics of study, we will also examine troublesome issues in grammar and study how to use outside sources appropriately.

MA 519-002: Geometry, Topology and Applications

Instructor: Radmila Sazdanovic

Topology aims at studying intrinsic structures of a given object or space. It captures properties of an input object that cannot be removed without tearing the object apart. It is a powerful tool for describing essential features of shapes. On the other hand, geometry is the quantitative study of shape using lengths and angles. Recently, there has been a new trend in developing computational topological and geometric methods for data analysis. Such methods have been incorporated with statistics and machine learning tools and successfully applied in a broad range of fields including computer graphics (e.g, feature identification), visualization (e.g, contour trees), sensor networks (e.g, hole detection), machine learning (e.g, clustering), and computational biology (e.g. breast cancer genomics, lung topology) . The final list of topics will be based on students' interests.

Undergraduate Updates

Check out what some of our current students have been up to!

Minoucha Previlon

My name is Minoucha Previlon, I'm a junior here at NC State. Over this summer I got promoted to Technology Services Intern for the College of Sciences (COS) , a role I've continued into this semester and expect to continue for the duration of the academic school year. I've been working for the COS for 2+ years at this point and got promoted to my current internship role, from simply having a discussion with my management about the progression of my abilities. After having had this talk I was offered the position in July and negotiated my salary from there.
Apart from the technology skills I've learned, here's how my internship has gone thus far:

1. A lot of resources became available to me. I noticed that with my increased commitment and responsibility to the team, I'd been told that if I wanted a program or a class all I had to do was ask and we'd go from there.

2. Other internship opportunities opened up to me. Once I put the internship title on my resume I started having more people reach out to me and following up on my request to connect with them.

3. My soft skills have been just as, if not more, important than my hard skills. Knowing things can only take you so far, you're one person on your team. Being able to communicate with your peers and not feeling intimidated in asserting yourself takes you to a lot more new places career wise, than expecting people to notice your abilities themselves.

Etienne Phillips

Over the summer, I got the chance to go to Michigan State University for the Summer Undergraduate Research Institute in Experimental Mathematics (SURIEM) REU. There, I worked with three other undergraduate students, a Ph.D. student, and a professor on topics involving recursively defined polynomials. I spent about 8 weeks in Michigan with room, board, and travel all paid for, so all I did for that time was learn about math and work on problems! It was super fun to get to dedicate time to inventing my own stuff and discovering new things and structures in the polynomials we were studying. I also loved getting to know my fellow undergraduate researchers and made many new friends there!

Our group ended up studying a sequence of polynomials that hadn't been defined before so we got to name and study something new, which was super exciting! We have since written and submitted our paper, and gotten the chance to present at several conferences including the Young Mathematician's Conference at The Ohio State and next year the Joint Mathematics Meetings in Boston which have been incredibly fun opportunities to meet other future and current mathematicians!

Puzzles, Jokes, Etc.

1.
Jenny has ten chickens that lay eggs everyday. She wants to give away her extra eggs to her neighbors, but she wants to give each neighbor an equal number of eggs. She figures out that she needs to give 7 of her neighbors eggs for them to get the same amount, otherwise there is one egg left over. What is the smallest number of eggs she needs for this situation to be true?

2.
Can you arrange the numerals 1 to 9 (1, 2, 3, 4, 5, 6, 7, 8 and 9) in a single fraction that equals exactly 1/3 (one third)?

3.
Captain Anne has a chest full of coins. When she arranges the coins in groups of two, there is one single coin left over. When she arranges the coins in groups of three, five, or six, there is also just one single coin left over. But when she arranges the coins in groups of seven, there are no coins left over. What is the fewest amount of coins she could have?

4.
What 5-digit number has the following features: If we place an extra numeral 1 at the beginning, we get a number three times smaller than if we put that numeral 1 at the end of the number.

5.
Did you hear about that one statistician...?

1. 301 eggs 2. 5823/17469 = 1/3 3. 91 coins 4. 42857 5. Probably...

OPINION: How to Thrive - NOT Just Survive - in Math!

By Etienne Phillips

Math is hard. There are no two ways about it.

Precise study habits will be different for all people, so I'm not sure what works for me will work for you. However, there is some general advice I think can help everyone. Here are a few concrete suggestions I would recommend implementing focused on school work:

1. Whether or not you take notes during lectures, remake those notes after the lectures. Reformat them, make them clear and concise. Type them up in LaTeX if you feel so inclined or if it helps you organize them. Make all your notes digestible for anyone to read, i.e there should be a clear, logical flow to them. Develop your notes as if you are developing a lesson or writing a short textbook chapter to teach someone the information. Ask yourself questions like "Why is this true?" after every line of a proof that you're copying down. Rewrite proofs in your own words. This is not possible to do during a lecture, but it should always be a part of your post-lecture study habits. For the Topology class, this idea can be applied to your own work instead of lectures or proofs: whenever you prove a theorem, rewrite it and compile all work done in a neat, logical, understandable fashion. You should be able to go through your notes again a month, a year, or a decade later and follow everything clearly from the beginning.

2. Take breaks as often as necessary, but come back. No need to sit down for 12 hours at a time, but thinking about a problem for one 20-minute sitting will often not be enough. Think about a problem, try different ideas, play around, reread notes, etc., but if you feel stuck after a while, don't force yourself to continue working (ie, you may be other thinking things). A good cure to overthinking is to leave everything, go get some tea, or lunch, or coffee, or a banana, come back in 30 minutes and start from the beginning. Ask yourself the basic questions: what do these words mean? Explain to yourself (out loud if possible) what all the words mean, what is the question asking. Reformulate the question. Reword it. Approach things methodically: what have you tried, what haven't you tried? What do you understand very well and what doesn't make sense to you?

3. Always go to office hours when you can. Always email your professor when you have questions. Always discuss ideas with classmates and peers, work on problems together (when allowed to do so) in addition to working some time on your own. You should try problems yourself, but there's no shame in asking for help, especially when it will save you time.

Understanding and developing an intuition for abstract math ideas is hard. There's no shortcut for it most of the time, and there's no replacement for just practice and time. It may be frustrating when you're introduced to a new idea and you just can't seem to wrap your head around it, and this is normal. It might not click right away, it might not ever just "click." But don't get overwhelmed by this. Patience is a virtue, especially in mathematics.

It's also important to think about concerns outside of the classroom, such as your own mental and physical health. Nobody can be successful academically without being able to take care of themselves in other areas, at least not forever. Here are some guidelines for thinking about your health:

1. Mental health and physical health is more important than ALL ELSE. If you must sacrifice study time to work out, meditate, destress, etc., then do it. Balancing these things is very difficult, but you have to make time for yourself. You cannot operate at peak capacity as a mathematician unless you are mentally and physically healthy. It benefits nobody for you to sacrifice your health to study or work more -- work quality is far more important than work quantity. Be prepared to spend long hours studying, but also to spend time off. To see friends on the weekend, to go to restaurants or movies or to pursue other hobbies. Always be looking forward to something, even if it's very small. Always make time for at least the bare minimum of exercise -- I try to do at least some push-ups and sit-ups every day, it's not much but it's better than nothing.

2. Do not stay up late studying if it sacrifices your quality of sleep no matter what. Get at least 8 hours every night, with no exceptions as best as you can. If you need 9-10 hours to feel well rested, then sleep for that long. Change your daily habits so this is possible. In the short term, it may seem like it's worth it to study one more hour, etc. This will be unsustainable in the long run, and you'll feel the consequences. Your ability to think, your long-term memory, and your ability to focus will all drastically suffer. For your long-term health, your short-term health, your ability to perform in school, and your general happiness and well-being, never sacrifice your sleep.

3. Everything from #2 but about food. Eat 3 meals a day with no exceptions as best you can. Eat good meals as best you can. Exactly what eating healthy is will be different for everyone and I am not qualified to elaborate on it, but suffice it to say eating poorly will be just as bad for your mental and physical health, and by proxy, your mathematical abilities, as poor sleep will be.

4. Minimize wasted time. Wasted does not mean "not being productive" in a classical sense. You don't need to be doing schoolwork, research, etc. 8 days/week and 25 hours/day. It's important to spend time with friends and on hobbies, and that's not wasted time. Wasted time is time spent that is not doing any favors for your mental or physical health AND is not tending to any of your responsibilities (school work, research, etc.) For me, this is scrolling mindlessly for hours through Reddit memes -- it's purely a time waster that doesn't make me feel any better after doing it. It may be that nothing you do falls into this category, in which case good job!

I hope this advice is helpful to you! Doing all of this is certainly much, much easier said than done, but it's always good to strive toward doing the best you can!