SIGMAA Sports News

Spring 2018

Upcoming events:

- On April 13-14, John David (Virginia Military Institute) will be conducting a short presentation about the SIGMAA on Mathematics and Sports at the VA/MD/DC MAA Section Meeting.
- Drew Pasteur (The College of Wooster) is on the organizing committee for the Fields Sports Analytics Workshop:
    - http://www.fields.utoronto.ca/activities/17-18/sports_analytics

Fields Sports Analytics Workshop

May 24 - 25, 2018, The Fields Institute

The Fields Sports Analytics Workshop is a two day workshop focused on current methods, practices, and research in the increasingly popular area of sports analytics. The topics of the workshop will include the use of analytics on both the on-field performance as well as the business side and fan engagement.

An important aspect of this workshop is to shine a brighter light on the role that advanced mathematical, statistical and computer science methods play in this area both now, and in the future. The major objectives of the workshop are to:

1. Disseminate the latest results and state of the art mathematical, statistical and computer science methods from researchers to academics, students, and especially to teams and industry
2. Communicate past work, types of data, challenges, and insights from the sports industry community to gathered researchers
3. Highlight the role that sophisticated analytical methods will likely play in the sports industry in the near future
4. Encourage and inspire students and other researchers to find new and innovative ways to apply the latest mathematical, statistical and computer science methods to the sports industry
5. Provide pathways for industry and researchers to utilize funding organizations to financially support future research, employment opportunities and internships

Letter from this issue's editors

Thank you all for your interest in mathematics and sports and being part of our MAA SIGMAA Sports community. Anyone who is interested in submitting a contribution for the next issue is welcome to email us at dcheng@towson.edu and tberezov@sju.edu.

~ Diana Cheng (Towson University) & Tetyana Berezovski (St. Joseph's University)

LEWIS UNIVERSITY

“Applying Linear Algebra to Sport Analytics”

Ranking sports teams can be a challenging task and using straight win percentage can be misleading at times. Among the many mathematically inspired sports ranking systems, the Massey and Colley methods are among the most elegant and simple. Both involve setting up and solving a matrix system. While at their most basic level, these methods are useful for sports rankings, unfortunately, they are not particularly strong at predicting future outcomes of games. One way to improve these methods for ranking and predicting future outcomes is by introducing weights to these systems. This research involves collecting sports data, and adding and testing features and weights to modified Massey and Colley methods. This research also often involves writing programs to construct huge systems of equations, so some programming experience is helpful, but my no means necessary.

- Dr. Amanda Harsey, Assistant Professor in the Department of Computer and Mathematical Sciences at Lewis University

2018 Joint Mathematics Meetings reflections from undergraduate students

Dr. Harsey’s undergraduate students, Carley Maupin and Marissa Koronkiewicz, spoke at the 2018 Joint Mathematics Meetings MAA Session on Mathematics and Sports. Their talk was entitled, Predictive Modeling and Analysis of Golf and Softball Teams Using Linear Algebra,” and their reflections on their experiences are below.

Marissa Koronkiewicz’s reflection

I was looking to get more involved in academia outside of my courses when Dr. Harsy happened to reach out to me about a research project relating to her linear algebra course. Two other students were already involved and planning to work on it over the fall semester, and I thought it would be a great opportunity for me to join them. One concept in linear algebra included different methods of ranking sports teams, which is how we chose to apply the Massey Method to a set of golf tournaments to determine how the individual players' scores affected the teams' rankings. I was not familiar with the structure of golf before our research at all, but working with students who are on the golf team helped to sort out any confusion.

The most difficult part about the actual presentation aspect of our research was trying to encompass all of our work within a single poster or talk. It was challenging to provide just enough detail so that our project could be easily understood, but not too much so that I exceeded the allotted time. Overall, I enjoyed the research project because it directly applies to our school and the sport that my research group loves. This research could also apply to a variety of other sports, which opens a path to several combinations of different factors and weights that affect sports rankings that we and other students may not have considered.

Carley Maupin's reflection

I initially decided to begin participating in Lewis University's Summer Undergraduate Research Experience program after I was asked to work on a project under the mentorship of my Applied Linear Algebra professor. She encouraged me to take my mathematics knowledge to the next level by applying my skills to a research project. I built upon linear algebra classwork to extend to this project – I could rank sports teams using a ranking system called the Colley Method. It involves setting up and solving a matrix system, while also adding weights. The project I worked on with my mentor allowed me to create and test the predictive power of the weighted Colley Method using data from softball teams in the Great Lakes Valley Conference; specifically, I tested whether past and present season results would transfer to the post-season conference tournament and beyond. The project was carried out in a MATLAB program, but it is an original research project.

Since I am a member of the women's softball team at Lewis University, I was able to provide much of the knowledge needed for the project. The outside sources my mentor and I used on the project were in the data analysis and computer science field. The challenges we faced throughout the project were in the programming portion, but it was a learning process, and the challenges certainly helped me learn how to code in MATLAB and how to look explore the data in new ways. I also faced the challenge of only having one set of season data to work with. It would have been ideal to have at least two seasons of data, but that only gives me more excitement to look forward to the data we collect from the upcoming 2018 season.

For other undergraduate students, I would encourage you to further your passion for mathematics by engaging in a summer research project. You will learn about new ways to apply mathematics to the real world, and you will learn the material in great depth. There is so much more to explore beyond the classroom. And, of course, the relationships you build with those you are working together with are for a lifetime. You will share this once-in-a-lifetime experience with other undergraduates, and it will be unforgettable. A summer research project will open many doors of opportunities for internships, careers, graduate school, and beyond. Imagine the possibilities, and you can reach those goals by simply taking the initiative to participate in a summer research experience.

High School Teacher's reflection on implementation of a figure skating related activity in his classroom

By David Thompson, Baltimore City Public Schools high school mathematics teacher

Reference: "Double the fun: Pairs skating jumps," by Diana Cheng and undergraduate student Maura Twillman in the January/February 2018 issue of Mathematics Teacher, Vol 111, No. 4, pp. 249-253.

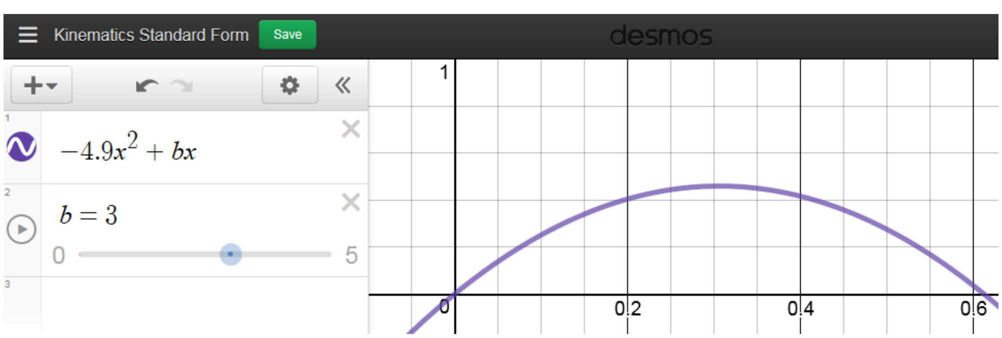
[portions of this article and reflection were presented at the 2017 Joint Mathematics Meetings – Math and Sports session]

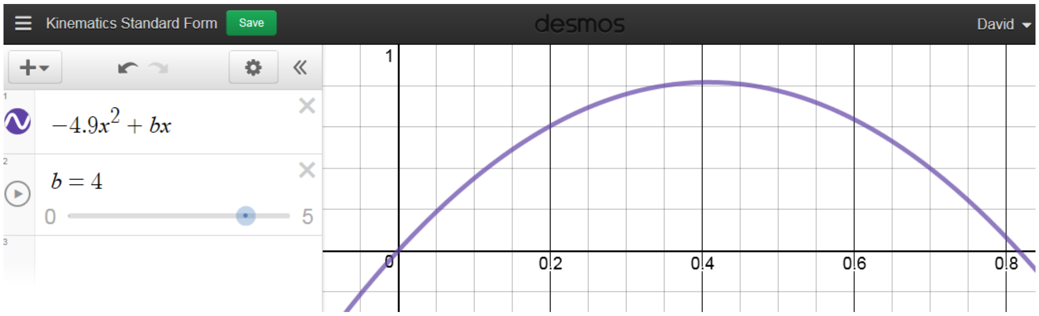
We used problems about side-by-side pairs skating jumps [problems 4, 5, and 6 from the article, page 250] in an 11th grade Honors Algebra II class at the end of a unit on interpreting linear, quadratic, and exponential functions. The class was 75 minutes long. None of the students were figure skaters, but many had seen figure skating on television and were enthusiastic about using a real-life situation to which they could apply their knowledge of quadratic functions. In our high school's science curriculum, physics is normally taken in the 12th grade, so the students did not yet have prior exposure to the kinematics equation discussed.

When solving the problems, we had to continually help the students notice the relationship between the functions and the context, and to interpret what the graphs meant in this context. For example, one of the students thought that the intersection of the two skaters' graphs was the "starting point." Since this response lacked precision, we are not sure if this meant that the two skaters began their jumps at the same spot on the ice, or whether the skaters started at the same vertical height and at the same time. Another student wrote that the intersection is "when the skaters jump at the same time," which only considered the independent variable of time but did not consider the dependent variable of height.

I also wanted to be able to help students to qualitatively explore the effect of a skater's initial velocity as it relates to the graph of this trajectory. Below is a Desmos tool that I created to help with this exploration, as well as screen shots depicting two different initial velocities.

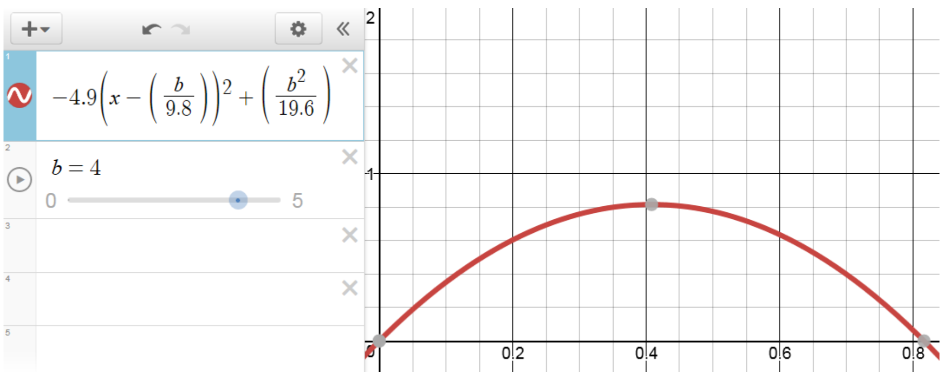
https://www.desmos.com/calculator/lnesgvmje5

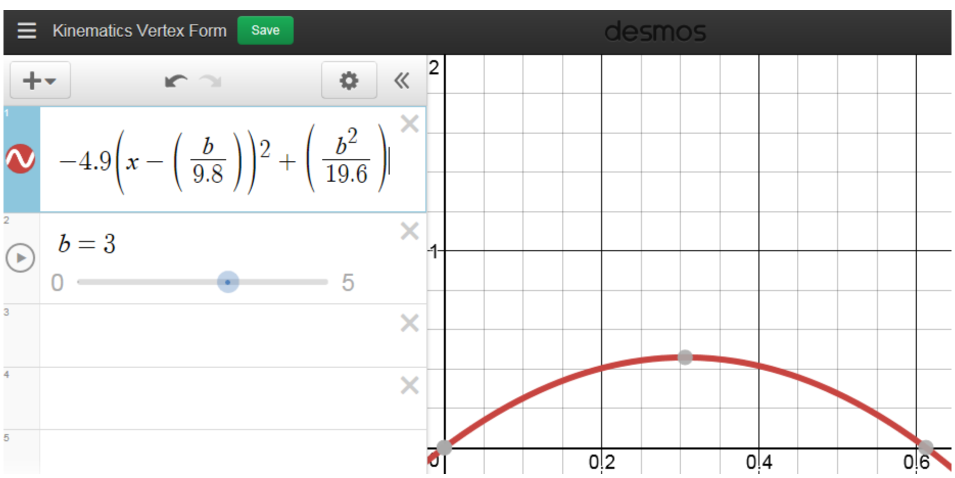




Alternatively, we can also write the kinematics equation in its equivalent vertex form and the below Desmos site can help with students' explorations.

https://www.desmos.com/calculator/c6clj4cm9m





As a follow-up activity, if we had more time, students could examine videos of pairs side by side jumps and describe the skaters' heights using the equations in this activity. For instance, students could use a stopwatch while watching a video to find out how much time skaters were in the air, and use that information to determine the skaters' heights at the apexes of their jumps and their initial vertical velocities.