



SIGMAA Sports News

Fall 2018

SIGMAA on Sports and Mathematics

We are a group of mathematicians and mathematics educators who are interested in the connection between mathematics and sports, including the interdisciplinary field of sports analytics.

Please join the Sports SIGMAA!

We welcome submissions to our newsletter. We aim to publish our Fall newsletter shortly after MathFest, and our Spring newsletter shortly after the Joint Mathematics Meetings each year. Please email dcheng@towson.edu with your submissions.

This issue contains:

- 1) Recognition of mentors & undergraduate research from JMM 2018 and MathFest 2018
- 2) Photographs from the MAA MathFest SIGMAA Sports pavilion event
- 3) 3 sports books' review
- 4) High School Teacher's Reflection on implementing an ice skating related activity
- 5) Undergraduate student's reflection on MathFest 2018
- 6) Conference reflection on Fields Institute's Sports Analytics workshop
- 7) Conference reflection on the Eastern Great Lakes Conference
- 8) Joint Mathematics Meetings 2019 SIGMAA Sports announcement

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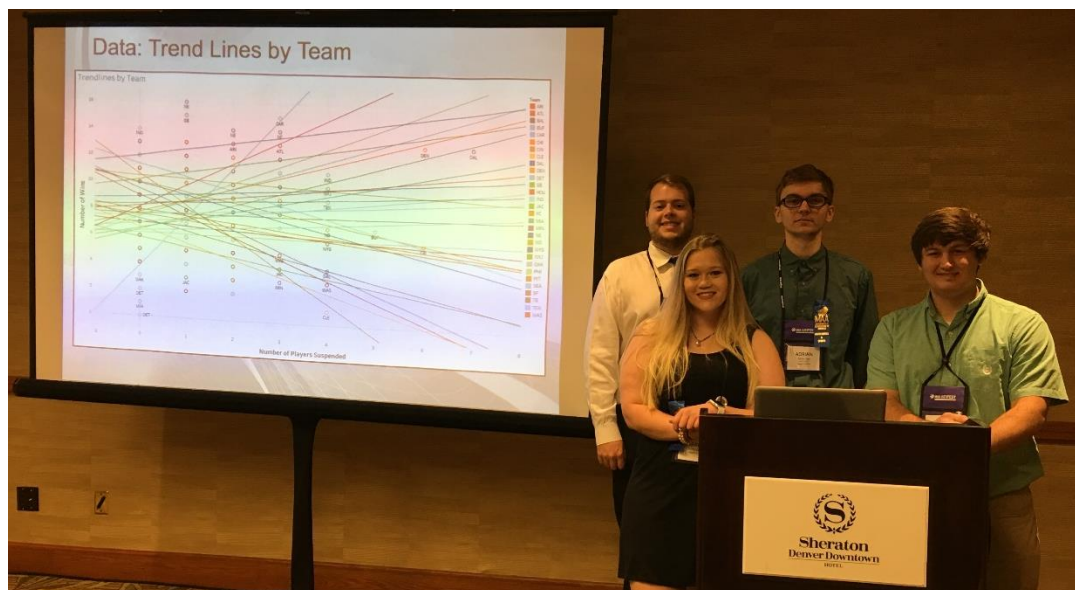
Faculty mentoring & Undergraduate research recognition

Below is a list of 2018 Joint Mathematics Meetings Math & Sports sessions with undergraduate research:

Mentor & webpage	Undergraduate Students	2018 JMM Presentation Title
<p>Dr. Amanda Harsey http://www.lewisu.edu/facstaffdirectory/FacStaffDirDetails2.htm?emp_id=1941&last=&dept_id=&box=&campus_id=&</p>	<p>Carley Maupin, Marissa Koronkiewicz  LEWIS UNIVERSITY</p>	<p>Predictive Modeling and Analysis of Golf and Softball Teams Using Linear Algebra</p>
<p>Dr. Megan Powell https://www.stfrancis.edu/academics/mathematics/meet-your-faculty/</p>	<p>Renee Martin </p>	<p>Analyzing NFL Overtime</p>
<p>Dr. Trent Gaugler https://math.lafayette.edu/people/trent-gaugler/</p>	<p>Keri D'Angelo, Quyen Do, Jamie Kunzmann, Joshua Radack </p>	<p>Predicting Outcomes of College Football Games</p>
<p>Dr. Noah Weiss https://www.carthage.edu/live/profiles/1715-noah-weiss</p>	<p>Juan Sanchez </p>	<p>Stayman and Four-Way Transfers in Contract Bridge</p>
<p>Dr. Diana Cheng https://www.towson.edu/fcsm/departments/mathematics/dcheng.html</p> <p>Dr. Tetyana Berezovski (St. Joseph's University) https://www.sju.edu/about-sju/faculty-staff/tetyana-berezovski-phd</p> 	<p>Rachael Talbert </p>	<p>Mathematical interpretations of figure skaters' blade tracings</p>

Below is a list of 2018 MathFest sessions with undergraduate research:

Mentor & webpage	Undergraduate Students	2018 MathFest Presentation Title
Dr. Amanda Harsey http://www.lewisu.edu/facstaffdirectory/FacStaffDirDetails2.htm?emp_id=1941&last=&dept_id=&box=&campus_id=&	Brandon Joutras, Adrian Siwy, Kevin Gannon LEWIS UNIVERSITY	Analysis of Golf Using Artificial Intelligence (Brandon & Adrian), Analysis of Golf Using the Massey Method (Kevin)
Dr. Bahaeddine Taoufik https://www.lynchburg.edu/academics/majors-and-minors/mathematics/faculty-and-staff/bahaeddine-taoufik/	Emmy Yarmy University of Lynchburg	Predicting Olympic Medals
Ladd Biro http://championmgt.com/the-team/	Preston Biro TEXAS A&M UNIVERSITY	NFL Suspension Analysis
Dr. Ryan Savitz https://www.neumann.edu/academics/divisions/arts_sciences/faculty.asp	Helen Cooney NEUMANN UNIVERSITY	A New Application of Sabermetrics to Ice Hockey
Dr. A.J. Hildebrand https://faculty.math.illinois.edu/~hildebr/	Samuel Guo ILLINOIS University of Illinois at Urbana - Champaign	Analysis of AP College Football Polls



Brandon Joutras, Emmy Yarmy, Adrian Siwy, Preston Biro at the Pi Mu Epsilon Session on Thursday August 2nd

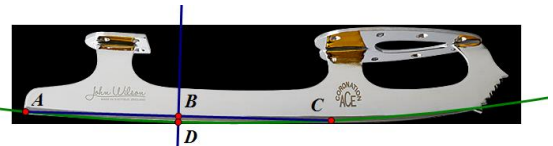
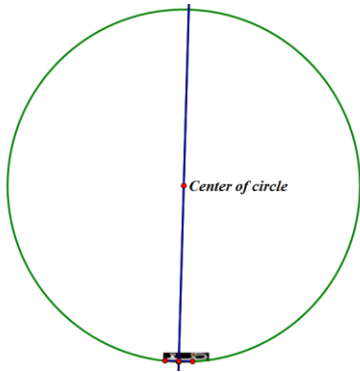
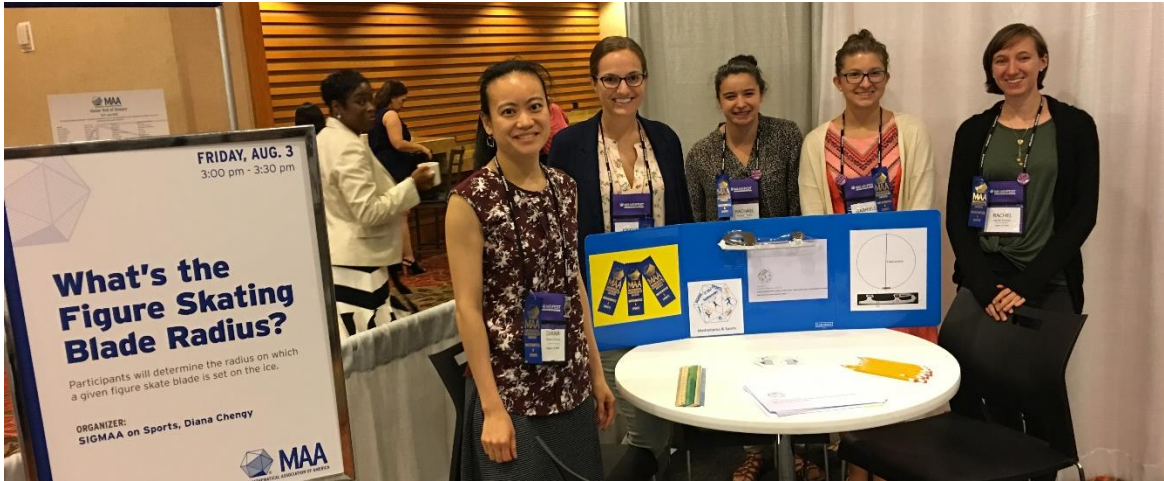


MAA MATHFEST

DENVER
Aug. 1-4, 2018

MAA Pavilion activity photographs from the SIGMAA Sports: “What’s the Figure Skating Blade Radius?”

Conducted by Sports SIGMAA officers Diana Cheng & Kristin Frank, and Towson University students Rachael Talbert, Gabriella Harris, and Rachel Schmitz on Friday August 3rd [activity designed with input from Robert Nedwick and Heather Stultz, Towson University students]

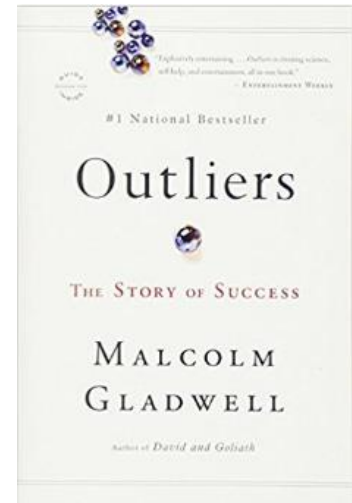
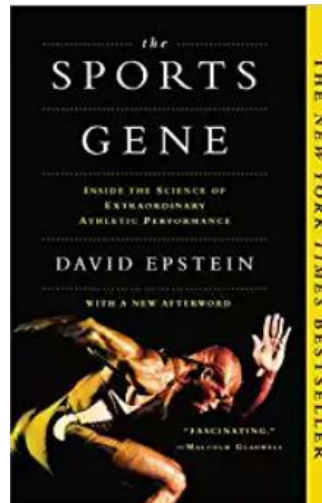
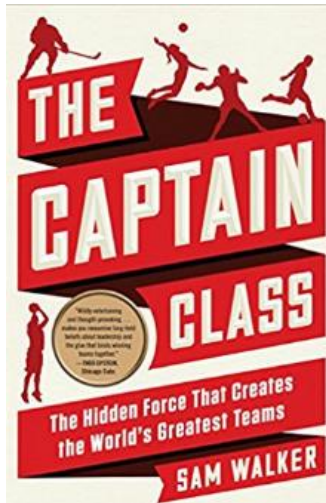


MAA's Doug Ensley solving the problem!

Reference for activity:

<https://www.towson.edu/provost/initiatives/leadership/teaching/academicinnovation/development/udl-newsletter-2018.pdf>

Review of 3 sports-related books:



The Captain Class: The Hidden Force That Creates the World's Greatest Teams by Sam Walker, Random House, 2017.

The Sports Gene: Inside the Science of Extraordinary Athletic Performance by David Epstein, Penguin Group, 2013.

Outliers: The Story of Success by Malcom Gladwell, Little, Brown, and Company 2008.

Review by Dr. Roland Minton, Roanoke College's M. Paul Capp & Constance Whitehead Professor of Mathematics, Department of Math / Computer Science / Physics:

What separates the great from the good? This is a universal question, but one that especially applies to athletics. Three books give us different facets of the answer. *The Captain Class* by Sam Walker explores team dynasties and qualitatively identifies characteristics of great leaders. Walker finds that team leaders work hard and are not afraid to bend the rules, they embrace conflict and work quietly to motivate teammates, and they have great emotional control. *The Sports Gene* by David Epstein looks at individuals and addresses the “nature versus nurture” question head on. Epstein surveys controversial research into genetic differences among athletes and gives us numerous case studies of successful athletes. If the short version is that an athlete excelled because of hard work, we are treated to research indicating that positive response to hard work is not automatic and may have genetic components. Athletes for whom the game comes easy often have special physical traits that are partially inherited. For example, baseball players do not have to be tall or quick or strong, but they almost all have phenomenal eyesight. Evidence that a high percentage of elite sprinters have the sickle cell trait is especially intriguing, though too controversial for full studies to be conducted. The interesting and surprisingly difficult question of what distinguishes genders is explored in depth. Epstein can be seen discussing many such ideas with Malcolm Gladwell in the Sloan Sports Analytics Conference video titled “10000 Hours Versus the Sports Gene.” Gladwell is the author of the book *Outliers* in which he made popular the notion that experts in a variety of fields put in 10000 hours of focused practice/study to achieve their skill. In the video, Gladwell freely concedes that the “rule” does not apply to most sports, having been unreasonably extrapolated for sound bite purposes from some preliminary studies of music and chess experts. The bottom line on nature versus nurture is “Yes” it takes both and the two are bound together. The specific ways this happens make for great reading and viewing.

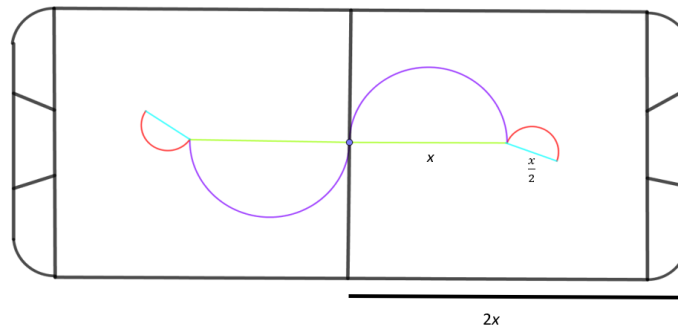


High School Teacher's reflection implementation of "Dancing on Ice" activity in her Geometry classroom

By Hilary Stanmyer, Harford County Public Schools (Maryland) mathematics teacher

Reference: "Dancing on Ice: Mathematics of Blade Tracings," by Diana Cheng, Tetyana Berezovski, and Rachael Talbert; accepted for publication in the Journal of Mathematics and the Arts. Portions of this article were presented at the 2018 Joint Mathematics Meetings' Mathematics and Sports session under the title, "Mathematical Interpretations of Figure Skaters' Blade Tracings."

As a high school mathematics teacher, my favorite question asked by students is "When we are ever going to need this?" Dancing on Ice is an activity that was created to help students answer this ever so popular question. I found this activity engaging and exciting, which is why I used it in my Geometry class at North Harford High School in Pylesville, MD. I tried this activity with a class of 28 advanced Geometry students. Overall, the activity went extremely well. I began by giving them the design that I had created in graduate class (Dr. Diana Cheng's MATH 580: Problem Solving for Middle School Teachers at Towson University) the week before.



The design I created involved four semi-circles, two with a diameter of x and two with a diameter of $\frac{x}{2}$. I wanted to involve Algebra along with the Geometry. I tried my best to design something creative that would look different when performed on the ice. After the students looked at the design, I had them work on the following questions:

1. Given the length of x , what is the length of one tracing in terms of x ?
2. A NHL skating rink has the dimensions 200 ft x 85 ft. What is the length of one tracing (in feet)?
3. Suppose a skater can skate at an average rate of 3ft/sec. How long would it take for a skater to complete one tracing on a NHL rink? How long would it take for a skater to complete two tracings?
4. Suppose a skater can skate at an average rate of a ft/sec. How long would it take for a skater to complete one tracing of a NHL rink? How long would it take for a skater to complete two tracings?

The students had a hard time setting up the first question. We ended up doing this as more of a guided example with the class. Once we came up with the equation $C = \frac{3}{2}\pi x$, the students were able to work on questions 2, 3 and 4 without an issue. They worked well with each other, asked each other questions and compared answers with their neighbors. In our class, we do a lot of discovery activities. We did a similar problem the class before involving circumference of circles. The problem given was:

Mia and Rosa are on a bike ride. Mia's bike has 29"-diameter wheels and Rosa's bike has 26"-diameter wheels. If Mia bikes at a rate of 270 revolutions per minute and Rosa bikes at a rate of 300 revolutions per minute, who will ride rather in 1 hour and by how much?

The students had to find the circumference of each wheel in order to solve the problem. Since we had done this problem the class before, the students had already been refreshed on the Circumference formula and how to use it. This was beneficial for this lesson because it helped the students figure out where to start.

The extensions for the Dancing on Ice problem are endless. You can change the dimensions of the rink; you can change the diameters of the circles. As stated in the article, I could have extended the problem by having my students create their own rinks. Overall, I think it was an effective lesson and I look forward to using it in the years to come with my Geometry classes.



Pre-service teacher's reflection on 2018 MAA MathFest

By Rachael Talbert, Towson University secondary mathematics education major



Presenting has always been nerve-wracking for me. I am always afraid of not being able to eloquently present my ideas and that others will not be able to see the worth behind what I am presenting. This being so, going into MAA MathFest, I was not as nervous for presenting as I had been for other presentations I have done in the past. I had presented this poster during the TU OURCI Forum in April which was an amazing practice for MathFest and it helped ease my nerves.

While in Denver, I was with two other undergraduate students and it was the perfect mixture of exploring Denver in our free time and attending informative mathematics sessions. The first day we arrived, we were able to relax and explore Denver before the next two days. On

Thursday, I attended multiple sessions revolving around teaching Calculus and Algebra. While attending these sessions, I learned about TACTivities which are tactile activities, that when used in a collaborative manner, can actively engage students with the mathematics content. Through using TACTivities, professors are able to incorporate hands-on materials that can be used to develop conceptual understanding, reinforce previously taught materials, and even as an introduction to new material. Later Thursday, I attended a session called "Fail: A Mathematicians Apology" and learned about how humans do not share any failures with others; however, success is only due to accepting failure and trying new ways to overcome certain failures. I think that imperative to instill in our students so that failures aren't seen as so discouraging. After this session, I set up my poster: "Choreographing in Problem Solving: Mathematical Interpretations of Figure Skaters' Blade Tracings" (photo below). During the poster session, many people came over and I shared about the background of the poster and our findings through completing a lesson revolving around circular relationship in figure skating patterns. I was able to have conversations about the importance of real-world applications, various mathematical representations, and student creativity in lesson planning. By talking to others in the mathematics field, I was introduced to other opinions and other ideas that could stem from the lesson. With the support of Dr. Diana Cheng and Towson, I felt prepared with presenting my poster and was extremely happy that my audience appeared appreciative and receptive to my poster and ideas.

On Friday, I attended more sessions on Calculus I. This upcoming semester I am beyond fortunate to be a learning assistant for a Calculus I classroom, and so, by attending these sessions I was hoping to gain more insight into helping create meaningful lessons for students. I saw sessions ranging from how to create a nurturing environment that stimulates conversation and openness in a classroom to specific lesson ideas; such as estimating Pi as an introduction to limits. I also helped Dr. Cheng, alongside the two other undergraduate students and Dr. Kristin Frank, with her interactive activity on finding the radius of a figure skaters' blade. It was interesting and informative seeing the different approaches different mathematicians took to reach the same conclusions.

On Saturday, we were able to explore Denver some more and relax before catching our evening flight to Baltimore. In all, I truly enjoyed attending MAA MathFest in Denver. I was able to attend informative mathematics sessions as well as further my presentation skills in a new setting. Looking back, I am incredibly lucky for the opportunities Towson has given me the past two years. I have been able to travel the United States to present in mathematics conferences and attend sessions that deepen my understanding of teaching as a whole which is truly incredible.

- Above photo of Dr. Diana Cheng and Rachael Talbert in front of poster: "Choreographing in Problem Solving: Mathematical Interpretations of Figure Skaters' Blade Tracings"

Conference Reflection



Reflection by Dr. Jeffrey W. Heath. Associate Professor of Mathematics, NCAA Faculty Athletics Representative, Centre College (Kentucky)

In May the Fields Institute in Toronto hosted a two-day workshop on Sports Analytics. The workshop proved to be a small and intimate venue where the roughly one hundred attendees had the opportunity to learn from many of the leading researchers in sports analytics and share ideas with one another. Seventeen invited speakers each gave 30-minute talks on topics that ranged from in-game analytics in a variety of sports to rating methodologies to business analytics. Many of the workshop attendees were academics from both American and Canadian institutions, but other attendees included owners of analytic startup companies and analytics representatives from professional franchises in the NBA, NHL, MLB, and MLS.

The speakers themselves were also a mixture of academics and professional sports analytic practitioners. The group of speakers included Devin Pleuler, of the Toronto FC, who opened the day by discussing how he is using tracking data to improve the performance of the soccer team. Michael Lopez of Skidmore College analyzed the scheduling advantages/disadvantages of teams in the major sports leagues as a function of schedule strength, game locations, and days of rest. Justin Detlor of Canadian Tire discussed how he is helping the Canadian Olympics Team determine the top athletes in their respective sports that give them the best opportunity to win medals in the Olympic Games. Keith Boyarsky of the Toronto Raptors and Luke Bornn of the Sacramento Kings outlined how they use NBA tracking data to diagnose plays. Mark Glickman of Harvard spoke about his 'Glicko' rating system, one which was referenced several times over the two days by several other speakers. Tim Chartier of Davidson discussed the ranking of teams for March Madness, while Amy Langville of the College of Charleston discussed the rankability of teams in sports. Mark Brodie of the Columbia Business School described how he uses the Shotlink database to rate PGA Tour putting. These speakers, along with the others not mentioned, gave a wonderful range of talks on how teams are using analytics to improve their performance, or how we as casual fans can use data to better discern some of the more unobservable factors at play in a variety of sports.

The Fields Sports Analytics Workshop was a unique opportunity to hear from and network with so many sports analytics researchers and practitioners in a focused setting. Late May was an ideal time to visit the city of Toronto, and many of the workshop attendees took advantage of the location and beautiful weather by taking in a Blue Jays game and a Toronto FC match. There was discussion of the Fields Institute hosting a similar workshop on sports analytics in the future, although it is not definitive at this time. With an affordable registration fee of less than \$100, the workshop definitely offered a great bang-for-the-buck opportunity to hear about high quality and cutting-edge sports analytics research.

Conference Reflection



Reflection by Dr. Roland Minton, Roanoke College's M. Paul Capp & Constance Whitehead Professor of Mathematics, Department of Math / Computer Science / Physics

The 2018 Great Lakes Analytics in Sports Conference in Stevens Point, Wisconsin on June 21 was a very well organized regional meeting of academics and industry practitioners. Several sports were represented, and talks addressed issues with machine learning, wearable technology, and spatial tracking. The first keynote address was by John Drazan, who runs an impressive outreach program taking his basketball and mathematics skills into the city to show kids the relevance of the STEM disciplines. His work is inspirational. Another newsworthy story is that of Kyle Allen, a Minnesota high school basketball coach who has turned a losing program into a conference champion by quantifying every aspect of his team's practice and play. Moving from the playground to the office, Eric Eager of Pro Football Focus and Jennifer Hobbs of STATS gave us a glimpse into modern analytics and the products of intelligent data mining. Two keynotes, 22 contributed talks, and numerous side conversations made for an excellent meeting to get specific ideas for research and to get excited about sports analytics.

Conference website: <https://www.uwsp.edu/cols/Pages/GLASC/analyticsconference.aspx>



The largest mathematics meeting in the world is returning to Baltimore next January! Mark your Calendar for the 2019 Joint Mathematics Meetings (JMM)!

2019 Joint Mathematics Meetings - Mathematics and Sports Sessions

Our SIGMAA's sessions will take place on Wednesday January 16th at 2:15-6 pm, and Thursday January 17th at 1-4:15 pm. The deadline for all abstract submissions to the Joint Mathematics Meetings is on September 25, 2018. See the following website for additional details about submitting abstracts: <http://jointmathematicsmeetings.org/jmm>

The expanding availability of play-by-play statistics and video-based spatial data, for professional and some collegiate sports, is leading to innovative kinds of research, using techniques from various areas of the mathematical sciences. By modeling the outcome distributions in certain situations, researchers can develop new metrics for player or team performance in various aspects of a sport, comparing actual results to expected values. Such work often has implications for strategic game management and personnel evaluation. Classic areas of study, such as tournament design, ranking methodology, forecasting future performance, insight into rare or record events, and physics-based analysis, also remain of interest. This session will include both presentations of original research and expository talks; topics related to the use of sports applications in curriculum are welcome. With a broad audience in mind, all talks are requested to be accessible to mathematics majors. Undergraduates and their mentors are particularly encouraged to submit abstracts for consideration.

Over the last decade, the interdisciplinary subfield of sports analytics has matured from an informal pastime to a specialized field of study. Peer reviewed journals include the Journal of Sports Economics (first published in 2000) and Journal of Quantitative Analysis in Sports (2007, now ASA-affiliated) and Journal of Sports Analytics (2015). The MIT Sloan Sports Analytics Conference annually draws hundreds of industry professionals, along with thousands of attendees, and receives extensive coverage by mainstream media. Smaller events such as the biennial NESSIS conference at Harvard, the recent two-day workshop at the Fields Institute, and several regional conferences, offer broader opportunities for those from academia (including undergraduates) to present their work and to interact with others who have similar research interests. The SportsSIGMAA, chartered by the MAA in 2018, gives interested mathematicians a natural community, something our colleagues in statistics and operations research already had.

Given the substantial representation of faculty and students from primarily-undergraduate institutions at the JMM, it is also notable that sports analytics is a very accessible field for undergraduate research. With the availability of rich data sets online, and the familiarity of some phenomena being studied, it is possible to involve younger students in associated research, even first-year undergraduates, teaching the relevant content on a just-in-time basis. Indeed there are a few math faculty at PUIs for whom sports analytics is their primary subfield, a trend that seems likely to continue on a small scale.

Aside from data-driven analytics, there are many other areas in which interesting mathematics arises in an athletic-related context, or that standard curriculum can be motivated by an example from sports. These may related to calculus (motion), linear algebra (ranking theory), graph theory (scheduling), combinatorics (best-of-n series), and of course, probability and statistics.

This session has a strong recent history, typically 20-30 talks and robust attendance. With the rising academic profile of related work across multiple disciplines, we believe that it will continue to add value to the JMM for years to come.