Mathematical Association of America
Golden Section (Northern California, Nevada and Hawaii)
Saturday, February 29, 2020
Mills College
STUDENT POSTER SESSION ABSTRACTS

Title. *Polyhedral Symmetry from Ribbons and Tubes*

Author. Wilder Boyden, Santa Clara University

Faculty sponsor. Dr. Frank Farris, Santa Clara University

Abstract. Shapes with polyhedral symmetry appear frequently in art, design, mathematics, and in the natural world. Our work focused on creating polyhedral symmetry from a collection of bands arranged in space, using parametrized surfaces, linear algebra, and group theory. To classify all such possible shapes, we investigated each subgroup of the three polyhedral groups - tetrahedral, octahedral, and icosahedral. By starting with a single band invariant under a given subgroup, we used the technique of coset averaging to duplicate and place that band to build a shape invariant under the entire group. Each band enjoys a multi-parameter design space, allowing readers the freedom to create diverse and beautiful examples. We comment on our artistic process, which guided how we chose to model, decorate, and display these shapes.

Title. *Pattern of the Last Digits of Consecutive Primes*

Author. Kate Johnson, Sacramento City College

Faculty sponsor. Dr. Ling Huang, Sacramento City College

Abstract. Prime numbers, their distribution, consecutive primes, the distribution of pairs of consecutive primes are of great interest. Lemke Oliver and Soundararajan (2016) describe the unexpected biases found in the distribution of consecutive primes. The authors use the first 100 million primes to calculate the number of primes up to x lying in the residue class $\underline{a} \pmod{q}$. In my poster I explore these biases and discuss their unexpectedness as it relates to the residue class ($a = \{1, 3, 7, 9\}$, $b = \{1, 3, 7, 9\}$; modulo 10). I present my results for various sets of consecutive primes and examine the unexpected trends found of these biases as x increases.

Title. *Decay of Solutions to the Inhomogeneous Wave Equation in a Cosmological Spacetime*

Author. Branndon Mariscal, Sonoma State University

Faculty sponsor. Dr. Jesus Oliver, California State University, East Bay

Abstract. Einstein's theory of general relativity revolutionized the way we think of space and time. On large scales we can think of space and time uniformly, thus giving birth to a spacetime. Cosmological spacetimes have been of great interest as they reveal information about the dynamics of the fabric of our universe. Studying the wave equation in a cosmological spacetime is one method for gaining insight into the behavior of the spacetime. We consider the Cauchy problem for the inhomogeneous wave equation in a cosmological spacetime. We take a vector field approach to construct an energy. We then establish a partial energy and with an iteration scheme, we achieve a decay result for the time derivative of solutions. Our work aims to extend the results of Costa J.L. et. al. (2019). We have partial results in this direction. This ongoing work is supported by the McNair and LSAMP program at Sonoma State University.

Title. *Blow up of Nonlinear Wave Equations in Cosmological Spacetimes*

Author. Gregory Mwamba, California State University, East Bay

Faculty sponsor. Dr. Jesus Oliver, California State University, East Bay

Abstract. In this work we examine smooth solutions to $\Box_{RW}\phi + f(\phi) = 0$, the nonlinear wave equation in cosmological spacetimes, where $\Box_{RW} = -\partial_t^2 - nqt^{-1}\partial_t + t^{-2q}\Delta$, is the wave operator on a Robertson-Walker (cosmological) spacetimes of dimension n, i.e. an expanding universe, and $0 \leq q \leq 1$. In particular we investigate and characterize under which conditions such smooth solutions blow up. An interest in studying these solutions is the fact that they can be used to model light waves as they propagate in an expanding universe. We currently have partial results. This work was supported by the California State East Bay Center for Student Research Program (CSR) and Louis Stokes Alliances for Minorities Participation (LSAMP).

Title. *Student Attitudes in First-Year Mathematics Courses*

Author. Stephanie Tran, California State University of Monterey Bay

Faculty sponsors. Dr. Alison Lynch and Dr. Alana Unfried, California State University of Monterey Bay

Abstract. At the beginning of Fall 2018, California State University (CSU) eliminated remedial mathematics courses that did not count for college credit. The problem with these courses was that they brought down the students' self-esteem, did not count for college credit, and delayed students' time to graduation. Upon eliminating these courses, students can now take CSU general education (GE) mathematics courses directly, gaining skills and college credits needed for graduation. After moving away from remedial mathematics courses, CSUMB's Mathematics and Statistics department wants to better understand student attitudes in GE mathematics courses. To do this, the department distributed the Attitudes Toward Mathematics Inventory (ATMI) in Fall 2018 and Spring 2019 to students in Precalculus, Finite Mathematics, and Quantitative Literacy. The ATMI instrument focuses on four constructs: self-confidence, value, enjoyment, and motivation. Each student was expected to take the ATMI survey at the beginning (pre) and at the end (post) of the math course. In this project, we created graphics and summary statistics to summarize the results for each construct based on class and term. The exploratory data analysis used includes violin boxplots, histograms, and scatterplots to compare the pre and post scores for each student. Based on the results, the histograms for the pre and post difference follows a normal distribution with a mean near zero. This indicates that a similar number of student scores increased and decreased on each construct over the course of the semester. On the contrary, student value of mathematics tended to remain the same or increase over the semester.

Title. *High School Student Health and Wellness Survey*

Authors. Yiwen Yang, Boston University; Zhuotong Xian, Los Gatos High School; Serena Mao, Mission San Jose High School; Haiyang Luo, Penn State University

Faculty sponsor. Dr. Xiaoyan Liu, University of La Verne

Abstract. Youth depression has always been a serious topic of discussion, especially in recent years. Factors like stress and anxiety may impact the mental health of youth more than other age groups, and scientific studies have confirmed that an increase in stress can lead to lower life expectancy and increasing risk for mental illnesses, not to mention the many students that commit suicide due to depression each year. Thus, it is crucial to understand the underlying mechanism of depression from the perspectives of teenagers. This study aims to identify factors that could potentially lead to depression for high school students. With professional assistance, we designed a 25-question online

survey about a participant's mood and stress level, and whether they experience symptoms related to depression. The participants, mainly from the population in the Bay Area in California, with a small portion of online participants from all over the US, filled out the survey and data is collected. The data was analyzed with some statistics tools. The results of this investigation show a high correlation between the amount of resources available and the level of stress with depression rates. In the end, this study strives to help youth by understanding stress and mental health and actively engaging in the conversation of improving educational policies to reduce depression rates in youth.

Title. *Applying Mathematical Modeling on Global Climate Change*

Authors. Alice (Jiaying) Zhong, Carlmont High School; Will (Peihong) Wu, Valley Christian High School; Zeru Li, Saratoga High School; Cindy (Jingru) Wang, Palo Alto High School

Faculty sponsor. Dr. Xiaoyan Liu, University of La Verne

Abstract. Modern climate change dominated by human influences is now large enough to exceed the bounds of natural variability. Caring the curiosity, our team has applied mathematical models to find the correlation between the CO2 expressed as a mole fraction in dry air and time in years. Based on the data from the NASA Global Climate Change website, using two regression models, comparing and contrasting the results from each model, we concluded that as time increases, the mean of CO2 expressed as a mole fraction would constantly increase as a quadratic function. In addition, we predicted that there is a high possibility that the mean of CO2 expressed as a mole fraction would be approximately 497.3 in the year 2050, which is increased by a factor of 58% from the CO2 level in 1959. It might cause a substantial increase in temperature since CO2 is a vital factor in rising of average temperature. We believe this is significant because if society doesn't act towards this global change, we might all die on this beautiful planet. It is our responsibility to pass the two hundred thousand years of human civilization that our ancestor has created for us to the future generations. Starting today, we think everyone should use the limited power that we have, to change and fix the damage we have made on this planet.
