Department of Mathematics May 18, 2020

Math Department Prizes Announced

Please join the Math department in congratulating this year's recipients of its prizes.

The Martin Terry Resch Prize

The **Martin Terry Resch Prize** is awarded to "the senior who shows the greatest promise for advanced study in pure or applied mathematics." This year, the math department gave this award to **Meichai Chen, Zachary Porat,** and **Mushan Zhong.**

The Eugene W. Hellmich Memorial Prize

The **Eugene W. Hellmich Memorial Prize** is awarded to "the senior who demonstrates excellence in mathematics and is planning to teach math." This year, the math department gave this award to **Tom Harrison.**

Calculus Help Center: Tutoring Positions Available[1], Fall 2020

The Math Department is now accepting applications for vacant Calculus Help Center (CHC) tutoring positions. Tutors in the fall work in the CHC one fixed night per week, Sunday through Thursday, from 7:30-10:00pm.

Qualifications: Calculus through Math 115 with grades of no less than A-. Preference will be given to students who

- have also completed Math 117 (with a grade of no less than A-),
- are considering becoming a math teacher or pursuing graduate work in mathematics, and
- have other tutoring experience (not necessary, though).

To apply for a position, send an email to Professor Paul Friedman (friedmap@union.edu) expressing your interest, listing your mathematical background, including coursework (term, professor, and grade) and tutoring experience (if any), and discussing why you think you would be a good tutor.

Application deadline: Friday, May 29 at NOON.

[1] While we do not know exactly the form the CHC will take, we anticipate being able to run it in some way.

Don't forget to accept or decline your petitions
Tuesday, May 19 – Thursday, May 21

Pieces from Theses

This week's contribution is from **Reid Nichols**, a double Math and Economics major. She wrote a joint thesis, advised by **Professor Roger Hoerl** in the Math department and **Professor Stephen Schmidt** in the Economics department.

During the fall and winter, I worked on my interdepartmental math and economics thesis with Professor Roger Hoerl from the math department and Professor Stephen Schmidt from the economics department. For my thesis, I chose to create estimates of marginal revenue products (MRPs) for players in the National Hockey League (NHL). MRP estimation is a topic that has been heavily discussed in baseball. However, I wanted to apply the work that had been done in baseball to the sport that I am most passionate about: hockey. Creating estimates for hockey players posed several new problems, the most notable being how to include the impact of a player's teammates in the estimate of the player's production value. The standard way to estimate player MRPs in sports is to create a production equation that estimates the effect of a player's production on team winning

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and a revenue equation to estimate the effect of team winning on team revenue. Then, coefficients from these two equations can be used to create the MRP estimates.

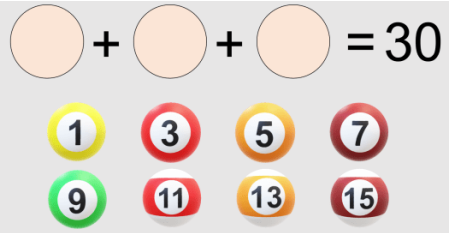
Since this was a double major thesis and I needed to meet requirements for both departments, I spent the majority of fall term researching previous literature and writing my literature review. I also began to collect my data towards the end of the fall term in preparation for the statistics heavy winter term. I ended up using NHL play-by-play data that recorded line changes for my production equation(s) in an attempt to isolate a player's production from his line mates. I used a web scrapping program in R to get this data from the NHL website and much of the beginning of the winter term was dedicated towards manipulating this data in R to put it into a usable form for my model (this is where my computer science minor came in handy).

Ultimately, I ended up creating a data frame with every possible combination of six players on the ice at a time during the 2018-19 NHL season. I then created dummy variables for every individual player in the NHL. These variables were equal to one when a player was in a given player combination and zero when the player was not present in the combination. I also planned to include player pair dummy variables later on to account for interdependence among players. This dummy variable approach resulted in production equations (one looking at goals for and the other looking at goals against) with incredibly high levels of multicollinearity because the dummy variables of two players who play a large majority of their ice time together will be highly correlated. The multicollinearity created some flawed coefficients that were then inputted into the MRP equation along with the revenue equation coefficients to create some preliminary estimates for a player's MRPs. While my estimates provided a more holistic view of a player's production by looking at all of the goals a player helps generate or give up while on the ice, they were not very accurate and I was not able to include the impact of teammates in the estimates due to the multicollinearity issue. I am currently working on an independent study to work off of my thesis research and try to lower the amount of multicollinearity in the model in an effort to improve my estimates.

My advice to any underclass students planning on writing a math thesis is to be flexible. My thesis certainty did not go as planned and it seemed as though every week a new issue with my model came up. While I did not get the results I was hoping for, I was still able to produce a product I am proud of. Original research can be frustrating and it is ok if your results do not turn out perfect. Additionally, if you are a double major, make sure to start reaching out to potential thesis advisors early and communicate clearly between your two advisors as different departments have different timelines for assigning advisors and different requirements for the final thesis you turn-in. Finally, find a topic that you are passionate about to study. I knew that wanted to do a thesis on something related to hockey and statistics. Because I am passionate about these two areas, the work was very enjoyable and rewarding. While it was still hard work and overwhelming at times, it was a lot easier to manage because I enjoyed doing the work.

Last Week's Problem of the Newsletter – Tricky!

Last week's problem asked you to place three balls in the circles so the numbers sum to 30. Some noted that all of the balls had odd numbers and that the sum of three odd numbers is odd, so it can never equal. However, the balls can be turned/rotated! So, the "9" can also be a "6"! With this, finish off this problem!



(Contact **Professor Paul Friedman** about Problems of the Newsletter)