Program in Mathematical Methods in the Social Sciences

2022-23 Year in Review

Northwestern

WEINBERG COLLEGE OF ARTS & SCIENCES Program in Mathematical Methods in the Social Sciences

Director Welcome Letter



Jeff Ely

Reflecting on the 2022-2023 academic year, the collaborative spirit and intellectual curiosity within our community flourished. The array of activities and academic advancements enriched our program, providing a supportive environment for growth.

We kicked off the year with the Annual Fall Welcome in October, bringing together our community of scholars, educators, and students. The MMSS Young Alumni Career Panel & Dinner in Spring 2023 offered a platform to connect with alumni, garnering career insights.

A milestone was the introduction of MMSS 211-3: Theory of Social Networks, led by Professor Ben Golub. This course expanded our academic horizon, delving into the dynamics of social networks.

Looking forward to the 2023-2024 academic year, I am optimistic about the continued growth awaiting us. Our program's strength lies in the collective endeavor of our faculty, students, and alumni.

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Jeff Ely is the Charles E. and Emma H. Morrison Professor of Economics at Northwestern University

Year in Review Fall 2022 September—First Year Orientation

First Year Orientation is held during the beginning of Wildcat Welcome Week and it serves as the initial gathering point for entering MMSS students. Program Director Jeff Ely, First Year Advisor Eric Schulz and our three Peer Advisors Ethan Jie, Savir Maskara and Dylan Yan helped to welcome the students and provide insights on what to expect over the next four years.

EMERGENCY DOOR

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Professor Ely shared some of the program's rich history and underscored how proud the faculty, staff and alumni are of the MMSS experience and community.

Year in Review **Fall 2022** September—MMSS 398 Kick Off Session with Peter Civetta

Each year, Peter hosts a couple of sessions with the MMSS seniors to support their thesis writing process. In the fall, he has a focus on how students can apply for grants to fund research expenses which can often revolve around data collection such as incentives for surveys, and travel costs. In the spring quarter, he returns to provide advice on how to prepare their final, 12-minute presentation to MMSS 398 Professor Joe Ferrie, along with their classmates. Peter outlines effective communication skills on how to distill and translate their 50-plus page research project into a clear presentation that tells a story. He also shares targeted techniques for the day of "performance" delivery on how to speak, stand and the importance of practice.

Peter Civetta is the Director of Northwestern's Office of Undergraduate Research with a particular focus on helping students get grants for creative projects.



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Year in Review **Fall 2022** October—Fall Welcome Party

We lucked out with a second year in a row of stunning, sunny weather which meant we were able to gather on the terrace outside of Harris Hall again. The beautiful, sun-filled sky was a perfect backdrop to Professor Ely's welcoming remarks. He highlighted the exciting new course offering Professor Golub would be launching in the spring, and reminded students to check in with the MMSS faculty and staff with any questions or concerns as they assimilate back to a rigorous fall schedule.







Students were all smiles as they took a break from classes—enjoying some great food and camaraderie with friends new and old.





Year in Review **Spring 2023** April—Young Alumni Career Panel

We were thrilled to have another great line-up of excellent alumni willing to offer their time and advice to the current student body. The panel included Asher Bornstein, '21, Varun Bhatnagar, '15, Aaron Coates, '21, Marisa Guo, '19, and Lindsay Pontello, '18, plus Kellogg School of Management Adjunct Lecturer Alex Schneider, WCAS '99, KSM '05, served as the moderator. Note: Charis Lee, '19, was unable to join but we look forward to hosting her another year!

Thanks again for the valuable insights and candid comments the alumni shared amongst the students. The panel recognized that being in MMSS affords one many opportunities, and provided ideas on how their knowledge and the MMSS network can be leveraged. Lindsay credited her MMSS experience in tackling complex problems—in a team setting for her rapid growth during her first two years at McKinsey, which in turn helped her land a strategic role in the interactive fitness industry for Peloton. Varun shared the decisions and touchpoints that led him from undergrad degree in MMSS and Econ to graduate school pursing his JD-MBA. After school, Varun will be going to a law firm in Santa Monica working on data privacy matters. Long-term, he hopes to work for the government to search out tech companies for biased AI or data breaches.

Marisa shared that she is surprised by how her schedule in a demanding industry like trading still provides her the time to pursue other personal and professional interests. Asher and Aaron are both in financial, data driven roles but noted it is their ability to work in teams and amongst a range of colleagues that has contributed to their career success. Student questions revolved around finding balance in post-grad life, and curiosity about how Artificial Intelligence will potentially impact the job market and future of employment.

Alumni also reflected on a few constant themes: students should cast a wide net, keep an open mind and be prepared for rejection!



Moderator: Alex Schneider LinkedIn Profile



Asher Bornstein LinkedIn Profile



Marisa Guo



Varun Bhatnagar LinkedIn Profile



Charis Lee



Aaron Coates



Lindsay Pontello

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April— Young Alumni Career Panel





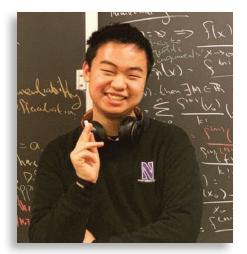


Above, left to right: Alex Schneider, Aaron Coates, Lindsay Pontello, Jeff Ely, Asher Bornstein, Marisa Guo and Varun Bhatnagar.



Graduate Student Spotlight

2023 Graduate Daniel Luo Now Pursuing His PhD at MIT as an NSF Graduate Research Fellow in Economics



How and when did you know you wanted to pursue a PhD?

I think I probably started thinking that I wanted to do research sometime late in high school—it was one of the reasons that I applied to MMSS actually! At the

time, I didn't really know what academic research in economics entailed, but had been pretty interested in economic policy in high school; I think I first wanted to do a PhD to help me better think about public policy. It probably wasn't until the end of sophomore year that I was 100% confident I wanted to apply for a PhD, and it was around this point that I decided on being an economic theorist—which was quite a shift from what I originally intended!

What area of study are you focusing on at MIT? How many other students do you work/study with in the program?

I'm currently studying economic theory, in particular mechanism and information design (with some repeated games mixed in there too). I'm super interested in the way that *information* shapes the way that we make decisions, and how frictions in the arrival and availability of information can affect player's strategic incentives and affect both observed behavior and aggregate welfare in a wide variety of different settings, theoretical and applied. Recently, I've thought about problems as varied as how college admissions affect the courses we take in high school, to the "optimal" way for a dictator to scare off revolutions.

What training/experience as an MMSS student prepared you best for the application process? And now that you are in the program—what do you think you draw upon the most from your MMSS experiences?

The senior thesis helped me the most; having a few soloauthored projects before applying definitely helped convince application committees that I was applying as a researcher, and not just a student, and it also helped me get a clearer idea of what I was getting into! I think I draw on a lot of the skills that I learned in my MMSS classes, including basic tenets of what makes a good economic model (from MMSS 300-0), and stuff from Jeff's incomplete information game theory class, which covers foundational topics in the areas I do research in now.

How does this experience differ from your undergraduate work/experience?

The biggest difference is probably that graduate school feels much more teleological. During most of my undergrad, I was just trying to explore and figure out what I liked, and coursework was the focus with research as a side hobby. Now it feels like research is at the center with classes on the side, which is a big shift, and there are very clear "big" goals to work towards: developing a research idea, submitting papers for publication, and eventually getting ready for the job market (which feels a little daunting). On a more positive note, it's really exciting to be surrounded by a community of fellow graduate students who are equally (if not more) passionate about the same topics I care about, and to be able to discuss these ideas at any time with other people in my program.

What types of courses are you taking this year? What has been most interesting?

I'm taking mostly field courses in areas of research I'm interested in—contract theory, organizational economics, and political economy. I'm also taking a first year "core" class in econometrics. I think I've liked the contract theory class the most—it's taught by a professor I hope to work with during my time here, and covers some frontier topics in research areas I'm super interested in. I've been inspired by all of my classes though, and am working on two early-stage projects that came out of two different courses that I've taken here, which is super exciting!

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"MMSS was founded with the vision that these talented students, inspired by Northwestern's pioneering faculty in formal social science, would be the main pipelineto the next generation of research. We are getting better and better at fulfilling that mission and Daniel is our latest and greatest torchbearer."

Professor Jeff Ely

Who have you found to be helpful in your pursuit of advanced education/degrees?

The list is too long to completely enumerate. My parents, who have always supported my educational interests and have encouraged me at every step of the way, need to top the list. I also want to thank my coauthor and best friend Eric Gao, who I talk to about research for multiple hours every week. At Northwestern, I can recall at least two or three important, positive experiences with essentially every economics faculty in theory group which have helped get me to where I am today (and I took most of their field classes, which heavily influenced my research interests). I want to specifically acknowledge my thesis advisor, Yingni Guo, and Harry Pei, who I chatted with often about my research ideas and advised my first research paper ever. The faculty who wrote me letters of recommendation-Yingni, Larry Christiano, Eddie Dekel, Bruno Strulovici, and Mark Witte, have also been particularly influential and helpful. Finally, my first MMSS TA—Udayan Vaidya—has become a good friend and read through multiple drafts of my papers and given me invaluable advice (and was the first person to introduce me to Bayesian Persuasion).

What advice do you have for a freshman MMSS student who may be interested in a PhD program?

MMSS is a special program that I think is uniquely positioned to help people interested in academia start on that path. You have access to some of the most influential economics professors in the entire field—for example, Eddie Dekel, a past president of the Econometric society, only ever teaches MMSS classes. Take advantage of that and don't be afraid to reach out to professors if you find the topics they're teaching interesting. My first research idea came partially from chatting with Eddie over zoom after a lecture. I would also encourage you to get involved in research early! I think MMSS (especially with 311-2 and 386-1, 2) prepares you for both theoretical and empirical

research pretty well. A lot of people put off getting their hands dirty with research because they're worried that they don't have enough tools yet, or that they won't be able to write a perfect paper yet, but in my experience the best way to learn is to practice: your first few papers will probably be bad, so it's useful to get them out of the way as fast as possible (my first 2 or 3 papers I can't even look at anymore at this point, but I learned a lot from them just by seeing them through and typing up a draft). Finally, I would encourage you to talk to your MMSS classmates, both in your cohort and across cohorts. MMSS undergraduates are some of the most driven people at Northwestern, and it's an amazing resource to have them by your side. Some of my closest friends ever are from MMSS, and honestly, you never know where your future coauthors might come from (one of mine is my high school classmate from the debate team!)

What do you hope to be working on 10 years from now?

Who knows? Cool new ideas come up in economic theory all the time (for example, my favorite paper of all time, *Bayesian Persuasion*, was only published 12 years ago!) Hopefully I'll still be working on problems that I find exciting and that can shed some useful insight for the real world. Outside of that, I'm not too sure, which is part of what I think makes academic research so exciting.

Did you have a favorite class at Northwestern? And/or a favorite MMSS course?

Yes :) My favorite class was a topics class in information economics (ECON 412-1) taught by Annie Liang; Annie is an amazing lecturer and a great economist whose class (which I partially audited once and took once) inspired my passion for a lot of the topics I work in today. I still find myself going to her lecture notes sometimes when I need to find a theorem to use in my work, and her notes (which are online) have been referenced a few times here in my classes at MIT, as well (which I think speaks to their quality and thoroughness). For MMSS classes, I would say MMSS 311-2 was probably my favorite. By the time I took it, I already had an inkling that I wanted to do research in economic theory, and so being in what I would consider my first "real theory" class, especially with Jeff's great lectures, was really fun. My experience was a little dampened by the fact that the course was taught over covid at 7:30 AM California time (where I was at the time), but I think the fact I (usually) woke up for lecture speaks for itself.

Graduate Student **Spotlight** 2019 Graduate Henry Li Reflects On

Post-Graduate Experience and Education

I've had the great fortune of exploring many new experiences since graduating in 2019, including traveling, working some interesting seasonal jobs, and redirecting my career path. While visiting campus earlier this year, I had the opportunity to reflect on how my experiences at Northwestern and in MMSS have shaped my post-graduation journey.

Currently, I am in the process of completing a PhD in the Ecology and Evolutionary Biology department at University of Colorado, Boulder. Though I never prepared to pursue

such a degree while in college, I was surprised at how easily and how much of my undergraduate training transferred over to what I do now. Whether I'm using regression discontinuity design to evaluate impacts of wildfire management strategies or writing proofs by induction to analyze models of ecosystem stability, I find myself frequently digging through my old MMSS course notes and handouts. In fact, a quarter long RAship at Northwestern's Science of Networks in Communities (SONIC) lab inspired my current work in modeling ecosystem dynamics from a network perspective, using food webs and other networks of species' interaction.

Unbeknownst to me at the time, MMSS was secretly preparing me for graduate study throughout the course of my undergraduate education. Frequent and close interactions with MMSS faculty habituated me to working with advisors and committee members daily. Going through the challenging MMSS curriculum also honed my collaborative problem-solving skills—those late-night group homework sessions turned out to be good for something!

I originally joined MMSS because I aspired to be a part of a tightknit community, work on intellectually stimulating problems, and learn about the application of quantitative methods. I'm very thankful that, amidst all the change brought on by the past four years, I've been able to find an environment where these cherished aspects of MMSS still hold true for me.





From top left:

Handline backfiring, Saint Joe National Forest, Idaho. Ecological Society of America 2023 conference, Portland, Oregon.

Surveying rocky intertidal ecosystems, Allen Island, Maine. Tracking demographics of long-lived alpine plants, Latir Peak Wilderness, New Mexico.

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MMSS 2023 Senior Thesis Projects

The senior thesis is the capstone to the MMSS curriculum. It provides students the opportunity to draw upon the skills they have gained in class and apply them to a substantial piece of original research. During their junior year, MMSS students already begin to select a topic and advisor. As seniors, they work to refine their research question, complete any further data collection, and compile their analysis into a cohesive paper. Here are summaries of three research projects from the class of 2023:

"Understanding the Satisfaction of Maximizers Across Choice Domains"

By Meghna Jain

Meghna explored the psychology behind decisionmaking, focusing on two types of decision-makers: maximizers and satisfiers, under the guidance of Advisor Marciano Siniscalchi. Through an online study involving 79 first-year students at Northwestern, she delved into the impact of choice complexity on these decision-makers' satisfaction with their decisions. The study revealed that maximizers exert more effort in decision-making but might experience less satisfaction, especially in complex choices like college decisions. The thesis highlights regret as a significant factor affecting satisfaction, while social comparison tends to increase satisfaction for both decision-maker types. Meghna's work illuminates the nuanced influences on satisfaction in decision-making, shedding light on potential strategies to enhance individuals' decision-making experiences.

"Indirect Effects of Immigration on Educated Women's Labor Outcomes"

By Allyson Gordon

Under the supervision of Diane Schanzenbach, Allyson Gordon delves into the relationship between immigration trends and labor outcomes of high-educated women in the US, spotlighting the significant role immigrants play in domestic and childcare industries. Utilizing the federal immigration policy Secure Communities (SC) as a focal point, Gordon investigates how its implementation influenced the labor market participation of educated women, particularly those with young children. Her findings reveal a notable decline in labor force involvement among this demographic in counties with active SC enforcement, underscoring the critical impact of immigrant labor on enabling career pursuits for educated women. Despite the policy's intent to "save American jobs," Gordon's analysis challenges this notion, suggesting that immigrants, in fact, enhance labor opportunities for women, thereby playing a crucial role in narrowing the gender gap in both paid and unpaid labor sectors.

"How Can Social Network Analysis and Mapping be Leveraged to Inform Chicago STEAM Out of School Time (OST) Policy Decisions?"

By Sean Liu

Sean examined the network of after-school programs in Chicago to address equity and diversity in program availability under Dr. Nichole Pinkard's supervision. Utilizing social network analysis and mapping techniques, Sean identified key providers and proposed policy solutions to enhance program alignment with community needs. His multi-pronged data visualization approach unveiled areas of inefficiency, providing actionable insights for policy makers to improve the alignment between employer offerings, educational opportunities, and after-school programs in different communities.

MMSS Senior Graduation Class of 2023 at the Allen Center

Professor Ely gave another stellar shout out to the talented MMSS seniors who joined with their friends and family to celebrate a remarkable milestone in graduating from Northwestern and the rigorous MMSS Program.

Ely shared several examples of how the various theoretical models in math and stats with social science theory combine in a unique way to provide MMSS grads with an outlook that marries the messiness of human beings and their interactions in the world with a way to recognize patterns and generate logic amidst the chaos of data.

With a focus on econometrics which uses statistics to help understand how one phenomenon can cause and influence another, graduates can look at everything from markets in economics, elections in political science and social networks in sociology to apply their skills. Since its launch in 1978, this pedagogy of the program and its goal of educating tomorrow's leaders has remained the same for almost fifty years. The longevity of the MMSS curriculum underscores the importance this type of interdisciplinary education is to the Northwestern community and the globalized world we live in today.



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Jeanette M. Dacey and Michael F. Dacey Awards

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Former MMSS Professor Michael Dacey and his wife Jeanette provided a monetary gift to both build a research fund in support of MMSS students as they completed their thesis and coursework, and award prizes for outstanding student accomplishments.

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The Michael F. Dacey Prize for the Most Outstanding MMSS Senior Thesis:

Using Deep Learning and Natural Language Processing to predict United States Supreme Court Outcomes By Will Cichowski Advised by Professor Zach Wood-Doughty

MMSS Senior Graduation Class of 2023 at the Allen Center



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Senior **Profiles**

>>> Drew Miller

Class of 2023, Quantitative Finance and Economics Associate, Ernst & Young



Why did you apply to MMSS?

My decision to apply to the MMSS program at Northwestern was guided by my passion for math, and more importantly, its practical uses in areas such as economics and political science. I was captivated by the notion of using math as a tool to better understand the world. The collaborative structure of the program was another major factor in my decision. I was drawn to the idea of studying closely with the same group of students,

allowing for ongoing teamwork and shared intellectual growth.

Additionally, I viewed MMSS coursework as a great foundation for deeper engagement with the STEM fields.

How has MMSS prepared you for graduation?

The MMSS program has been instrumental in my preparation for graduation. The rigorous coursework in mathematics, economics, and modeling during the initial two years equipped me with the knowledge and skills I needed for my subsequent studies in the Kellogg Undergraduate Program and graduate statistics courses.

Perhaps more importantly, the MMSS program has honed my ability to collaborate effectively--a skill that is undoubtedly vital in the professional world. By working intensively with the same group of students for over two years, we've developed a strong sense of camaraderie and mutual understanding that has facilitated highly productive teamwork.

What have you enjoyed the most about MMSS?

Without a doubt, the highlight of my experience at MMSS has been the people--the students, staff, and professors. My peers in the program are not just classmates--they've become some of my closest friends, with whom I often engage in stimulating discussions about academics and potential market modeling ideas. My roommates after graduation include two other MMSS students.

The faculty and professors have been equally influential in my journey. At the start of our college coursework, we immediately jumped into the deep end with multivariable calculus and turbo microeconomics. The professors, especially Professor Schulz, offered great support in our transition to college coursework. I made it a point to take two more of Schulz's classes while pursuing my economics major.

>>> John Cao

Class of 2023, Junior Trader, Belvedere Trading



Why did you apply to MMSS?

I applied to MMSS because I wanted a more quantitative experience in college to supplement my economics education.

After successfully completing the MathWorks math modeling challenge in high school, I wanted to learn more about how to apply my mathematical skills to issues in finance and economics.

How has MMSS prepared you for graduation?

MMSS has prepared me for graduation by allowing me to take courses that I would have otherwise not have had access to. The econometrics courses were especially helpful in interviews and my internships.

What have you enjoyed the most about MMSS?

What I enjoyed the most about MMSS was writing my senior thesis, "How Market Maker Inventory Affects Options Liquidity." I was able to apply my knowledge in options market making and quantitative finance in a way that was meaningful and fruitful for both my personal interests and my future career.

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>>> Alyssa Connor

Class of 2023, Associate at BCG



Why did you apply to MMSS?

I applied Early Decision to Northwestern with the intention of pursuing my interests in mathematics and psychology, not knowing until after I had gotten in that MMSS existed, a program that combined all of my interests. Nothing else felt like the perfect fit—a pure math major seemed too theoretical, while psychology or economics majors on their own didn't have enough math to excite me. When I found out that there was a program that provided enough mathematical and theoretical education to challenge me, without ever straying too far from the real-world phenomena that motivated me, I quickly applied and the rest is history!

How has MMSS prepared you for graduation?

MMSS has prepared me for new opportunities and challenges more than I often realize. MMSS classes challenged me in ways that fostered my critical thinking and

problem-solving skills, encouraging me to look at problems from different angles and work collaboratively to identify the best path forward. The economic and analytical principles taught in MMSS courses shape the ways in which I parse complicated and nuanced issues. And, no matter what industry or path one takes, the technical skills gained from MMSS are unmatched. For example, it hit me recently how useful the program was when it started paying out huge dividends—as I worked on my thesis, I knew way more about the theory behind and implementation of econometric and statistical methods than I realized. When I was asked by a research advisor to help grade an MBA course, I saw how much knowledge I had about topics taught in graduate school and how prepared I would be if I chose to go that route. I'm constantly being surprised by new contexts in which my MMSS education comes in handy.

What have you enjoyed the most about MMSS?

It is difficult to pick just one aspect, so I'll share two. First, I really enjoyed the close-knit community of MMSS. The classes are challenging, but they never felt cutthroat—instead, the challenge of the material encouraged collaboration and support. It is helpful to have a built-in community and structure when you first enter college. The second aspect I most enjoyed was the proximity to brilliant professors. There are fantastic educators throughout Northwestern, but MMSS has a particularly great concentration. It was a joy to get to learn from accomplished professors such as Prof. Jeff Ely, Prof. Eddie Dekel, and Prof. Rob Porter, and I was also blown away by the amount of support I received. Prof. Porter helped me get a research assistant position that I held during junior and senior years, while Prof. Ely supported the various ideas, I had to shape my course of study. The MMSS program is so unique in allowing these close connections with brilliant and highly supportive faculty. "I really enjoyed the close-knit community of MMSS. The classes are challenging, but they never felt cutthroat—instead, the challenge of the material encouraged collaboration and support. It is helpful to have a built-in community and structure when you first enter college."

MMSS student Alyssa Connor, Class of 2023

Alumni **Resources**

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Thank You to Our MMSS Alumni Supporters

No other undergraduate program in the nation matches the scope, advanced level or degree of integration of social sciences and mathematics. We are thankful for the support that has allowed us to make sure MMSS students are well prepared for the future—whether going on to the graduate school of their choice, being highly sought by Fortune 500 employers, or bringing analytical rigor to traditionally less data-driven fields.

Donating to MMSS

Donations from our loyal and generous alumni help ensure that the MMSS Program continues to provide vital resources to our students such as statistical software licenses, periodic replacement of computer hardware, support for senior thesis research, community building events and more. Donations to MMSS have a positive impact on the Program's intention of providing a rigorous learning experience within a supportive and resourceful community.

Nathan Carl Popkins MMSS Legacy Fund

In addition to a gift to the MMSS Program, alumni and friends can also direct support to The Nathan Carl Popkins MMSS Legacy Fund. This fund was established in 2018 in honor of late MMSS alum Nathan Carl Popkins '01, who embodied a drive and love for math in all facets of his life. In that spirit, the Popkins Legacy Fund is the first permanently endowed fund exclusively dedicated to enhancing the experience of the MMSS students and building a strong, tight knit community of scholars for years to come.

You can designate gifts directly to MMSS through this secure link:

https://giving.northwestern.edu/MMSSnews

Or if you are mailing in a check, please include MMSS or the Nathan Carl Popkins MMSS Legacy Fund on the memo line.

Stay Connected

Due to the MMSS Program's selectivity, the student body is small by design and the average graduating class is 32 students. Since the first students graduated in 1981, there have been approximately 1,300 MMSS alumni. Here are some key ways this community can all stay connected:

LinkedIn

With over 900 members in our "MMSS Northwestern Alumni" LinkedIn Group, it can be a great resource for connecting. To join, visit our LinkedIn Group **here**, email **mmss@northwestern.edu**, or search for "MMSS Northwestern Alumni" on LinkedIn.

MMSS Mentorships

Sign up to serve as an MMSS mentor through Northwestern Network Mentorship Program.

Alumni Profiles

Send an update to **mmss@northwestern.edu** and provide an alumni profile on how MMSS has impacted your life.

Year In Review

Sign up to receive this annual newsletter by sending an email to **mmss@northwestern.edu**.

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