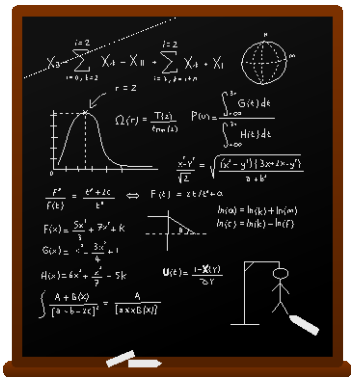
Department of Mathematics

February 10, 2020

UNDERGRADUATE MATH SEMINAR



This week's seminar is MONDAY afternoon! Details, including speaker name, title and abstract can be found on the posters around Bailey Hall.

DATE: **Monday, February 10**

Time & **4:00 pm** – light refreshments in Bailey 204

Location: **4:15 pm** – Seminar in **Bailey 207**

Pieces from Theses, by Nicholas Kender

Nick's thesis was supervised by Professor Jeffrey Hatley

Writing a thesis in mathematics has been one of the most challenging, yet rewarding, experiences of my time at Union thus far. Over the course of ten weeks, I discovered an entirely new topic, applying the fundamentals of what I learned over the last few years as a math major. The first step in my approach to writing my thesis was exploring the background information of my topic; I studied symmetric polynomials which are a special type of polynomial such that if any of the variables in the polynomial are interchanged, then we get the same polynomial.

One of the things that I identified early on was that I had to include a proof of the Fundamental Theorem of Symmetric Polynomials, which essentially says that we can rewrite any symmetric polynomial in terms of the *elementary symmetric polynomials*, which are the building blocks of all symmetric polynomials. There was a complex proof in one of the texts that I read, and someone who had little background studying symmetric polynomials may not have been able to follow along. Thus, one of my goals for my thesis became to come up with a more concise proof of this theorem, a "man on the street" proof. In order to make a more straightforward proof of the theorem, I worked through creating and proving lemmas and corollaries that stemmed from the original proof of the Fundamental Theorem, so that in my final version of the theorem, I could just apply those lemmas and corollaries that I had already proven.

Once I had the proof done for the Fundamental Theorem, I moved on to another big theorem, the theorem of Uniqueness, which takes the Fundamental Theorem one step further by asserting that there is exactly one way to write a symmetric polynomial in terms of the elementary symmetric polynomials. This theorem was stated but not proved in one of the textbooks, so it was my job to formulate a proof for this theorem. Anyone who knows proof-writing knows that this is a long process, but frequent meetings and email chats with my advisor, Professor Jeff Hatley, allowed me to successfully prove this theorem. With a few sections of lemmas and corollaries and two big theorems, that took up all of the time I had to write my math thesis, but the final step was to tell a story. In the last week of the term, the task at hand was to provide the exposition that took a collection of proofs and created a math thesis.

My experience writing a math thesis was quite rewarding due to the fact that I began the term with hardly an idea of what a symmetric polynomial even was, and I ended the term with a solid understanding of the intricacies of these special polynomials. To any underclassman who will be writing a thesis soon, prepare yourself for a very unique opportunity. You get free reign over the direction your thesis will take; it can be as complex as you want it to be; my suggestion is to come in with an open mind and in the first couple of weeks do as much research into your topic as possible in order to figure out what you want the main focus of your thesis to be.

Spring '20 Petitioning Process Begins this Coming Weekend

Petition course signup runs Saturday, February 15 – Tuesday, February 18 via webadvising.union.edu.

The following spring math courses require a petition: Math 112, 224, 332, and 430.

The courses: The full course schedule is (or will be soon!) online at WebApps. Course of particular interest to math majors and minor, beyond the Calculus and Differential Equations courses, include

- **Math 199** is the department's "bridge course," intended to help students make the transition from computationally oriented courses to more theoretical proof-writing courses. It is a **required** course for all math majors and minors that is *usually* taken after a student has taken Math 115.
- **Math 224** (Geometry) is a course in transformation geometry, studying and classifying the distance preserving functions, called isometries, of the plane. It is a course that is appropriate for students coming straight from Math 199. Additionally, as rudimentary transformation geometry is now included in the Common Core in middle and high school math, this course is wonderful for students considering teaching as a career.
- **Math 238** (Methods in Applied Mathematics) is an introduction to the fundamental concepts and techniques in applied mathematics. Topics may include dimensional analysis, scaling, perturbation theory, boundary layer analysis, differential and integral equations, calculus of variations, optimization, and eigenvalue problems. The emphasis is the use of mathematics to quantify and solve problems arising from physical, chemical, biological, and economic phenomena. This course has (Math 130 or Math 234) AND (Math 197 or Math 199) as prerequisites.
- **Math 332** (Abstract Algebra 1) is a beautiful course that generalizes what you know about algebra in the integers and real numbers to a more abstract setting. The main objects of study in this course are groups, rings, and fields. This course is required for the major. The prerequisite for this course is one of Math 219, 221, 224, 235, 248, or 257.
- **Math 430** (Complex Analysis). In this course, you will study the calculus of functions defined on the complex plane, rather than on the real numbers or R^n! What is the same? What is different? There are lots of really cool ideas, methods, and results to be learned, including, perhaps, the proof of the Fundamental Theorem of Algebra, showing that every nonconstant polynomial has a root. This course is a good choice for students seeking honors in the major and/or considering going to graduate school in math. A 300-level course is a prerequisite for Math 430.

And don't forget Statistics! This spring, **two** statistics courses are being offered:

- **STA 164** (Strategies of Experimentation)
- **STA 364** (Big Data Analytics)

For more info, see the online course listings, https://www.union.edu/mathematics/course-offerings

Problem of the Newsletter – February 10, 2020

Last week's problem: Congratulations to **Son Nguyen** for solving last week's problem. His solution has been posted at the newsletter sites in Bailey Hall.

This week's problem: Players 1, 2, 3, …, *n* are seated around a table, and each has a single penny. Player 1 passes a penny to player 2, who then passes two pennies to player 3. Player 3 then passes one penny to Player 4, who passes two pennies to Player 5, and so on, players alternately passing one penny or two to the next player who still has some pennies. A player who runs out of pennies drops out of the game and leaves the table. Find an infinite set of numbers *n* for which some player ends up with all *n* pennies.

Professor Friedman (friedmap@union.edu) will accept solutions until noon on Friday, February 14.