Natural Disasters, Climate Predictions, and Human Settlement Patterns

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Problem Research

Humans have time and time again expressed one singular desire: the desire to exert control. This desire to control extends to various categories, such as control over themselves, control over others, and control over their surroundings. When humans discovered fire, they immediately used it to regulate the temperature to make life more accommodating. When humans first experimented with agriculture, they began domesticating animals, such as pigs and cows, to become entirely dependent on perimeters which fit the human agenda. This resulted in an echelon of animal life which humanity exerted absolute dominance over. Humanity's ability to adapt and manipulate our surrounding to accommodate our needs is what solidified us as the sovereign form of consciousness, and apex predator in every land-based Earth ecosystem. One concept, however, continues to elude our control and understanding. This concept is Mother Nature, and the various destructive ways in which she manifests. We are forever at the mercy of nature's arsenal: hurricanes, floods, tornadoes, monsoons, etc. The most we can do is predict her patterns, and attempt to react accordingly. The ever-present threat of nature's wrath has governed the decision-making process of innumerable entities. For instance, a docking company may have to decide if it's worth constructing a shipyard in an area notorious for experiencing hurricanes. Agricultural contractors have to consider the threat of wildfire before they begin the ranching process. Airports have to decide proper contingency landing strips if their destination has been compromised by general inclement weather. This research paper will tackle the task of identifying which areas of the United States are objectively the most dangerous, and which areas are the least dangerous, or safest. Furthermore, once these locations have been decided, the paper will analyze why individuals continue to live in areas of increased risk, and why they don't migrate to areas of mitigated risk.

The research team assigned to this project originally hypothesized that the least dangerous area of the United States would be Ohio. Ohio is located on the edge of 'Tornado Alley', too far inland to be affected by hurricanes or winter weather, and in stable enough temperatures that wildfires weren't a likely scenario. Conversely, the research team hypothesized that the most dangerous area of the United States was located in the southeastern area of the United States, such as Louisiana or Florida. The hypothesis was rooted in media baseline and anecdotal experience. Additionally, the research team hypothesized that the most dangerous natural disaster would more than likely be the hurricane. Generally, when the news reports on hurricanes, such as Katrina and Irma, they report the epicenter of the carnage being in either Louisiana or Florida. Concerning the question of human habitation, the research team was certain that economy and industry would play a much larger factor in location of residence than the threat of natural disasters. Infrastructure, the promise of new and lucrative employment, entrepreneurship, and simple human curiosity were the reasons why the first settlers departed England to settle the United States in the first place, and by extension the reason that those same settlers eventually began pioneering and settling the rest of the mainland United States. If the risk of natural disasters with respect to industry and economic advancement failed to dissuade settlers in a time period where there were threats exponentially more dangerous than the weather, then it is unlikely that the threat would dissuade the modern American citizen with access to NORAD and several other advance warning systems. By extension, safety would more than likely have very little bearing on a citizen's location of residence.

The research team had decided to specify classification to state. Once a specific state was identified to be the safest, then the team would identify the objectively safest area within the state. The next step was to identify a process in which to objectively rate a state's level of danger. The research team decided to use the following list of natural disasters for their research: hurricanes, tornadoes, earthquakes, wildfires, blizzards, floods, volcanic eruptions, dust storms, droughts, sinkholes, and mass movements. Initially this task appeared rather daunting, given the sheer magnitude of variables involved. Considering the psychological, ethical, philosophical, and moral definitions of 'safety' it may have been difficult to simplify such an abstract and dynamic concept. However, through the magic of statistics and probability, the research team realized that they could simplify the classification process through the only language that is both entirely objective and incapable of telling a lie: mathematics.

Safety is defined by a lower likelihood of experiencing damage to one's self or their property. Thus a 'threat vector' will have to find a way to weight the frequency of a natural disaster and how much destructive potential that natural disaster contains. Analyzing a combination of threat to life and property, while still acknowledging the economic impact of property loss is oftentimes comparable to the moral implications of human mortality the research team derived a mathematical formula to translate the safety of an area to a numerical value. A ratio for loss of life with respect to loss of property was derived in order to simplify the threat vector. The state that would rank the highest on the rating system would be deemed the most dangerous and the state that ranked the lowest would be deemed the least dangerous. This allows the research team to determine which states are individually considered safe when compared to the other states. the data collected could be simplified to four major archetypes: frequency of occurrence, probability of recurrence, loss of life, and loss of property. The archetypes provided perimeters for the research team to operate within when gathering data on the various natural disasters.

The research team had partitioned the data collected into two separate charts: probability and destructive ranking. The probability chart state the likelihood of each natural disaster occurring by state based on the frequency of the natural disaster in the past and the frequencies' projected patterns based on trends found in data. The second chart using an algorithm to assign each natural disaster a 'danger rating'. This yielded interesting data. For instance, droughts have killed the most people over over the past forty years. Droughts have killed over 5175 individuals in total. However, hurricanes cause the most raw damage on a more widespread scale. Despite having a death toll of 1574, which is only 30% of the deaths caused by droughts, hurricanes had caused approximately $267 billion over the same range of time. Droughts had caused only $59 billion which is only 22% of the damage caused by hurricanes. When coupled with the previously derived formula, this yields an exponentially higher level of destructive potential than droughts, despite droughts showing the highest level of fatality (Borden, K.A., & Cutter, S.L., 2008).

The final results prove to deviate from the original hypothesis. The safest state in the United States had proven to be Michigan. The most frequent natural disasters that Michigan experienced were blizzards, tornadoes, and floods. Michigan experienced 16 tornadoes annually U.S. (Tornado Climatology, 2010). Michigan has experienced 17 blizzards and 22 floods since 1970 (Coleman J.S.M., & Schwartz R.M., 2017; The Weather Channel, 2016). After analyzing the data, this is still lower than the national average of 25 annual tornadoes, or the 19 blizzards and 62 floods since 1970 experienced in other states. Furthermore, even the destructive nature of these natural disasters pales in comparison to the other natural disasters on the list. Tornadoes and floods only comprise 8% and 7%, respectively, of the destruction wrought by national disasters since 1970. Floods are a particularly destructive force, comprising 24% of natural disaster related destruction since 1970, but the number of floods in Michigan is only a third of the national average which subsequently spares Michigan from its overall destructive potential. Conversely, Texas had proven to be the most at risk state in the nation with respect to natural disasters. Hurricanes, floods, and droughts had proven to be the most dangerous natural disasters on the list, causing 37%, 24%, and 8% of all natural disaster related damages since 1970, respectively. Texas experienced 61 hurricanes, 114 droughts, and 85 floods since 1970. This is well above the 9 hurricanes, 25 tornadoes, and 24 droughts experienced on average by every other state in the United States.

Human migratory patterns in the face of the omnipresent threat of natural disasters can be explained through game theory by using risk/reward behaviors associated humans exhibit concerning economic opportunity with respect to external threats. As an example, we'll compare the dilemma surrounding Flint, Michigan following the collapse of the automotive industry with the industrial success of Texas. Flint has been in the news indefinitely for having toxic water, after General Motors left Detroit, the city had fallen into legendary levels of disarray, and signs of a renaissance happening anytime soon in the Michigan are negligible at best. Texas, on the other hand, is an economic powerhouse and industrial leader in American economy. The rural area and STEM field are collectively successful through the efforts of universities such as Texas A&M utilizing the scientific method to strengthen their hold on the agricultural market. For all the damage Texas receives from mother nature, her industry makes up for the loss of profit several times over.

Job/Career Research

Dr. Jill S. M. Coleman

Biography

Dr. Jill S. M. Coleman is a full-time geographical professor, specializing in hydroclimatology at Ball State University, a public co-educational research university in Muncie, Indiana. She earned her bachelor's degree in geography, with a minor in geological sciences, at the University of Missouri-Columbia, a master's in geography-climatology from the Ohio State University, and a PhD in geography-climatology from Ball State University. Dr. Coleman belongs to several organizations which include, but aren't limited to: The American Association of Geographers, regular reviewer for a number of academic and research journals including Journal of Climate, Journal of Geophysical Research-Atmospheres, Journal of Hydrometeorology, Climate Research, Applied Geography, AMS Conference on Biometeorology and Aerobiology, and numerous other organizations (American Association of Geographers 2014). The following is the list of awards, presented by the American Association of Geographers' profile of Dr. Coleman:

> External grants from the National Science Foundation and the Discovery Foundation as well as numerous internal research and professional service grants. Elected Fellow of the Royal Meteorological Society (2009); AAG Warren G. Nystrom Award Finalist (2007); Tromp Foundation Young Scholar Award for Biometeorology (2007); E. Willard and Ruby S. Miller Graduate Fellow, The Ohio State University (2004).

Her professional experience is predominantly comprised of various positions within the academic field, including a professor Ohio State University and Ball State University, Ohio State's adjacent research complex, and the Byrd Polar Research Center. Dr. Coleman has also been published in several academic journals, including but not limited to The Journal of Geophysical Research, The Professional Geographer, and the Journal of Climate.

Career

According to page 27 of the Ball State University 2014-2015 Annual Salary report, Dr. Coleman earned approximately $70,399 annually, which according the Bureau of Labor Statistics is typical post-secondary geography educator pay. Job outlook projections for geographers also look promising. Career planning website MyFuture.com, data compiled from the Bureau of Labor Statistics, National Center of Education Statistics, and Defense Manpower Data Center indicate that employment of geography educators is projected to increase by 13% from 2014 to 2024, which is higher than the average of all other occupations. Careers similar to geographers include, but aren't limited to: cartographer, environmental consultant, and town planner. All of which require a strong understand of physical science and how the Earth operates.

Use of Mathematical Models in Research/Publications

The research team utilized Dr. Coleman's examination of spatiotemporal trends released January 2017 in the American Meteorological Society Journal. Dr. Coleman utilized a combination of decision theory, synoptic analysis, frequency analysis and probability. The research team had no direct use for synoptic analysis and proposed utilizing decision theory in their own research. Eventually the research team decided against decision theory, but adopted the probability and frequency analysis for their own research. Additionally, Dr. Coleman's data on blizzards was used in later analysis (Coleman J.S.M., & Schwartz R.M).

Dr. Neumann János Lajos

Biography

Hungarian mathematician Neumann János Lajos (known as John von Neumann to English speakers) had pioneered the mathematical concept known as 'game theory'. It would be a disservice to list Neumann's specializations, as Neumann's academic and professional career covered encompassed so much that, for all intents and purposes, the only truly accurate title to give von Neumann is polymath. Neumann, as a child, had shown signs of genius. Neumann's family reported that at 8 he would regularly converse in ancient Greek, memorize entire phone books for fun, and was able to perform numerous other impressive feats of cognitive discipline. Neumann's early childhood years in Hungary were mildly chaotic. For instance, his family had to flee Hungary to escape a short lived communist regime in 1919. Neumann was originally discouraged from pursuing a career in mathematics, as it wasn't considered a financially lucrative career. As a result, Neumann pursued a dual degree in chemical engineering and mathematics in 1925 at the Swiss Federal Institute in Zürich. Neumann subsequently earned a doctorate in mathematics at University of Budapest in 1926. Neumann had an extremely prolific career in the STEM community. Neumann worked with the likes of Niels Bohr, Erwin Schrödinger, and Werner Heisenberg. He had several works published covering topics such as quantum mechanics and axiomatic foundations for mathematics. Neumann's many exploits are legion, seeing as he contributed to every major mathematical discipline in some fashion save for topology (Poundstone, W. 2018).

Career

John von Neumann's career expanded beyond the typical mathematician. Neumann began his early career in teaching and research. The average annual for a present-day math professor is approximately $75,576 (Department of Defense). According to MyFuture.com, employment of math professors is expected rise by 13% from 2014 to 2024. A growth rate faster than average for all other careers. Neumann was also personally recruited by J. Robert Oppenheimer to work on the Manhattan Project (Poundstone, W. 2018). The salary for the Manhattan Project is vague at best. The closest comparison would be federally contracted nuclear engineers and physicists. FederalPay.org states that the average median salary for a federal nuclear engineering specialist is approximately $135,000, with a stable job outlook (2018). The number of jobs similar to a mathematician is extremely varied, which is reflected in Neumann's impressive resume. Every company from insurance firms to federal agency require the invaluable expertise of mathematicians.

Use of Mathematical Models in Research/Publication

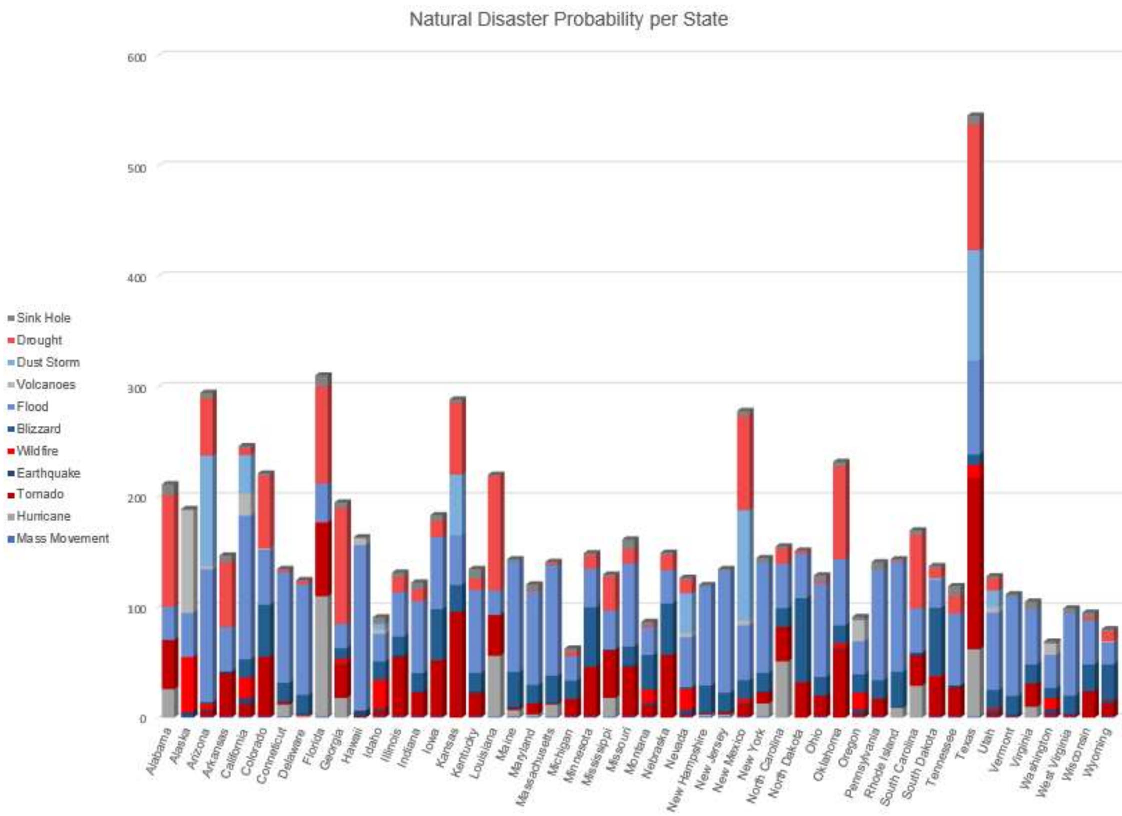
Neumann spearheaded the mathematical concept of game theory, which was used regularly during the data analysis portion of the research paper. Though game theory was by no means the most prominent mathematical contribution Neumann had made, considering the part he played in projects on the level of the Manhattan project, however game theory is a powerful tool utilized by social engineers, economists, psychologists, philosophers, and anthropologists the world over. Game theory, simply put, is the process where individual participants, known as 'players', make decisions independently of each other, and each player is expected to form their own strategy in an effort to find the most optimal outcome. The desired outcome can be a mutually beneficial dialect, or it can be at the expense of another player. This concept of independently deciding whether the desired outcome should benefit the individual or the whole is the prototype for the game theory concept of zero-sum and nonzero-sum outcomes. Game theory can be, and has been, translated to pure mathematical data. In certain situations, such as warfare or business competition, humans follow repeated patterns. When a player recognizes said patterns, they can then make predictions and proactive decisions based on the predicted outcome. This research paper employs a more intuitive approach to game theory, which is oftentimes the most prominent way game theory is utilized in the global theater (Poundstone, W. 2018).

A subcategory of game theory, evolutionary psychology, states that humans will instinctually calculate the risk/reward of every decision with the final goal of ensuring optimal genetic proliferation. In the case of this research paper, how prominent do the risks of natural disasters have to be to dissuade human habitation, and how little can the promise of reward be that humans refuse to settle an entirely safe region of the United States? Once the level of safety of each state has been identified, game theory then helps explain the patterns of human behavior with respect to each state.

Mathematical Model

This research paper employed a combination of game theory, probability, and proportionality/geometric similarity to determine the magnitude of the loss ratio of each natural disaster. The students involved with the research partitioned the data into two separate charts: probability and severity. The probability chart mapped the frequency of each natural disaster by state, thus offering a table of data to determine which areas have been historically affected the most by each disaster, and are consequently more likely to continue being affected by their respective natural disaster. Once each natural disaster was assigned a level of severity, this allowed the student researchers a rapid means in which to discern which natural disaster was the most destructive, and which one was the least destructive. The severity chart assigns a weighted loss value to each natural disaster. This allows the student-researchers to rank the natural disasters' level of danger as objectively as possible. The weighted loss value makes use of proportionality and geometric similarity. One of the world's most archaic and controversial questions are whether anybody can, or morally *should*, assign an objective value on human life. Philosophically, this question will more than likely never be answered. Analytically, however, researchers are required to assign some form of value onto human life to perform objective research into the risk/reward factors associated with civil engineering, geographical survey, and various other forms of industrial and entrepreneurship.

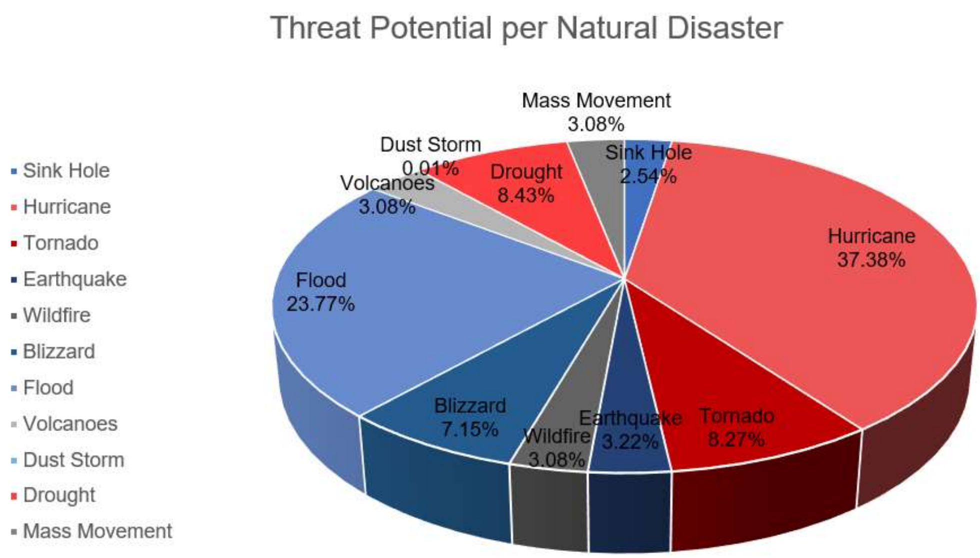
Coupled with proportionality and geometric similarity is the use of game theory. Game theory is oftentimes a little more abstract than simple mathematical procedure. Thus, the research team used the more psychological and social applications of game theory general reserved for the economic applications concerning zero-sumness and the emergent Darwinian paradigm of evolutionary psychology. Though game theory is rooted in mathematical procedure, the form used here was simplified to a more intuitive nature. The following chart represent the sum magnitude of destructive potential each state holds with respect to natural disasters.



(Colorado State University, 2018). (U.S. Tornado Climatology, 2010). (Federal Emergency Management Agency, 2018). (National Interagency Fire Center, 2017). (Coleman J.S.M., & Schwartz R.M., 2017). (The Weather Channel, 2016). (Pfeiffer, T., 2004a). (Pfeiffer, T., 2004b). (Pfeiffer, T., 2004c). (Williams, A., 2017). (Miskus, D., 2018). (Davies, W.E., 2004). (Metcalfe J., 2015).

For the sake of brevity, this research paper will default to the wisdom of the United States Military. The American military is an organization that is required to refine risk/reward factors concerning decisions that inevitability end in the fatalities of foreign and domestic nationals to an acceptable degree of objectivity, while still maintaining a modicum of metacognition that human fatalities of any capacity will always carry moral repercussions. With that in mind, according to 2014 iteration of the Servicemembers' Group Life Insurance (SGLI) policy, a human life is worth $50,000 increments not to exceed $400,000 (U.S. Department of Veterans Affairs, 2017). Money was assigned as the governing factor to determine the weighted value of loss with respect to a natural disaster. Money, by its very nature is an arbitrary manner in which to assign value to an object, service, or product. This arbitrary value is unanimously accepted by every official global organization as valid. Thus, this arbitrary value can, for all intents and purposes, be assigned to human life as well. The notion is by no means a popular one, however it is an entirely objective and effective notion. The two most prominent factors that determine the severity of a natural disaster are the loss of life and the loss of property. By ascribing to the notion that money assigns an arbitrary value on anything and everything life has to offer, including life itself, researchers can use money as the weight determining factor for varying degrees of loss.

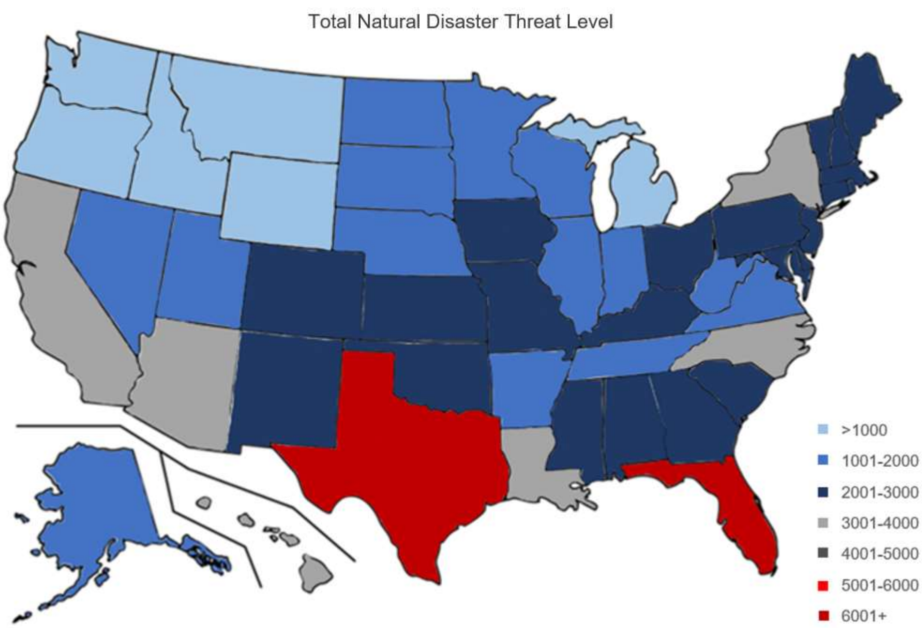
Assigning the SGLI range average of $250,000 as a standard in which to measure the level of loss during an event, researchers assigned to this project set a loss ratio designated with the variable l as property value p with respect to human value h. This can be expressed in mathematical notation as $lnet$=ph. As an example, if one individual is lost in a natural disaster, it can be annotated as $250,000 worth of damages incurred. Set to the previously derived loss ratio, this can be expressed as *l1*=ph=$250,000$250,000=1, with *l* being expressed as a dimensionless unit *a la* radians. A second example is then introduced with $125,000 in property damage incurred, expressed l2=$125,000$250,000=12. This yields the following equation lnet=l1+l2=1+12=32.Which yields a loss factor of 32. The final decision on what is considered the most severe natural disaster, and what is the least severe natural disaster, is based off the magnitude of the loss factor each natural disaster was rated, after careful dissemination of a combination of loss of life and loss of property. Each natural disaster is then rated on a scale from 1 to 100. This chart shows the break down of the disasters.



(Borden, K.A., & Cutter, S.L., 2008).

Severity is only one aspect of a natural disaster's destructive potential. The second factor is being used to weight an area's destructive potential. The second mathematical tool utilized was the probability model. The probability of the natural disaster occurring is just as important as the level of destructive caused. Frequency helps map out an area's destructive potential. If an area experienced one catastrophic natural disaster, but nothing else for thirty years with nothing else predicted to happen for another thirty years, then the respective area is objectively safer than an area that frequently experiences the same natural disaster on a smaller level. The latter has more destructive *potential*. Each one of the hypothetical second area's natural disasters has the potential to be just as catastrophic as the natural disaster that affected the hypothetical first area. The research team addressed each state individually, and mapped how frequently each natural disaster happens in each state. This provided the research team ample enough information to predict which states had been the most susceptible to natural disasters, and which ones continued to be struck by them. Taking the frequency each natural disaster occurred while keeping in mind the natural disaster's threat vector was how the research team weighted each state's level of danger. Each state presented its own unique threat; however, the combination of frequency and loss factor provided an objective portrait deciding which state was more dangerous than the next.

If point A experiences a higher frequency of natural disasters that individually rated higher on the loss rating scale than point B experiences, then point A has more destructive potential than point. By this logic, point A would then be compared to point C, and so on. Once the research team had finished evaluating every possible comparison of each state, the team was able to identify which state had the highest destructive potential, and which state had the least destructive potential. This map depicts each states potential disaster level with respect to its threat vectors.



Finally, through predictions based on game theory, the researchers then used past patterns in quality of life and the economic history of Michigan to determine why individuals don't all move to Michigan. Considering that Michigan has a poverty level of 15% when compared to the 12.7% average poverty level, is home to some of the most notorious cities in the nation such as Detroit and Flint, and has seen consistent economic decline since General Motors had left during the infamous 'Decline of Flint', it is highly unlikely that American citizens will be flocking to Michigan anytime soon (Guest, G. & Wadley, J. & Kerecman, K. 2017). In fact, analyzing human migratory patterns in the Michigan area since it began its decline, more inhabitants emigrate *from* Michigan instead of immigrating *to* Michigan (Tanner 2016).

Thesis Defense

With respect to natural disasters, Michigan is the safest area to live. The number of natural disasters that affect Michigan are negligible at best, when compared to the average number of natural disasters affecting other states in the nation. Michigan has an average of sixteen tornadoes annually, low frequency of floods, and was at negligible risk for any other major natural disaster. The only natural disasters that appeared to be comparable in Michigan with respect to the rest of the United States are blizzards. The frequency of blizzards, however, was no more or less severe than the national average. Michigan didn't experience nearly as many blizzards as Montana, Colorado, or North Dakota. Regardless of the frequency of blizzards experienced, the calculated loss rating of blizzards is miniscule at best. Blizzards only accounted for 7% of the total destruction wrought by natural disasters since 1970. Region 5 of Michigan had proven to be the safest area Michigan had to offer, with respect to natural disasters. Region 5 only experiences one tornado annually on average and has been subject to only a single destructive flood since 1970. There were no other natural disasters that occurred during this region on record since 1970. Region 5 is, for all intents and purposes, the safest area in the United States. So why doesn't everyone flock to Michigan and try to set up a new life in the southwestern area of Michigan?

(American Nurses Association, 2018)

Answering the question as to why everyone doesn't live there requires the research paper to address issues wholly unrelated to natural disasters. Michigan maintains a powerful notoriety where quality of life is concerned. Flint's lead poisoning crisis has been affecting the residents of Flint, and the areas surrounding Flint, since the state of Michigan seized control of Flint's budget in 2011. The government seizure of Flint is a direct result of Michigan's increasing poverty levels. Michigan has a poverty level of 15%, slightly higher than the national average of 12.7% (Guest, G. & Wadley, J. & Kerecman, K. 2017). Following the collapse of the automotive industry in Michigan, the industrial network in Michigan cities saw a rapid and unforgiving decline. This led to the infamous 'Decline of Detroit', and the birth of one of the most dangerous and crime ridden areas the United States has to offer. The urban blight and rapid decay in economic opportunities don't offer much incentive for individuals to move to Michigan. Additionally, Region 5 of Michigan is in close proximity to Chicago, yet another one of America's most notorious cities. Conversely, Texas had proven to be the single most dangerous state of the United States to live with respect to natural disasters. However, Texas had a booming agricultural and STEM field, which is represented with the advent of universities such as Texas Agriculture & Mechanics. The economic and bureaucratic allure of Texas is so powerful that NASA's Christopher C. Kraft Jr. Mission Control Center, one of NASA's most iconic command centers, is located in Houston. The average salary of mechanical engineers in Texas is $91,710, the fifth highest in the nation by state, which is substantially higher than the $86,550 yearly salary in Michigan, which is rated 21st in the nation for mechanical engineers (Sokanu 2018). While not necessarily backed by science, a more visceral demonstration of the dichotomy between living in each state can be found in the pride of each state's citizens. There are few anecdotal stories of a Michigan resident talking about how proud they are to live in Michigan, however there are quite a few anecdotal stories of Texans proudly announcing how proud they are of Texas.

Robert Wright speaks of the nature of the zero-sumness in his book, *The Moral Animal* (1994). The new paradigm of Darwinian psychology is a fledgling, and oftentimes unpopular branch of psychology, however it offers a more emotionally detached explanation of why humans behave the way they do. Throughout Robert Wright's book he constantly stresses that humans will forgo the threat of bodily harm if it means an increased chance at genetic proliferation (p. 157). The blatant disregard for safety in the face of economic growth appears in the case of natural disasters appears to support that claim. Game theory also speaks on the matter of intelligent competition through constant reference to the zero-sum nature of mankind. The zero-sumness of man ensures that people generally find a way to capitalize on situations even if it proves to be at the expense of their peers. Mother Nature is only a deciding variable in game theory if the risk outweighs the reward. Even though no businessman or fledgling entrepreneur could hope to 'get one over' on Mother Nature, those same businessmen and entrepreneurs could maximize risk/reward payout. Michigan might be safer with respect to natural disasters, however Texas is more conducive with respect to game theory.

The original hypothesis the research team proposed that economic opportunities and financial responsibilities would outweigh any exterior threat had proven entirely to be true. The most economically feasible nations in the United States are often the most at-risk for natural disaster, yet these areas continue to increase in population and see increased urbanization than several 'safe' states such as Michigan. Perhaps Michigan was originally chosen by the automotive industry because it was safe and uneventful, however it became notorious for the way the economic collapse affected its citizens, not for its weather safety. However, if an individual expressed that they wished to reside in the safest region from natural disaster in the United States, it would serve them just right to point them in the direction of Michigan's Region 5.

References

American Association of Geographers. (2014). Nominating Committee. April 15, 2018 from, http://www.aag.org

American Nurses Association. (2018). ANA-Michigan Regions. [Regions of Michigan]. Retrieved April 15, 2018 from, http://www.ana-michigan.org

Ball State University. Board of Trustees (2014) 2014-2015 Ball State University salary report. Retrieved April 15, 2018, from http://libx.bsu.edu/

Borden, K.A., & Cutter, S.L. (2008 December 17). Spatial Patterns of Natural Hazards Mortality in the United States. Retrieved April 15, 2018, from https://ij-healthgeographics.biomedcentral.com

Coleman J.S.M., & Schwartz R.M. (2017 January 11). An Updated Blizzard Climatology of the Contiguous United States (1959–2014): An Examination of Spatiotemporal Trends. Retrieved April 15, 2018, from https://journals.ametsoc.org

Coleman, J. (2018). Jill Coleman. Retrieved April 15, 2018, from http://cms.bsu.edu Colorado State University. (2018). 2018 Tropical Meteorology Project Forecast Schedule. Retrieved April 15, 2018, from https://tropical.colostate.edu/

Davies, W.E. (2004). Engineering Aspects of Karst. [Karst Map of the United States]. Retrieved April 15, 2018 from, https://pubs.usgs.gov

Department of Defense (n.d.). Geography Teachers, Postsecondary. Retrieved April 15, 2018 from, https://www.myfuture.com

Department of Defense (n.d.). Mathematical Science Teachers, Postsecondary. Retrieved April 15, 2018 from, https://www.myfuture.com

Federal Emergency Management Agency. (2018 April 12). Earthquake Hazard Maps. Retrieved April 15, 2018, from https://www.fema.gov

Federal Pay (2018). Pay Rates for "Nuclear Engineer". Retrieved April 15, 2018, from https://www.federalpay.org

Guest, G. & Wadley, J. & Kerecman, K. (2017 December 21). New map offers snapshot of poverty, well-being in Michigan. Retrieved April 15, 2018, from http://ns.umich.edu

King, H. M., Ph.D., (2018). Homeowners Insurance Does Not Cover Many Types of Damage. Retrieved April 15, 2018 from, https://geology.com

Kost, M.A.,Albert, D.A.,Cohen, J.G., Slaughter, B.S., Schillo, R.K., Weber, C.R., & Chapman, K.A. (2014 November 26).Michigan's Natural Communities. Retrieved April 15, 2018 from, https://mnfi.anr.msu.edu

Livingston, I. (2012 April 10). Violent F4/EF-4 and F5/EF-5 Tornadoes in the United States since 1950. Retrieved April 15, 2018, from http://www.ustornadoes.com

Metcalfe J. (2015 April 21). The Deadly Geography of Landslides. Retrieved April 15, 2018, from https://www.citylab.com

Miskus, D. (2018). U.S. Drought Monitor Change Maps. Retrieved April 15, 2018, from http://droughtmonitor.unl.edu

National Interagency Fire Center. (2017). Fire Info Stats. Retrieved April 15, 2018, from https://www.nifc.gov

National Public Radio. (2012 July 18). Interactive: Mapping The U.S.. Retrieved April 15, 2018, from https://www.npr.org

National Oceanic and Atmospheric Administration. (2016 May 13). Summary of Natural Hazard Statistics for 2011 in the United States. Retrieved April 15, 2018 from, http://www.nws.noaa.gov

National Oceanic and Atmospheric Administration. (2016 May 13). Summary of Natural Hazard Statistics for 2012 in the United States. Retrieved April 15, 2018 from, http://www.nws.noaa.gov

National Oceanic and Atmospheric Administration. (2016 May 13). Summary of Natural Hazard Statistics for 2013 in the United States. Retrieved April 15, 2018 from, http://www.nws.noaa.gov

National Oceanic and Atmospheric Administration. (2016 May 13). Summary of Natural Hazard Statistics for 2014 in the United States. Retrieved April 15, 2018 from, http://www.nws.noaa.gov

National Oceanic and Atmospheric Administration. (2016 May 13). Summary of Natural Hazard Statistics for 2015 in the United States. Retrieved April 15, 2018 from, http://www.nws.noaa.gov

Pfeiffer, T. (2004). Volcanoes of Alaska & Aleutians (93 volcanoes). Retrieved April 15, 2018 from, https://www.volcanodiscovery.com

Pfeiffer, T. (2004). Volcanoes of Canada and USA (mainland). Retrieved April 15, 2018 from, https://www.volcanodiscovery.com

Pfeiffer, T. (2004). Volcanoes of Hawai'i. Retrieved April 15, 2018 from, https://www.volcanodiscovery.com

Poundstone, W. (2018). John von Neumann. Retrieved April 15, 2018 from, https://www.britannica.com

Sokanu. (2018). Mechanical Engineer Salary. Retrieved April 15, 2018, from https://www.sokanu.com

Tanner, K. (2016 December 20) Michigan's population increased for the fifth straight year in 2016. Retrieved April 15, 2018, from https://www.freep.com

The Weather Channel. (2016 August 3). Where Flooding Has Been Most Frequent in the U.S. Retrieved April 15, 2018, from https://weather.com

U.S. Bureau of Labor Statistics (2018 March 30) Occupational Employment Statistics. Retrieved April 15, 2018, from https://www.bls.gov

U.S. Department of Veterans Affairs. (2017 December 11). Servicemembers' Group Life Insurance (SGLI). Retrieved April 15, 2018 from, https://www.benefits.va.gov

U.S. Tornado Climatology. (2010). Retrieved April 15, 2018, from https://www.ncdc.noaa.gov

Williams, A. (2017 June 9). Are more dust storms in the southwestern US causing a spike in valley fever cases?. Retrieved April 15, 2018 from, https://www.accuweather.com

Wright, R. (1994). *The Moral Animal. Why We Are the Way We Are: the New Science of Evolutionary Psychology*. New York City, NY: Vintage Books.