Sports SIGMAA

Mathematics and Sports MAA Special Interest Group

Supporting, encouraging, and disseminating interests in connections between mathematics and sports

Winter 2019 Newsletter

Sigmaa.maa.org/sports

Student Spotlight

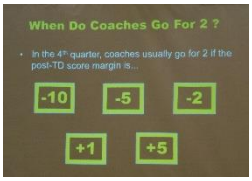
Ryan Orphan of University of Ahwai'i-West O'ahu presented his work on connections between teams who are NCAA men's basketball conference champions and March Madness tournament winners at JMM 2019. Ryan and his faculty advisor Michael Furuto found that there is a statistically significant difference between the advancement of the conference champions over the non-champions. This work has helped students have a renewed interest in mathematics by connecting data analytics to college basketball.

Nominate a K-12 Educator!

Nominate an outstanding K-12 teacher or coach who has made contributions related to Mathematics and Sports. Nominations are due July 24, 2019 and winners will be announced at the 2019 Math Fest in Cincinnati, OH.

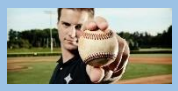
Recent Events

The Mathematics and Sports Session of the 2019 JMM in was a big success! With over 20 talks covering topics from basketball and football to gymnastics and figure skating, it was a great session thanks to the on-going work of organizers Drew Pasteur and John David.



Upcoming Events

Saturday, April 13, 2019
Carolina Sports Analytics Meeting
Furman University, Greenville, SC.



July 31-August 3
MathFest Math and Sports Session, Business Meeting with a Panel on Sports research with undergraduates in Cincinnati, OH

Saturday, November 23, 2019
Midwest Sports Analytics Meeting
Central College, Pella, IA

SIGMAA Officers

Chair: Diana Cheng, Towson University
Chair-elect: Liz Bouzarth, Furman University
Past-Chair: Drew Pasteur, College of Wooster
Program Coordinator: John David, Virginia Military Institute
Secretary-Treasurer: Tetyana Berezovski, St. Josheph's Univeristy
Communications Officer: Megan Powell, UNC Asheville

Student Reflection

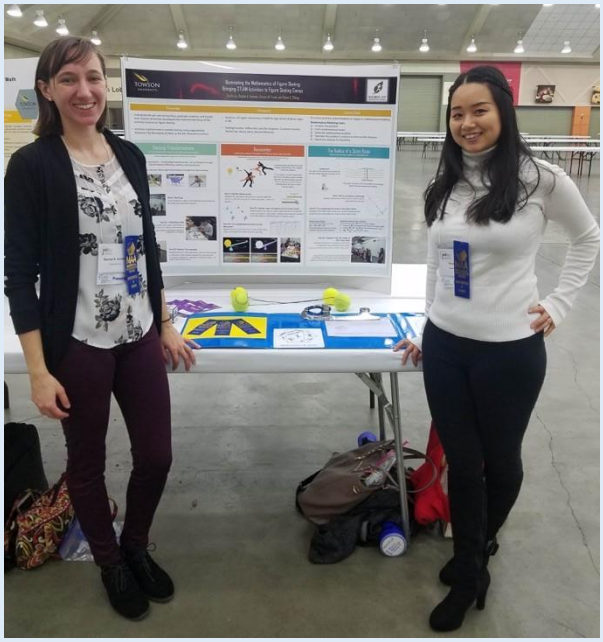
A Pre-service teacher's reflection on JMM 2019

By Rachel A. Schmitz, Towson University secondary mathematics education pre-service teacher in the combined BS/MS program

In my experience, each conference is unique in some way, shape or form. In the past, I have presented at JMM in 2018, MAA Mathfest in 2018, and various other teacher conferences. I have also attended conferences as an observer rather than a presenter. Whether presenting a poster, speaking in a session, or attending to learn from and connect with others, each conference has something different to offer.

JMM this year was unique to me for a few reasons. Firstly, it was held in Baltimore City- a home field advantage for the students and faculty of Towson University. Although this conference lacked a bit of excitement due to the fact that I did not get to take a plane across the country and stay in a hotel, being so close to home offered a familiar and relaxing feeling that calmed my nerves about speaking in front of people. Additionally, more students and faculty from Towson were able to attend the conference due to its proximity. Many professors showed their support at my session, which boosted my confidence.

JMM was also unique for me because I both spoke in a session and did a poster presentation, and I did both of these with fellow graduate student Yuki Liu. I had experience doing both posters and talks before, yet it was different to collaborate with another student. Learning how to collaborate with Yuki was a memorable experience. Naturally, working with another person can often be difficult if you do not see eye to eye on everything. Although working with somebody else on a presentation can be challenging, we found that collaborating was ultimately beneficial because we were able to learn from each other and create a better presentation than either of us could make individually. Yuki brought many amazing ideas to the table, and we presented mostly on her ideas about teaching rigid transformations through dance. However, she did not have experience speaking at conferences before. Since I had experience presenting, I was able to organize the information and present it in a way fit for a conference. In this way, we both learned from each other and worked together to make a good presentation.



Finally, the sessions at JMM this year also made for a unique and memorable experience. Sometimes at a conference like JMM, it can be overwhelming and hard to choose what sessions to attend. However, this year was fairly easy to choose; I wanted to see my peers from Towson present. With topics ranging from tessellations in M.C. Escher's art to finding the radius of an ice skate's blade, I was amazed at how creative my fellow undergraduate students were with their presentations. The sense of community and support from both professors and students is what set this conference apart for me, making JMM 2019 like no other conference.

Faculty Reflection

Get in the Game: Forming a Sports Analytics Group by Tim Chartier of Davidson College

Want to start a sports analytics group? Where do you start? Frankly, there is more than one way to start. Here are some options that can help springboard your thinking about the type of group that you may want to form.

First, what type of sports analytics interest you? Do you want to use math to study the game and create blog pieces or publishable articles? Such work can be targeted to fans of the game (via a blog) or the academic sports analysts' community (via journals). Do you want to offer analytics to coaches at your school and give them a glance at the game from data? Your answer to these questions can drive how you initially form the group as it impacts where you focus your initial energy.

Second, who's the group? Are you wanting to work with a math class where the entire semester focuses on sports or simply a single lesson or project? Are you wanting your group to be a club driven by students or a research group? Will the group be posed as a come-one, come all group where a student can find a place regardless of mathematical experience? Your answers to these questions can impact the type of sports analytics you study.

So, you've answered these questions, formed an initial group and are ready to dig into the data. Now what?

If you are interested in blog pieces for fans, look at professional sports to see what articles and ideas are engaging fans. If you are willing to dig into college sports, how can you transpose professional league analytics to the college level? Some ideas can be transferred and some are much harder, if not impossible. Looking at existing work can begin a conversation and move you to an area ready for your analysis.

If you are interested in publishable work, you may want to begin by reading sports analytics journals. Find articles from the Journal of Quantitative Analysis in Sports, the Journal of Sports Analytics or the Journal of Sports Sciences. Watch videos from the MIT Sloan Sports analytics meeting and look at their research articles. Attend a conference like the Midwest Sports Analytics Meeting, Carolina Sports Analytics Meeting, Great Lakes Analytics in Sports Conference or New England Symposium on Statistics in Sports.

Want to work with coaches? Set up a meeting with a subset of the coaching staff. In my work, I begin such a meeting by simply asking what the coaches already do with numbers and listen for where we can help. Then, I ask what data or analytics the coaches wish they had. Supporting a coach's preparation for a game, in my experience, increases the chance of buy-in and engagement in the analytics that will follow.

And then? You begin. You dive in. You explore. You try. Just like sports itself, you get better with experience and practice. I doubt I made my first shot at a basketball hoop. More importantly, I don't remember. Were we successful analyzing our first analytics question? I don't remember. We learned and moved forward.

So what about me? What were my answers and what group did we form? My group wanted to offer analytics to the men's basketball coaching staff at Davidson College which was natural as two of the founding members were managers of the team. We met with assistant coaches once a week for two months before the season to develop what we'd offer. Halfway through the season, our analysis was an important piece of the coaches' game preparation. I started with four students and now lead over seventy. Within the college, my sports analytics group works with men's and women's basketball, women's soccer, baseball, football, swimming, and volleyball. Our work expanded beyond college sports. We've completed projects for ESPN, the New York Times, the US Olympic Committee and teams in the NBA, NFL and NASCAR. Yet, we started wanting to develop analytics for one team for one season. Given the success of that team and coaching staff, it wasn't clear we could offer helpful information. We all knew this, talked about it, and pushed forward.

Still, on that first day, it all began with our asking ourselves who do we wanted to be and who would be in the group. Then, we began our journey into math and sports!

Faculty Reflection

Organizing a Sports Analytics Conference – MSAM 2018

Dr. Russell E. Goodman, Central College

While the thought of Iowa in November might scare some people away, Midwesterners are a hearty folk, especially when it comes to their sports analytics. For the third year running, I organized the *Midwest Sports Analytics Meeting* (MSAM) on my campus at Central College in Pella, IA. And for the third year, I feel the event went off quite smoothly with the attendees having an enjoyable, stimulating time. On Saturday, November 17, 2018, approximately 90 people signed on to come to MSAM for our two keynote speakers, sessions of concurrent talks, and lunchtime student poster session, and the attendance made for a lively event where lots of like-minded sports analytics people were able to connect.

Our first keynote speaker was Davidson College's Tim Chartier, whose talk *Ranking – It Isn't All Madness*, set the stage for an energetic day of talks by sharing his perspectives dabbling in sports analytics, rankings, bracketology, and on developing the Cats Stats basketball analytics program at Davison. Tim has such a knack for giving presentations and connected extremely well to the morning audience, attributed to some small degree to the fact he is a professional mime/performer! After the event, Tim shared, "Speaking at MSAM was energizing! It started several exciting interchanges with speakers at the meeting and then in follow-up email conversations. I even began some projects with students who attended the meeting."

Following Tim's keynote, we had a session of concurrent talks on topics ranging from an alternative rating index for ranking Iowa high school football teams to a presentation on the development of a new, non-invasive technique for assessing concussions. The afternoon session of concurrent talks similarly had a variety of topics: gender equity in sports analytics, an analysis of perceived "weak" NHL hockey goals, and a rhetorical analysis of MLB hitter "walk-up" music.

Not to neglect our student poster session, nine teams of students presented their sports analytics research over the extended lunch period. A healthy 90-minute lunchtime was offered in order to allow attendees to network over a meal while also having time to browse through all the posters which were hung in and around the dining area. Second-year student Brandi Gilbert, one of our Central College student researchers, commented, "I was blown away by the number of people who love mathematics AND sports! Being a poster presenter at MSAM really pushed me out of my comfort zone. The observers asked some difficult questions, but it was an experience I won't forget."

At the end of the day, to bookend Tim's morning keynote, we had speaker Weller Ross, Football Analytics Coordinator for the NFL's Houston Texans, give a talk entitled *You Must Unlearn What You Have Learned*. Weller did an amazing job connecting with his audience, bringing some students to the front of the room for a fun "NFL Trivia Challenge" with questions like "What percentage of plays have NFL quarterbacks been under center so far this year?" and with the students needing to give their best guess of the answer (provided at the end of this reflection). Weller spring boarded from this interaction to share intriguing perspectives on Prospect Theory, which involves concepts like *anchoring*, where one's perception is influenced by another suggestion, *availability*, where one places more emphasis on information their brain recalls more vividly, and *loss aversion*, where one values the cost of being wrong more than the benefit of being right. Connecting these notions to the work many of us do in sports analytics was quite thought-provoking.

Putting on an event like MSAM truly is a rewarding passion project for me, but I have learned there indeed is an audience in the upper Midwest for an event like this. While MSAM 2018 drew attendees and presenters from 26 different collegiate institutions, two high-schools, and one NFL team, my hope is to expand the reach of MSAM beyond the 12 mostly Midwestern states represented this year. I would love for MSAM to appeal, even just a bit, to folks west of the Rocky Mountains. Regardless, with its rich program and enthusiastic atmosphere, I hope many of you consider a) attending MSAM 2019, and b) putting on an event like MSAM in your own region of the country! #SportsAnalyticsEverywhere

[Answer to NFL Trivia Challenge question: 35.13%]

Book Review Analyzing Baseball Data with R, Max Marchi and Jim Albert, CRC Press, 2014

Dr. Russell E. Goodman, Central College

A terrific resource for both novice and experienced folks in sports analytics is Max Marchi's and Jim Albert's *Analyzing Baseball Data with R*. This review is of the first edition of the book even though a second edition (adding co-author Ben Baumer) was recently published in the winter of 2018. Marchi, who has contributed to *Baseball Prospectus*, and Albert, Professor of Statistics at Bowling Green State University and editor of the *Journal of Quantitative Analysis in Sports*, have written a book that is multipurpose. It can be used as a course textbook, a reference guide for practitioners of sports analytics and/or the statistical software R, or as an inspiration for topics in baseball analytics to explore. Regardless of its use, *Analyzing Baseball Data with R* is an essential element of a sabermetrician's library.

To be clear, the purpose of this book is to introduce R to sabermetricians through a variety of examples, exercises, and suggested research topics. Upon reading the book, one sees that the authors have toed the line between a cookbook for coding in R and thinking about exciting topics in baseball analytics quite nicely. While example scenarios are well-illustrated and explained, the authors walk the reader through the process of using R to research those scenarios quite smoothly. The text incorporates quite a bit of R code in the narrative, but in an incredibly effective way. This reviewer has used the book in a sports analytics course for students with no R experience and his student feedback has been exclusively positive regarding the quality of the writing and the ease of implementing the code that is shared.

Analyzing Baseball Data with R begins with a chapter introducing several well-known resources of baseball data: the Lahman database, Retrosheet game-by-game and play-by-play databases, and pitch-by-pitch data from PITCHf/x. Through a variety of examples and exercises, the reader is introduced to those datasets in a friendly and instructive way. Further, there are appendices devoted to details on accessing and using the Retrosheet and PITCHf/x databases. It is implied from the authors' writing that the manner one interacts with these databases is similar to how one might interact with other, similar baseball datasets and so the reader comes away feeling prepared for what to expect in using other datasets. As an example, one exercise connected to the introduction of Retrosheet play-by-play records is an analysis of the Retrosheet coding of the Philadelphia Phillies' Mickey Morandini and his famous 1992 unassisted triple play versus this reviewer's beloved Pittsburgh Pirates. This reviewer's students found it challenging to decode the Retrosheet data and yet fascinating to see how such an intricate play can be encoded in the first place.

Subsequent chapters cover an eclectic set of other sabermetric topics including the Pythagorean Theorem for baseball, calculations of run expectancy, balls/strikes analysis, player career trajectories, a fascinating chapter on game and season simulation using Markov chains, and an intriguing chapter on park effects which more broadly introduces the reader to database management via R connected to Oracle's free and open-source MySQL.

Serving its role as an introduction to R, Chapter 2 is particularly effective because it introduces the reader to R in a gentle way, uses real examples with legitimate calculations and, and as mentioned earlier, has all the necessary introductory code included so the reader knows how to interact with R, to load packages, generate graphics, etc. Marchi and Albert practically beg the reader to code along with them! This introductory chapter focuses on basic concepts in R like vectors, matrices, scripts, working with dataset files, manipulating dataframes, and slicing and dicing data with the plyr package. There is also a basic introduction to graphics in R, built on in a subsequent chapter on advanced graphics where the reader is shown how to use the ggplot2 and lattice packages.

The exercises in the book are a strength because they are interesting, sometimes open-ended, and are not always cookie-cutter, sometimes needing some creativity or ingenuity to solve. Even more, every chapter ends with a "Further Reading" paragraph that takes the reader to other, relevant resources they might wish to explore.

The final resource connected to Marchi and Albert's book is their quite useful website at https://baseballwithr.wordpress.com/about/. Resources available there include an active blog/Q&A discussion where Albert interacts quite regularly with discussants, a link to publisher CRC's website, and finally an essential link to the authors' GitHub repository for all scripts, exercise solutions, and errata for the book. This reviewer is quite thankful to the authors for making the repository available to users of the book.

Those interested in further sabermetrics and R resources with comparable quality are encouraged to connect to Albert's two books *Curve Ball* (2003) and *R by Example* (2011). Overall, this reviewer offers a strong recommendation for Marchi and Albert's *Analyzing Baseball Data with R* and considers it an excellent resource for aspiring sabermetricians and should be considered an essential part of one's sports analytics library.

Book Chapter Review Voting in Sports Math by Roland Minton

Dr. Peter Coughlin, University of Maryland

There are some important economic contexts where decisions are made by voting. One example is when a state legislature or the U. S. Congress votes on taxes or votes on budgets. Another example is when the Federal Open Market Committee votes on monetary policy. Decisions are also made by voting within a corporation. For instance, shareholders vote on who will be on the board of directors and the board of directors votes on a variety of major decisions (such as whether to acquire a large asset and whether to hire a particular person as the Chief Executive Officer). I teach a course for undergraduates which introduces them to 1) some of the voting rules used in important economic contexts, 2) models, concepts and methods that have been used to analyze those voting rules and 3) important results about voting rules that have been established. Among the results that I cover are a theorem for settings with two alternatives proven by Kenneth May, Kenneth Arrow's Impossibility Theorem, Duncan Black's Median Voter Theorem and a theorem that Donald Saari proved about the number of rankings that can occur when the set of voters and their preferences are held constant and the only thing that is allowed to vary is the voting rule that is being used.

In my course, I also try to convince the students that the models, concepts and methods that are commonly used to analyze voting rules in economic contexts are also useful in other contexts. As part of this effort, I use some material that is in Roland Minton's book Sports Math. More specifically, I use material that is in Chapter 6 (which is entitled "Voting Systems"). The chapter covers some models, concepts and methods that have been used to analyze voting rules and describes several ways that voting is used in sports contexts. For instance, the chapter describes the voting rule used to select a host city for the Olympics. The chapter also describes the two different voting rules used to select an NFL MVP on the one hand and an MLB MVP on the other. In addition, the chapter describes the voting rule used to select the Heisman trophy winner. Another example is a description of a voting rule that has been used to rank figure skaters. Yet another example is the voting rule used to determine who is selected for the Baseball Hall of Fame.

The way that the material in Chapter 6 in Sports Math has been written causes it to be engaging for its readers. What's more, its descriptions of voting rules provide a lot of useful details about the rules. So a reader is always clear about the nature of the ballots that are cast and how those ballots are used to make a decision. As a result, a reader can use the book as the starting point for deriving conclusions about the rules.

I highly recommend the chapter to anyone who is interested in voting theory and/or sports and wants to learn about ways that voting is used in sports contexts.

Faculty Reflection by Tetyana Berezovski (St. Joseph's University)

2019 Joint Mathematics Meetings - MAA Minicourse: *Mathematical Inquiry and Writing through Sports*, presented by **Eric Kahn**, Bloomsburg University, and **Tricia Muldoon Brown**, Georgia Southern University.

The minicouse was offered in two parts and ran for two days. Participants of the course were primarily faculty, but also some graduate students. The main objective of the minicourse was to introduce two evidence-supported strategies, inquiry and writing, to facilitate effective learning of undergraduate mathematics using the context of sports. During the first meeting, participants were engaged into learning and analyzing various samples of in-class activities presenters used in introductory mathematics courses such as Math for the Liberal Arts and Introduction to Statistics. These activities utilized a variety of sports in order to demonstrate learning statistics and probability with an inquiry approach. The participants worked individually and in small groups. The meeting concluded with a class discussion of participants' experiences and summative analysis of presented activities. The activities were carefully selected, some emphasized different aspects of

students' learning of introductory statistics and others were focused on multiple ways of solving problems. The second part of the course was devoted to data-driven sport-based curriculum design. First, participants were guided on finding actual sports data. Several sources were analyzed and classified for possible ways of utilizing data for classroom activity design. The session concluded with participants sharing their sports related projects and writing assignments in their teaching. I would recommend this course to any faculty who teaches entry-level statistics, or general education mathematics courses that includes some basics of sports analytics.