A low-cost alternative for diagnosing scoliosis using computerized technologies
Katarina Costa, Amber Ann Thompson, Samantha Thompson

Abstract: Scoliosis is a disease defined by excessive lateral curvature of the spine. Diagnosis is traditionally diagnosed and monitored by manually measuring the (Cobb) angle formed by endplates of the most tilted vertebrae on an x-ray of the patient's back. While this is a simple and effective method of diagnosis, it does have drawbacks: There are often large variations in measurement between clinicians, large doses of x-ray exposure are necessary to get sufficient resolution, and adequate equipment is not available in some parts of the world. AI programs trained to segment the spine and automate measurement of the Cobb angle has been proposed as a way to reduce measurement error and possibly reduce the need for high dose x-rays. We propose an alternative using markers along the patient's back, locating spine through palpation. The Cobb angle is then approximated by extracting locations of the markers from a photograph of the patient's back using computer graphic and curve fitting techniques. We are currently In the process of validating an implementation of this with the goal of building a phone app that can be safely and inexpensively used to diagnose scoliosis.

A Sufficient Condition for Blowup of the Nonlinear Klein-Gordon Equation with Arbitrarily Positive Initial Energy in general FLRW Spacetimes
Gregory Mwamba

In this work we examine smooth solutions to $\Box_g u - m^2 u = f(u)$, the nonlinear Klein-Gordon equation with arbitrarily positive initial energy in general Friedmann-Lematre-Robertson-Walker spacetimes, where $\mathbf{g} := -dt^2 + a(t)^2(dx_1^2 + dx_2^2 + ... + dx_n^2)$, is the metric. In particular we demonstrate a sufficient condition for blowup for an open set of (large) initial data with arbitrarily positive initial energy. An interest in studying these solutions is the fact that they can be used to model particles as they propagate in an expanding universe. This work was supported by the California State East Bay Center for Student Research Program (CSR) and Louis Stokes Alliances for Minorities Participation (LSAMP).

How a Global Pandemic Changed Students' Perspectives in Undergraduate Mathematics Courses
Amber McNeill

While there is no overstating the shared impact the Covid-19 pandemic has had on us all, a unique opportunity for mathematics education researchers has presented itself. In this research, as part of the national SEMINAL Research Project, we explore qualitative data collected from all students in Precalculus, Calculus I, and Calculus II at CSU East Bay in the two semesters leading up to the start of the pandemic (Spring and Fall 2019), and two semesters after the start of the pandemic (Fall 2020 and Spring 2021). The research question I will be addressing is: How, if at all, did students' answers change in response to the pandemic (and being forced into online instruction), and how can we as a mathematics department at CSUEB use this information to improve student engagement, success, and retention in STEM Pathway courses? Results are presented with possible interpretation of the results. This work was supported by the SEMINAL grant and by the CSUEB Center for Student Research.

Replicating the Stradivarius
Bryan Liu

Stradivarius violins are some of the most expensive and sought-after violins in the world due to their rarity, name, and perhaps most importantly, the sound it produces that is thought to be irreplicable. Scientific knowledge of sound and tone production has long matured since Stradivarius violins were created three centuries ago. Mathematical evidence from this study paired with knowledge on violin-crafting imply it may be possible to counterfeit a very close replica of the legendary Stradivarius violin.

SEAIRV Model of COVID-19 for Sonoma State University
Serina Cabrera

A simplified differential equations-based model for Covid-19 infection on a closed population of students, faculty, and staff at Sonoma State University (SSU) in Rohnert Park, CA is proposed. Positive cases at SSU were tracked and a visualization of the prevalence of Covid-19 over the Fall semester was created. An SEAIRV model which includes both vaccinated and unvaccinated individuals, as well as, asymptomatically and symptomatically infected individuals in proposed. Simulations were conducted in R to explore the effectiveness of higher or lower vaccine uptake in the SSU community. Continued use of masks and social distancing is recommended and increasing the proportion of vaccinated individuals on campus to 100%, which is a stated goal of the university, would serve to reduce the total number of cases in the population.

American's incapability in paying off national debt
Wendy Wang

As one of the most important public policy issues, national debt has played a significant role in fostering the long-term growth and prosperity of a country. However, as the US keeps borrowing money from the public, the rate of growing of national debt gradually exceeded the rate of growing of annual GDP, which is widely used to determine the size of an economy. Then the rate of growing of the overall economy is negative. It is reasonable to be concerned about whether the US will be unable to pay off their debt one day. In this research paper, the growing of both national debt and GDP are modeled, and used to determine in which year, the US may experience another economic recession.

Applying Mathematical Modeling on Analysis of Changing Factors of Global Climate
Kevin Gong, Owen Ouyang, Yisha Tang, Andy Dai

It was not grandiloquent to state that the natural environment propelled human prosperity is at the imminent edge of a significant turning point. As a group of high school students, we have collected data on annual fossil fuel consumption, the statistics of global Carbon dioxide emissions, and rise in temperature as well as sea-level rising data from authoritative organizations, applied regression models, affirming the proliferating fossil fuel consumption as major causation of global warming. By using our model, we can predict the average temperature in 2050, will be 1.595, 50% greater than the average temperature now. Overall, it was clearly that the environment of our planet had reached a critical moment when disruptive transitions were desperately needed. In conclusion, our group contribute pragmatic suggestions to optimize the situation.