

## 2017 Commencement Address by Demetri Brizolis

Thank you Professor Duke. To the accomplished Graduates of the Department of Mathematics, Congratulations! To their dedicated support group-- families, significant others and friends—Welcome! And, to the esteemed Mathematics Faculty, thank you for inspiring your students and providing them with a stimulating, intellectual environment. It's an honor for me to be here on Commencement and Father's Day to address such a distinguished audience.

Graduates, fifty years ago, almost to the day, I was seated where you are. I was about to receive my bachelors degree from one of the most respected mathematics departments in the country, and our Men's Basketball team, under the direction of the legendary John Wooden, had just won its third national championship. But at the time, I faced the reality that career opportunities for mathematicians were few, and our nation, mired in one of the most controversial wars of my generation-- the Vietnam War, was deeply divided. In those days, "being drafted" had nothing to do with college sports and "One and done" had a dire meaning for those of us graduating during wartime. Caught up in this web of contrasting circumstances, my emotions were a bittersweet blend of pride, hope and fear. As YOU sit here today, you're probably experiencing your own emotional extremes—euphoria generated by your outstanding achievements, and anxiety precipitated by significant, if not bizarre, global events that are certain to affect your future. I can't promise you another basketball championship, but the good news is, given that you are graduating from a Mathematics Department that is ranked 7th in the world, given that the career landscape for mathematicians has dramatically improved, and given that our planet has historically had a remarkable propensity for survival, it should be easy to prove the following conjecture, and that is, the probability of your continued success is equal to 1 minus epsilon. Today, I'd like to give you, the Graduating Class of 2017, some insight into its proof, and provide your Support Group with a little bit of our history.

In 1967, we mathematics graduates could either join the ranks of academicians or take the leap into "industry"; if we took the corporate route, there were only two options -- IBM or Bell Labs. That was it!

In my case, with my B.A. in hand, I decided, as many of YOU will, to pursue an advanced degree; I had the good fortune of earning my doctorate under the direction of Ernst Straus, whom some of you sitting here today will remember. Professor Straus was a rather imposing figure—his colleagues appropriately compared his sharp mind to a Steel Trap. But his brilliance was belied by his patience and humility, and he never talked about his storied past—it was sometime later, about halfway through my dissertation, that I found out he was one of a handful of mathematicians that assisted Albert Einstein at Princeton. I am grateful for his guidance and miss his genius! Regardless of the level of YOUR degree, and in light of the high caliber of this faculty, I am sure that each of you, like me, has had at least one professor who has made a tremendous impact in your life. So, before you leave today, please take time to give your mentor a big "Thank You".

In 1973, after completing my studies, I decided, like most Ph.D.'s, to pursue a career in teaching and research. Ten years later, when it became evident that the real-world demand for mathematicians was increasing, I departed Academia and entered the private sector where I applied my problem solving skills to carve out a successful second career in real estate finance. Coincidentally, in 1986, President Ronald Reagan officially created Mathematics Awareness Week to, as he stated, "raise the public awareness of the importance of this basic branch of science to our daily lives". Reagan really nailed it! Today, to your benefit, the career opportunities for mathematicians, unlike when I graduated, are diverse and numerous. Mathematicians are making significant contributions in the fields of biology, chemistry, genetics, cryptography, economics, finance, psychology, medicine, pharmacology, actuarial science, music, architecture, graphic arts, gaming, computer animation and climatology—just to name a few! While IBM still recruits mathematicians, it is now competing with the U.S. government, Wall Street hedge funds and tech companies such as APPLE, GOOGLE, AMAZON, FACEBOOK and MICROSOFT. Graduates--and this is no exaggeration—your future is very bright and the choice is yours! In the words of Karl Gauss, considered one of the greatest mathematicians of all time, "Mathematics is the Queen of the Sciences"; today, in light of the public's awakening to the power of mathematics, his profound declaration is more relevant than ever!

The history of our subject is deep, and the extraordinary, colorful characters that played a crucial role in its rich development have exhibited a fascinating array of brilliance, creativity and eccentricity very similar to history's greatest artists and composers. Even the word "mathematics" has a notable origin; it was first coined by Pythagoras in the 6th Century B.C. and stems from the Greek word "mathema", or "learnings". However, mathematics was born before it was named; according to archaeologists, its first signs appeared in prehistoric Africa from where it evolved into a system of symbols that were used for calculations and measurement in trade and agriculture. Remarkably, records show that the Sumerians, Babylonians and Egyptians had solved quadratic equations and estimated "pi" to within 3 decimal places over 3 thousand years ago. It was the ancient Greeks, though, that presented to the world the rigor and formality that is the hallmark of pure mathematics. You know some of the other names—Euclid, Archimedes, and Diophantus.

After the Hellenistic Period, mathematics flourished in China, India and the Middle East, but it was really in Europe, in the 17th Century A.D., that its pace of development accelerated through the study of astronomy and motion. It was around this time that the Calculus was "invented" by Sir Isaac Newton and Gottfried Leibniz. Another notable mathematician of that period, Pierre de Fermat, was actually a lawyer by profession and was considered an "amateur" by mathematicians of his time. He is best known for a number theoretic conjecture that he scribbled in the margin of a book in the year 1637. The conjecture itself was concise and simple to state—but in true lawyer fashion, while claiming to have devised a proof, he avowed that the margin was too small to fit it in. As it turned out, no one ever found his actual proof, but the efforts of scores of mathematicians, over a period of 350 years, to prove what is known as Fermat's Last Theorem, resulted in an avalanche of new branches of mathematics that, arguably, might have never been discovered if it wasn't for Fermat. This so-called "amateur" is now recognized as the Father of Number Theory. Why

is that significant? Well, the complete quote that is attributed to Karl Gauss really goes like this: "Mathematics is the Queen of the Sciences, but Number Theory is the Queen of Mathematics". I guess that could have made Fermat a king!

There's also a hidden message here: be careful when calling someone an amateur; and think twice before making jokes about lawyers!

The 18<sup>th</sup> through the 20<sup>th</sup> Centuries saw monumental advances in all branches of pure and applied mathematics and produced a vast number of intellectual giants who made enormous contributions. For example, George Riemann's revolutionary work in non-Euclidean geometry paved the way to Einstein's Theory of Relativity, thus opening the door to the Atomic Age. Riemann has another claim to fame—anyone who solves his famous conjecture, known as the Riemann Hypothesis, will receive a \$1 million dollar prize. Graduates, do the Math! And, in 1995, the elusive "Fermat's Last Theorem" was finally proved by the British mathematician Andrew Wiles. His proof, by the way, took up 108 pages, which is equivalent to about 378 margins!

The end of the 20<sup>th</sup> Century also saw the advent of the Internet that enabled mathematicians to share their work at the speed of light; this not only resulted in a proliferation of research, but also led to the dismantling of the perceived wall between pure and applied mathematics. Indeed, one day in 2007, as many of you have probably done, I decided to Google myself, and, to my surprise, the first item that appeared on the page was "The Brizolis Problem". After quickly determining that my wife was NOT responsible for the article, I read on. Apparently, one of the research papers that I published in the 70's stated a number theoretic conjecture that I left for others to prove. Sound Familiar? I was completely unaware that this conjecture made its way into a book titled "Unsolved problems in Number Theory" and was eventually solved in 2000 by a graduate student at UC Berkeley. Being a diehard Bruin, I was, of course, relieved when I found out that she was a Bear and not a Trojan! I was even more pleased when I learned that this problem, conceived and stated in an abstract setting, had tangible applications in the field of cryptography. At that "Eureka" moment, it was evident that mathematics had actually traversed the fuzzy boundary between abstraction and reality. Today, thanks to social networking, our subject no longer lives in a vacuum. It is a global contact sport, involving thousands of mathematicians, amateur and professional, pure and applied, from practically every country on earth, intent in solving history's most celebrated problems.

So, graduates, as you can see, the path to your continued success is clear; I sincerely hope that each of you is one step closer to finding the least upper bound of your epsilon. And, Support Group, since I allowed you to peek into our fabled, mysterious past, I feel comfortable in asking you for just one small favor --- PLEASE do NOT do to your newly minted mathematician what my family and friends delighted doing to me on so many occasions: PLEASE do not ask "Have you discovered any new numbers lately?" Fifty years ago, being woefully unprepared, I didn't have a good answer. Graduates, if you are ever asked that question, whether it be at a Thanksgiving dinner, wedding or Bar Mitzvah, you will be armed with a suitable answer that could go something like this: "Not recently, but my predecessors did and it paved the way to solving Fermat's Last Theorem". This should end any further discussion!

From this day forward, you are officially “mathematicians”, and, as such, you are revered, yet feared! You are descendants of a unique pedigree. You now belong to an elite club; your entry fee, in the form of years of hard work, has already been paid. By accepting that membership, you are also accepting an obligation, your dues, so to speak, to use your discipline wisely—to inspire others, to create a ripple in the ether of knowledge and, above all, to leave a positive mark in history for the benefit of humankind. So, guided by the spirit of Pythagoras and following in the footsteps of Karl Gauss, let the “Queen” take you by the hand and lead you into the garden of “learning”. Thank you.