Pieces from Thesis – by Greg Melchior-Fisher

*In an ongoing (and popular!) series in the math newsletter, students who have completed a thesis or participated in the Senior Writing Seminar in the math department are given the opportunity to write a piece for the newsletter in which they share a bit about their thesis/writing experience and their mathematical work. This week, **Greg Melchior-Fisher** kicks things off with the following article.*

This Fall term, under the advising of **Professor Jue Wang**, I completed my thesis, titled *Health and Heatwaves: Quantifying and Visualizing Socioeconomic Disparities in Arizona's Heat-Related Mortality*. The prospect of writing a math thesis was daunting, but the numerous options provided by professors made it easy to pursue my interests. I settled on this project because it overlapped well with my political science major and offered research techniques that are not found in standard math classes.

The main goal of the thesis was to quantify healthcare disparities. Professor Wang allowed for lots of flexibility in choosing my focus, and I settled on heat-related mortality in Arizona after finding a useful government data set and considering the possible effects on immigrant populations. The regressions and index of disparity provided evidence that men, Latinx, and lower income Arizonans are more vulnerable to heat-related mortalities.

The regressions and index of disparity were the main mathematical components of the paper, and were rather simple. Running regressions with R created an equation that resembles the following:

$$Deaths = \beta_0 + \beta_1 X90. + \beta_2 Density + \beta_3 No. Car + \beta_4 Pct. BA + \beta_5 Male + \beta_6 Latino + \beta_7 X65$$

The program R would then determine each beta coefficient and the fit of each equation. The index of disparity is the rate of mortality of a certain demographic divided by the average mortality rate.

The bulk of the thesis work was the visualization of my data and results. I accomplished this in R using packages such as tidycensus and ggplot. These allowed me to create maps of Arizona broken down by county to compare demographic levels across the state. I also created bar graphs, box plots, and correlation plots which provided further observational analysis. With little prior experience in R, this was the most challenging part of my thesis, and it was very rewarding to breakthrough and create the first of these many plots.

The senior thesis is an exciting opportunity for students to reinforce and expand their learning in a concentrated manner. I believe my thesis is a prime example of how a math major can be useful in a wide range of fields, as I hope my work can be used by researchers spanning a wide range of majors. As I said above, the math thesis can be daunting at first, and the finished product can often seem an impossible goal. Eventually, I learned to trust the process, and the somewhat jumbled collection of notes and graphs I had in week 6 resulted in a lengthy research paper that is the culmination of four years of work as a math major. Taking the thesis one week at a time and trusting the guidance of my advisor got me across the finish line, and it is the best advice I can provide.

Thanks again to Professor Wang for guiding me through this project and to the many professors past and present who provided me with the tools and analytical skills necessary for the paper.

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Sunday - Thursday: 7:30 – 10:00pm in the Sorum House Seminar Room