"Getting You Closer to What You Want"

Less Than Epsilon

Notre Dame

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Adding a Seat to the Table

By VERONICA KIRGIOS

Most nights, I wake up around 3 a.m. in desperate need of water. As a child, I'd slip out of my sheets and tip-toe downstairs to the kitchen. I vividly recall one night, I passed my mom's room and found her pacing in the lamplight.

She was muttering under her breath and rapidly scribbling something. When I asked her why she was awake, I was met with her bewildered gaze and the reply: "I need to figure out this proof, it's right there - I can feel it."

The next morning when I woke up, I found my mother where I left her. She was fully investing her mind and heart into what she was doing. Of course, at the time I couldn't understand my mom's passion. Who stays up all night just to finish a proof? Nevertheless, it inspired me, and I hoped one day I could love my job half as much as my mom loves math. The first time my mom sat me down to complete a proof I was ten years old. I can't remember what I was proving or how I did it, but I do remember my mother's reply when I asked her why we were spending our Saturday afternoon on this exercise: "You need to learn how to think, Veronica. Numbers are beautiful and they are everywhere, if you don't understand them you will never understand the world." Of course, it was a dramatic statement, but coming from a woman whose entire life has been dedicated to mathematics, it was on brand. From a young age my mother taught me that a life without math was a life without understanding. In that sense, I'm not surprised by my major today.

Despite inheriting some of my mother's love for math, I drew the short end of the stick when it came to her culinary skills. My mother, true to her Italian roots, loves to cook, and she does it well. So, whenever her colleagues came to town, she'd invite them to our family dinners. While the courses on the table and the visitors changed over time, one thing stayed constant: her colleagues were always male. It wasn't hard to notice, even from the confines of my dining area, that her field was male-dominated. And, even today, when I enter my Honors Calculus class and notice only two other women among the group of 15 men, I'm still aware of it. However, when I asked my mom how she felt about it, she shrugged and told me that if I didn't believe in myself, nobody would. At the end of the day, there would be times when others wouldn't think I could succeed, but I needed to learn to not let that matter. Despite being intimidated, and despite having my moments of doubt, I've pushed through it all because of my mother. After all, her success story is one that hits very close to home. On top of teaching me the importance of mathematics, my mother taught me how to fight the perceptions of those that would never think I was good enough.

The International Language

By XIAOSONG YU

Mathematics is an international language. The charismatic nature of mathematics inspires people from all continents speaking all languages to observe, interpret, and articulate the universe via the common mathematical language. Such a diversity is very well present on the Notre Dame campus. The Notre Dame mathematics department welcomes undergraduate and graduate students from a variety of geographical, ethnic, cultural, and religious backgrounds each year, including and not limited to international students from Asia, Africa, and South America, and their stories with mathematics should never be neglected. This column is the space for these international scholars at Notre Dame to have their unique voices.

I was born and raised in Shenzhen, a major city in southern China, and I spent sixteen years of childhood there until I came to the United States five years ago. I continued my high school education in the greater Philadelphia area before I came to the University of Notre Dame. Currently, I am a sophomore majoring in mathematics, political science, and philosophy, with a concentration on philosophy, science, and mathematics.

Like most, if not all, other international students, I experienced immense culture shock as I first moved to America. It took me a while to memorize my height and weight in the imperial units (I literally had to memorize them because these units made no sense to me at first) so that, whenever asked, I could answer "six-one" and "one-thirty-four" instead of answering "one-eighty-five" (centimeters) and "sixty" (kilograms) confusing everyone; I had a difficult time getting used to referring to "football" as "soccer" (I learned British English in China). Besides these obvious cases of culture shock, however, there are myriad occasions that are rather subtle and yet equally

annoying and difficult to articulate. I remember one instance vividly: one day not long after I came to America, I asked a person if she had some tissue while I was eating, and she said, "No, but I have some napkins." In Mandarin, tissue, napkins, and paper towels are usually referred to as the same name zhi (which means paper in Mandarin); moreover, they virtually are the same thing and have the same functions, so it had never occurred to me during my sixteen years in China that tissue and napkins are actually different things. I immediately thought the woman's response was a joke (in the sense similar to one saying, "I don't want to travel by airplane, but I'm going to take a jet") and started laughing, but I soon found an extremely awkward air that she was anything but joking. It is, in fact, even quite difficult for me now to apprehend the reason why I thought the woman was telling a joke as I have lived in America for several years, but it was me back then—a young boy who had long lived in China and knew little about the new land. One linguistic difference between western countries and China is the way large numbers are expressed: the former separate large numbers by every three digits, whereas the latter separates large numbers by every four digits. The following table demonstrates this difference:

Number	English	Mandarin
10	Ten	Shi
100	Hundred	Bai
1000	Thousand	Qian
10,000	Ten Thousand	Wan
100,000	Hundred Thousand	Shi Wan
1,000,000	Million	Bai Wan
10,000,000	Ten Million	Qian Wan
100,000,000	Hundred Million	Yi

Try it, and you probably won't find it an easy task, especially for the first time, to do a numerical conversion in this manner. I have countless times encountered questions such as "what is the population of China?" I knew deep in my heart that the population of China is "fourteen yi," but I obviously couldn't answer it this way. I would often contemplate for ten seconds and sometimes make several unsuccessful attempts before I eventually make the correct answer "one-point-four billion," and others would often walk away thinking that I had absolutely no talent in math and unaware of the sophisticated calculations that had just transpired.

Amidst the everyday differences I face in a foreign country, mathematics gives me a new light. Regardless of what country you come from, what your cultural background is, what religious belief you hold, what language you are most familiar with, what language you learn math with, and even what color your skin is, mathematics draws you into its own world and puts you in the exact same context with everyone else. In studying mathematics, I no longer feel that I am an international student.

Being a math major and a political science major simultaneously always seem to spark curiosity; the question I incur most frequently when I introduce my majors, either because he or she actually wants to know or because the conversation has to be kept on, is what makes me study math and political science, which are hardly relevant in form or in nature. The short and simple answer to this question, which I often give, is that I love both subjects. Alternatively, I would occasionally present the more sophisticated answer by describing a project I engaged in during my senior year of high school, on which I usually receive faces marked by confusion. It is nonetheless this project that, to a considerable extent, excited my passion to explore math.

Three years ago, I had the opportunity to work on a project that utilizes analytical models in mathematics to detect and evaluate partisan bias in state-level elections in the United States due to gerrymandering, a technique widely practiced and yet falls into a grey area of law. Gerrymandering refers to the technique where politicians achieve improper purposes by manipulating the boundaries of voting districts. The courts have nonetheless always been reluctant to deal with gerrymandering, insisting that, however blatant, it is not justiciable. The novel idea of applying mathematical analysis to political issues at such a level of complexity deeply intrigued me. I participated in the design of an algorithm applicable to any given electoral map; I applied the algorithm to historical maps and obtained quantitative indices indicating the extent of bias. I then compared these results with those from other algorithms that were designed for a similar purpose but based on different mechanisms: amazingly, the results are consistent across algorithms. This experience elevated my enthusiasm in math to a whole new level. I gained meaningful insights into not only the charming complexity but also the widely applicable nature of mathematics: I began to understand the unique power of mathematics to quantify objects that are otherwise impossible to gauge; I started to appreciate the unique beauty of mathematics to translate abstract issues into concrete numbers.

That is my story with math, but it is only my story with math. I do not consider myself a typical international student. In fact, I do not believe that there exists a typical international student. Just like any other students walking across the campus every day, every international student has his or her own identity. There is no story that encapsulates international students; there are only stories whose uniqueness in nature spark empathy and inspiration. Let us pause and listen to our international students, and let their stories shine in this foreign land.

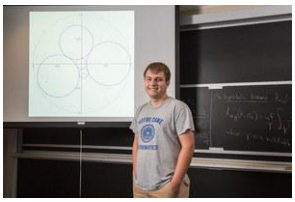
A Brief History of The Bunker

By ALEX KOKOT

This is going to be a brief history of the bunker as its history has been incredibly brief. The Bunker, the home of Notre Dame's proof based tutoring, opened only a few years ago, and I am no historian. Beyond those who tutored me I simply have no idea who actually worked there. This is an issue I hope to rectify, but I will come back to that later. I am sure that if there is anybody I leave out, they were inspiring and worthy of being remembered in their own right, but the truth is, in the words of one of the best tutors Notre Dame has ever seen, this is our "foster home." We each step onto this campus and savor what years we have, but we are all hopefully destined for something better, and maybe a little more exciting, than a dingy basement in South Bend, IN.

Any recount of the bunker would be sorry to omit "The Fisher of Men," Nick Lohr. Like any good tutor, he was incred-

ibly sharp, and quick to find a solution to whatever problem you had long ago rendered as hopeless. What set him apart was his dedication, and his complete lack of a filter. I don't think anybody will ever come close to matching his paid tutor hours, those he was officially registered to teach, and those still make up only a miniscule portion of the total time he could be found in the Math Library, helping students on this or that sometimes until well past 1 am. Despite everything he did, he wore a façade of apathy. Virtually everything he said was cloaked in a veil of sarcasm, like he was incapable of saying anything serious. Seeing him sitting there as your tutor is much like the experience of realizing Hayes Healy is the math building. You might first think that it is a joke, with their foreboding exteriors that certainly do not comply with any modern sense of style. What you come to realize, however, is that there truly is something special inside, something that you will grow to appreciate, and miss when you finally are forced to part ways, even if it is after a rather controversial graduation speech.



Nick Lohr

If Nick Lohr at all hid his passion for teaching, Caitlyn Booms more than made up for it. Any unity that can be found in the Math major today can be more or less traced back to the example she laid, whether it was as president of the math club, the first inkling of a math mentoring program, or in the inaugural Math party at the end of my first year (you know where to find me if you want information on the next one). Before finals she would always arrange an extra tutoring session, well past when any of the tutors were mandated to stay, when most had their own finals, anxieties, and futures to worry about. Caitlyn was always there for us, and her example is a continuing inspiration at least for me as I look toward the future. She was the first Notre Dame student seeking a PhD in Mathematics to be awarded an NSF fellowship in a period of 5 years before I came to school here, and she was the first student I saw who had such incredible opportunities laid out for her from so many prestigious programs. I hope that she continues to be as valued in her studies as she was, as she is, here.

Caitlyn Booms

Paul Sweeney and Patrick Leblanc are a pair of tutors who I feel perfectly comfortable remembering as a pair. Their dynamic was comparable to your favorite buddy cop movie, complete with their own "police chief" always on their case. I distinctly remember their panic regarding their senior theses, particularly how one of them was always deeply concerned that they were disappointing their advisor. Paul picked up the moniker "Sir Paul" during his time in the bunker. Perhaps it was because of his year at Oxford, although I do not think there was any actual reason. At the end of the day he earned that title, as I made him painstakingly read through my pages of homework solutions multiple consecutive weeks. Patrick is one of those rare Mathematicians who seems to care more about helping people than, well, Math, or at least he holds them at a similar level. I remember him talking about his summer internship using statistics to, and this is not an exaggeration, help orphaned children or something. If you look this guy up, you can find the absolute mountain of awards he has, even if he was always too humble to mention them, if not directly discredit them. These two breathed life into the bunker, making it feel not just like a place of work, but a place where I was welcome, where I wanted to be.

Paul Sweeney (left) & Patrick Leblanc (right)

If there was any pair of tutors who would be particularly uncomfortable being remembered as a pair, it would be Matthew Schoenbauer and Matthew Drnevic. Whether it is because they were both in unusually good shape for Math tutors, shared the same name, or worked the same night, they both reside in a similar pocket of my memory. Drnevic had this cool, cocky attitude where you just knew he could answer whatever you threw at him. Schoenbauer, on the other hand, was deadly serious, and the thought that he could not answer a question would be a regrettable one to ever let wander in your mind. The confidence these two shared pervaded the bunker, their value seemed to rub off on whatever student had the fortune of stopping by on that one 2-hour block of the week. My first Math course was nothing short of a beat down for everyone involved, but they reminded us why we did it. Like all of the tutors, they were riddled with their own awards and accomplishments, but what was most apparent was that they knew Math, and they knew Math in a way we all desperately wanted to see.

Matt Schoenbauer (left) & Drnevic (right)

The challenge of being an Math student, and a Freshman in particular, is something I am sure I do not need to attest to. Frankly, that year was one of the most difficult in my life, and I would never have made it through it without the incredible tutors and amazing students I was lucky to share so many grueling evenings with. While I have a lot more to say about my experience, I think it would be unfair to have my words be the only ones that are heard. Hopefully, we will be able to assemble a variety of different authors, with each one being able to key in on different people and stories that were so defining in our academic experience. In this spirit, we will also be starting a Notre Dame Math student genealogy tree, with emphasis on these past tutors who have not only shaped my education, but whose work will surely be felt for many classes to come.

Child's Play

The Notre Dame Math Circle debuted in the Fall semester, bringing together faculty, undergraduate and graduate students, and some of the finest 4-18 year olds in the local community. As one might imagine, some of the youngest students also brought with them an enthusiasm, and love for mathematics paralleling the most exciting professors you could hope to have in class. They also seemingly brought with them quite the variety of Mathematical tools. While it did not come easy for all of them at first, counting, at least up to 25, played a pivotal role in some of their biggest results. Other things, such as whether a number was even or odd, turned out to be instrumental in answering a problem that does not have a clear answer, at least so it appeared to me at first.

In all seriousness, I was deeply impressed by the mathematical ability which they were able to develop over the semester. They incessantly hacked away at problems many of my fellow students would find daunting, or at the very least, frustrating. If you want to go into further detail on what exactly happened in the classroom, you can read further in the college of science news, but in this article, I invite you to experience the problem for yourself.

The highlight of the fall semester was a class of problems dubbed "Wiggle Worms." In these, you are given an $n \times n$ grid, which you must traverse by moving through the walls (up, down, left, or right, but not diagonal) of the boxes, with the objective of filling every box in the grid. In the initial box, you write a 1, and as you go through the grid you increment this number, leaving a 2 in the second box, and so on.

25	24	23	22	21
16	17	18	19	20
15	14	1	2	3
12	13	8	7	4
11	10	9	6	5

An example of a valid wiggle worm

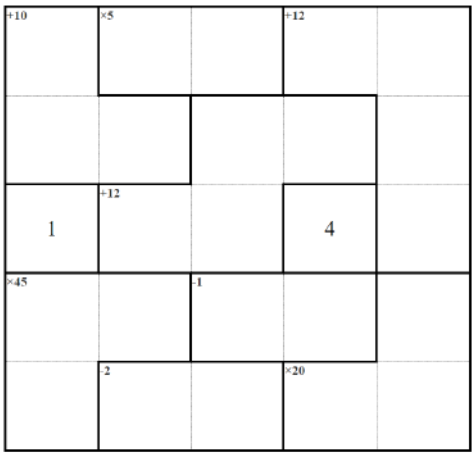
To make the problem more interesting, some boxes are given a fixed number at the beginning. However, sometimes those with the least information can be the most challenging. If this still sounds like something to scoff at, I invite you to try the second of the two following examples. The solution may surprise you.

36					19
	30			23	
		26	25		
		11	12		
				14	
7					2

1				

If you like teaching, or want to work with the students in the local community, reach out to Amanda Serenevy at amanda.serenevy@riverbendmath.org. Her programs at Notre Dame and at other schools in the area always could use more help.

Here are some other games for those bored enough to get this far in the paper. While most are probably familiar with sudoku, we also are including a less common variant. A *KenKen* similarly is an $n \times n$ grid where the numbers 1 through n must appear once and only once in every row and column. In addition to this, however, blocks of numbers are partitioned so that the numbers they contain must satisfy a given relation. In the top corner of each of these blocks is a number and an operation. The numbers in the block must be such that when taken in some order with the given operation applied between them, they are equal to the number in the corner.



		2		8		3		
8				6	2			
			9				4	
2							3	
	1		3	9	8		2	
	6							4
	2				1			
			4	7				5
		7		2		9		

Publish in Scientia!

Have you been engaged in research? Have you thought of publishing? Then consider Scientia, Notre Dame's very own student-run, predominantly rolling-submissions online publication with an annual copy in print. Scientia offers undergraduate students the chance to publish research and scholarly work in an academic journal. If you've presented at a conference or written up a research paper, publishing through Scientia is a great opportunity to have your hard work seen and shared!

If you are interested in submitting work, please email Alex Kokot (akokot@nd.edu), Scientia's Math Section Editor, for more information. Please contact us at scientia@nd.edu if you have any further questions.

The deadline for submissions is February 10, 2020. We look forward to receiving your work!

Welcome to Honors Calc

By ALEX CLINTON

From problem sets that have taken over 10 hours to complete, to a math "social" publicly promoted by the professor, it's easy to say that honors math has been a ride. While I did know that honors calc I would be a proof based course (I say this because there were many who unfortunately did not realize that at first), it wasn't until further along in the semester that I saw what really made the class different.

I was originally enrolled in calc III; however, after the first few lectures, I began to reconsider my decision. The importance of that course cannot be understated as it is essential in so many fields, but perhaps that is ultimately its greatest flaw. Due to the fact it is a requirement for multiple majors, there were many different reasons people were in the class. Even though some were interested in the theory behind what we were doing, it was clear that the consensus was otherwise, and frankly, that is not what the course was designed for. When the professor, perhaps naively, asked if we wanted an extra proof for why something was true, all he got was a loud "NO!" from the crowd that was there to learn about applications in physics, engineering, or to simply fill a course requirement. I thought back to the letter I had dismissed over the summer which encouraged me to take a look at the honors math classes, starting with honors calc I. After opening the letter and skimming through the pages, I tossed it aside thinking "I don't want to take calc I again, been there done that". I could not have been more wrong. I went to sit in on the class and almost left, thinking I was in the wrong room. Prof. Galvin was up at the board talking about logic and the fundamentals of how to mathematically argue. In my mind, to prove meant to develop an intuition for and understand where things come from, not to actually reinvent what we were learning.

Even though the class wasn't what I expected, I liked the approach that it took and later that day swallowed my pride to sign-up for the class I specifically tried to test out of in high school.

The switch was easily the best academic decision I've made at Notre Dame. I've encountered ups and downs over the course, such as starting the second homework the night before it was due thinking it would be as easy as the first one (it was not), and running into the first test 10 minutes late with a bloody nose. However, it was the most satisfying class I've taken despite it's difficulty and the time investment it required. Outside of being engaging for its rigorous approach to teaching math, the class has allowed me to make new friends, who I continue to have lunch with every day after lecture, and engage with people of similar interests and mentalities. I've also enjoyed getting to know the friendly faces in the math bunker whether it's a result of Thursday night homework scrambles or just messing around and talking nonsense because I'm unproductive. While I don't really have a coherent message, and I'm only a freshman so my experience is quite limited, I'd like to encourage anyone who is uncertain about a given class or major to just try it out. Worst case you don't like it and choose not to pursue it further (shoutout to political theory), and best case you find something you really enjoy and a passionate community around it.

Running with the Wolves

By ARAM RASHDUNI & KYLE DUFFY

Many mathematics students that are not interested in academia end up pursuing Wall Street for job opportunities. Since the late 1960's, there has been a boom in quantitative strategies at financial firms. Various quantitative careers on Wall Street today include structuring complex derivatives, implementing and designing risk models, and developing trading strategies. Wall Street actively searches for quantitative people to fill roles because we bring a different set of skills to the table. There are plenty of internship opportunities available for sophomores and juniors at financial firms where you can learn more about these

career paths. However, most positions are reserved for juniors so don't get discouraged as a freshman or sophomore!

Famously there are two "sides" of Wall Street: the "sell side" and the "buy side". The sell side is the group of companies that act as broker dealers or market makers for institutional investors. Whenever an investment firm needs to buy or sell something, they contact a sell side firm such as a bank or a market maker and the sell side firm would facilitate the transaction. Banks deal with individual clients such as hedge funds, pension funds, and family offices, whereas market makers look at the order flow of an exchange and try to satisfy orders that come through. Both banks and market makers buy securities at a low price and sell them at a higher price and make the difference. People at these sell side firms that facilitate these transactions are called traders. There are other employees at sell side firms called researchers or quantitative analysts that do financial research, structure complex financial products, and develop trading strategies. Some examples of sell side firms include Goldman Sachs, Morgan Stanley, JP Morgan, Citi, Barclays, Bank of America Merrill Lynch, Optiver, Citadel Securities, Jane Street, IMC Trading, Akuna Capital and Belvedere Trading.

Aram Rashduni

Buy side firms are firms that buy products from sell side firms, often with a directional opinion about the market. These firms are usually (loosely) labeled as asset managers. There are different types of asset managers that focus on different kinds of strategies. One type of asset manager is a Hedge Fund, which focuses on generating superior returns that are uncorrelated to the market. Hedge Funds are good for investors that want part of their portfolio to be free of exposure to market risk. Other asset managers are generally focused on generating superior relative returns - meaning they want to beat a specific market index such as the S&P 500.

Clients of asset managers are typically high net worth individuals and institutions such as such as Elon Musk or the Notre Dame Endowment Fund. Asset managers are specifically interested in developing investment strategies. A lot of math students are interested in working at buy side firms that specialize in developing quantitative strategies. These are called systematic funds because most of their investment strategies are automated, whereas other firms which have people making decisions are called discretionary. If one wants to work at a systematic fund, most of the work would be regarding quantitative research, modeling, and implementation. At a discretionary fund, there are quantitative and non-quantitative research roles, and portfolio management roles. Portfolio Managers (PM) are the employees who actively manage money and use the fund's internal research to make decisions. Typically one becomes a PM after 3-5 successful years at an investment firm. Buy side firms (especially hedge funds) are significantly more difficult to enter into as an undergraduate because most buy side professionals have at least a couple of years of sell side experience. Some funds such as Vanguard, Blackrock, Goldman Sachs Asset Management, AQR, Bridgewater, Citadel, and DE Shaw actively recruit undergraduates for investment and research roles (but are very competitive). It is possible to enter other buy side firms with aggressive networking and an impressive resume.

For finance internships, networking is a key variable in getting an interview and eventually the position. As Notre Dame students, we have a significant advantage with our alumni network. Typically students at Notre Dame find professionals on LinkedIn and then message them on LinkedIn or find the person's email address on the Notre Dame Alumni Directory. It also does not hurt to contact people outside of the Notre Dame network. These companies are looking for people to hire, so make sure you do everything you can to be noticed! Ask the person for a short phone call and show that you are very interested in them and their industry. Then, keep in touch with this person! You want them to be acquainted with you so if there is ever an opening, you will be on their list of prospective employees. If someone does not respond to you, follow up! People appreciate persistency at an appropriate rate - follow up in one week if the person does not respond.

When you get an interview, your preparation is dependent on the type of company and the role that you are applying for. If you are interviewing at a very quantitative firm (Optiver, Belvedere, AQR, DE Shaw, Citadel Securities, etc.) all of the interviews will be heavily quantitative and the interviewers will assume no finance experience if it is not on your resume. Typically you will be sent an online assessment which will consist of various logic puzzles, brain teasers, mental math, and probability questions. If you pass, there will typically be anywhere from 1-3 phone screenings, and then if you pass these you will be invited for an onsite interview. Most of these interviews will be similar in nature to the online assessment except you will get more challenging problems. You may also have to code short algorithms by hand. The most sought after programming languages to know are Python, Java, C++, and C, but if these aren't for you then C, R, and Go are also attractive options. Be prepared to be asked about anything that's on your resume. If you have a course on your resume that is relevant to the field such as stochastic modeling, be prepared to be asked questions about random walks. A good book to prepare for these types of interviews is: Heard on the Street: Quantitative Questions from Wall Street Job Interviewers by Timothy Falcon Crack. If you are interviewing at a more traditional firm for a traditional role such as trading at a bank or an investing/research role at a discretionary fund

Kyle Duffy

you may be asked about current events and your own views on the economy and specific trading strategies. At these firms you will also be expected to have some financial acumen. Expect to be tested on how basic derivatives work such as options and futures, and how various factors affect prices of certain products. Typical questions would be "What is the delta of an at-the-money european call option?" or "How do interest rates affect bond prices?". You may also be asked to pitch a stock or trading strategy.

If you are a competitive sophomore or junior, you may get offers from multiple mid tier to upper tier firms. Your primary objective should be to have a balance between prestige and learning opportunities. Though the prestige of a large firm may be a very attractive feature, it may be more valuable to spend time at a smaller firm where you'll have more room to contribute. Remember, the point of an internship is to learn, so try to make your decision based on what you think will be the right fit. Would you be able to learn in the firm's office environment? Do you get along with the people you met? Would you have access to feedback and mentorship from senior employees? These are all important questions to ask yourself before choosing which internship is right for you. In any case, if you're interested in math and finance, then definitely give your best shot at getting an internship. No matter what happens, it'll be a valuable experience!

Aram and Kyle are both Honors Math Majors in their junior year at Notre Dame with extensive finance experience in internships and extracurricular activities. If you would like some extra advice, feel free to contact Aram at arashdun@nd.edu and Kyle at kduffy5@nd.edu.

Actual Math

If you feel the need for a warm-up after diligently working your way through the paper to get to the very last section, here are some additional problems with unconventional solutions. Please do not submit these, none of us will grade them.

1. Let $A_1, A_2, \ldots, A_n$ be points in the plane. Prove that on any segment of length ℓ there is a point M such that
$$MA_1\dot{M}A_2 \ldots MA_n \geq 2\left(\frac{\ell}{4}\right)^n.$$
From *Challenging Mathematical Problems with Elementary Solutions* by A.M. Yaglom and I.M. Yaglom.

2. Given distinct integers $x_1, x_2, \ldots, x_n$, prove that $\Pi_{i>j}(x_i - x_j)$ is divisible by $1!2! \ldots (n-1)!$.
From *Mathematical Mayhem 1995.*

3. Let n be an odd positive integer and A an $n \times n$ matrix with the property that A^2 is the identity (I_n) or 0 matrix. Prove that $\det(A + I_n) \geq \det(A - I_n)$.
From *Romanian Mathematics Competition, 1987.*

Now that that is out of the way, onto the problem which we are more than interested in grading. If the prospect of your solution being published in the next edition are not enticing enough, the "best" solution (as defined by the following criteria) will also merit a $50 cash prize. What matters most is the elegance of the submitted solution. As long as it is before the next edition, it will be considered, and if it is unquestionably the best, it may just win (we will see if we agree with you). Secondly, time has to play some role. If two identical (at least almost everywhere equal) solutions are submitted, then priority will be given to the first one. Failing all of these as differentiators, the third criteria will be based on a submitted solution to the wiggle worms listed on page 4. If all of these criteria fail, then all hope is lost. Email your solutions to akokot@nd.edu, and winners will be contacted by the end of the month. Good luck!

Jeff Jackson, coach of the 33-man Notre Dame hockey team, wants to train his players' minds as well as their bodies, so he plays the following game with them: in a room, he places two boxes, one red and one blue. Each box can be either open or closed. Initially none of the team knows the statuses of the boxes (open/closed). Every so often, he brings one of the players into the room, where the player is required to change the status of one of the boxes (of the player's choosing). At any time, any of the players can go to Coach Jackson and say "I know for certain that all 33 of us have been brought into the room at least once". If the player is correct in his declaration, the team wins a prize — a day off training. If the player is wrong in his declaration, the team pays a price — an extra hour in the weight room.

Throughout the game, the players are not allowed to communicate with one another in any way, and Coach Jackson is allowed to make arbitrary choices of players to invite into the room; in particular a player may be invited multiple times. He only makes one initial promise to the players: no matter how many times a player has been invited into the room, the player knows that eventually he will get invited in again.

Before the game begins, he gathers the players together, explains the rules to them, and allows them to confer together. Is there a strategy that the players can agree to on in this conference, that makes it certain that they win the prize? (*From Professor David Galvin, Notre Dame*).

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- Your editors, Alex Kokot and Ting Gong.