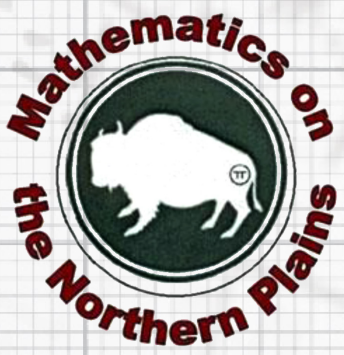

19th Annual

Mathematics on the Northern Plains Undergraduate Conference

Hosted by University of **Sioux Falls**

Saturday, April 7, 2018

PROGRAM SCHEDULE

Registration | 8 a.m.–8:45 a.m. | Salsbury Science Center (SSC) Lobby

Morning Address , Dr. Daniel Schaal | 8:45 a.m.–9:45a.m. | SSC 120

Coffee Break and Poster Session | 9:45 a.m.–10:15 a.m. | Lobby

9:45–10:15 a.m.	*Analysis of Breast Cancer Screening Utilization in South Dakota Using Standardized Incidence Ratios* **Megan Aadland** South Dakota State University	*Quality Control for the Strength of Carbon Fibers* **Nehal Adhikari** University of South Dakota

Student Talks—Morning Session | 10:15 a.m.–11:05 a.m.
SSC 202 and SSC 203

	SSC 202	SSC 203
10:15–10:35 a.m.	*Mathematical Model on Crimean-Congo Hemorrhagic Fever Virus* **Michaella Crouch** University of South Dakota	*PI: Yesterday, Today, and Tomorrow* **Erin Boyle** Mount Marty College
10:40–11 a.m.	*A Study of Parallel Implementation of Physics Simulations* **Jonathan Hedman** South Dakota State University	*Cyclic Graphs, Their Edge Ideals, and a Comparison of Powers* **Jason Vander Woude and Thomas Kamp** Dordt College

Math Jeopardy! | 11:15 a.m.–12 p.m. | SSC 120

Lunch | 12 p.m.–12:45 p.m. | Lobby

Keynote Address, Dr. Daniel Schaal | 12:45–1:45p.m. | SSC 120

Student Talks—Afternoon Session | 1:45–2:35 p.m. | SSC 202 and SSC 203

	SSC 202	SSC 203
1:45–2:05 p.m.	*Statistical Analysis of the SMSU Women's Basketball Team* **Alana Christianson** Southwest Minnesota State University	Queueing Theory: Designing a Better Line **Emily Ortmann and Laura Schuck** *Dakota State University*
2:10–2:35 p.m.	*A Markov Chain Approach to Strategic Baseball* **Austin Nordike** University of Sioux Falls	*Using Tiered Modeling Problems As a Math Pedagogical Tool in Secondary Education* **Taylor Stacey** Augustana University

KEYNOTE SPEAKER

Dr. Daniel Schaal
Professor of Mathematics at
South Dakota State University

Daniel Schaal was born and raised in Bridgewater, SD. He attended South Dakota State University (SDSU) and earned a double major in Physics and Chemistry with a minor in Mathematics. After graduation he volunteered to serve in The Peace Corps and spent two years as a high school Mathematics and Science teacher in Greenville, Liberia. It was during his Peace Corps service that he realized that Mathematics was his academic passion. After returning to the U.S., he earned an M.S. in Mathematics from SDSU and a Ph.D. in Mathematics from the University of Idaho, with a specialization in Discrete Mathematics and Combinatorics. He taught three years at Clarion University of Pennsylvania before returning in 1997 to SDSU as a member of the Mathematics faculty.

His personal research area is a branch of Combinatorics known as Ramsey Theory, but his biggest interest is involving undergraduate students in his research. He has over 25 articles published in Mathematics research journals, but he is most proud of the dozen or so articles that have undergraduate students as co-authors. In the summers of 1999 and 2000, Dr. Schaal was a co-director of National Science Foundation-funded Research Experiences for Undergraduates programs, where top undergraduates from around the country came together to do research in Combinatorics.

Dr. Schaal's wife Madeline works as a Physician's Assistant and claims that her husband only teaches to support his hunting and fishing activities. He has three children. Isaac and Isabel are undergraduate students and Benjamin is in middle school.

KEYNOTE ADDRESSES

MORNING ADDRESS | SSC 120, 8:45 a.m. – 9:35 a.m.

Mathematics from the Talmud

Dr. Daniel Schaal, South Dakota State University

The topic of this talk is the equitable distribution of an estate when there are insufficient funds to cover the debts owed by the deceased party. The Jewish Talmud addresses this problem, but only gives some examples of how to settle an estate. No general algorithm for settling an estate is given in the Talmud. For centuries scholars have tried to determine an algorithm that would be consistent with all the examples given in the Talmud. Recently two economists discovered an algorithm that apparently solves this mystery. In this talk the examples from the Talmud will be presented and the newly discovered algorithm will be explained.

KEYNOTE ADDRESS | SSC 120, 12:45 p.m. – 1:35 p.m.

Should you take the bet?
A problem from Marilyn Vos Savant.

Dr. Daniel Schaal, South Dakota State University

In this paper we analyze a coin showing game that appeared in the "Ask Marilyn" column in PARADE Magazine, a column written by Marilyn Vos Savant. This simple game illustrates some of the basics of game theory but has some unusual and interesting twists. It is also not clear if Marilyn was right or wrong in her answer. Note, this talk is NOT about the "Monte Hall Problem" which was made famous in the same column.

Analysis of Breast Cancer Screening Utilization in South Dakota Using Standardized Incidence Ratios

Megan Aadland
South Dakota State University

The All Women Count! program in South Dakota offers free mammograms for low income, uninsured women between the ages of 40 and 64. The utilization of this program was analyzed for each county in South Dakota using standardized incidence ratios. Seven counties were found to significantly over utilize the program while 25 significantly under utilized the program in 2015. Regression methods were used to identify the factors contributing to under and over utilization. The analysis concluded that the number of providers in the county, median income, percent uninsured and percent living in poverty were all significant predictors of screening utilization.

Quality Control for the Strength of Carbon Fibers

Nehal Adhikari
University of South Dakota

Carbon fibers are ingredients for the rigid composite material used in aerospace and other applications. It is very important to ensure the strength of carbon fibers to meet the required standard. Lio et al. (2014) studied Burr type-X distribution for percentile quality control charts of carbon fibers through maximum likelihood estimator (MLE) and moment method estimation (MME). However, both MLE and MME did not provide close mathematics forms for the estimators of percentiles. Therefore, three additional methods, estimator based on percentile, least square method, and modified L-moment method, is used here. Empirical distribution data were collected through simulation using R language. Stimulation was carried out with different sample sizes, and different percentile of interest. Two thousand bootstrap repetitions, B=2000, had been used to determine the control limits for each bootstrap chart. The collected ARLs, UCLs and LCLs through stimulation can be compared with all proposed control charts and two existing procedure by Lio, et al. (2014) to monitor carbon fiber strength quality in terms of average running length for in-control and out-control procedures.

Mathematical Model on Crimean-Congo Hemorrhagic Fever Virus

Michaella Crouch
University of South Dakota

Mathematical models are effective tools that allow multiple disciplines to describe the real world and predict outcomes. The math models that study the dynamics of infectious diseases are based of three main categories, SIS, SIR, SIER; with S standing for the population of susceptible, I for the population infected, E for the population latent, and R for the population removed/recovered. The three different models give us a foundation for the general transmission rate of diseases.

A Study of Parallel Implementation of Physics Simulations

Jonathan Hedman
South Dakota State University

We will present our current progress on the parallel implementation for physics simulations based on the differential equations. The parallelization required the following updates: 1) global and local index sets for data communication through processors, 2) parallel global data structures, and 3) local data structures for the time

decomposition preconditioner. This parallelization process was implemented using PETSc (Portable, Extensible Toolkit for Scientific Computation) from Argonne National Laboratory.

PI: Yesterday, Today, and Tomorrow

Erin Boyle, Mount Marty College

A wealth of information surrounds the numerical value PI (π), the ratio of the circumference of a circle to its diameter. PI is an essential component of countless formulas and equations used in geometry, trigonometry, physics, and engineering. The paper begins with a discussion of the history of PI and how it was used in the ancient world. Further exploration of PI is then discussed in light of the work done by mathematicians from previous generations. This portion of the paper focuses on methods used to increase the accuracy of PI (i.e., additional decimal places. The final portion of this paper presents how mathematicians of this generation are using technology to study PI. This paper provides information into one of the most highly intriguing topics in the world of mathematics—one that has maintained its relevance over the course of many generations of great thinkers and tracks the discovery and development of PI: yesterday, today, and tomorrow.

Cyclic Graphs, Their Edge Ideals, and a Comparison of Powers

Jason Vander Woude and Thomas Kamp, Dordt College

We consider various means of comparison of the standard and symbolic powers of edge ideals generated from graphs. Given such an ideal I where I^t is the t^{th} standard power and $I^{(t)}$ is the t^{th} symbolic power, we conjectured and proved an equation of the form $I^{(t)} = I^t + J$ for a particular ideal J. In our talk, we will present a relatively simple but essential visual insight required by our proof.

Statistical Analysis of the SMSU Women's Basketball Team

Alana Christianson
Southwest Minnesota State University

The purpose of this presentation is to analyze statistics from the SMSU women's basketball team. By analyzing statistics from the last seven seasons, we are able to determine if there is a correlation between different variables that would lead to winning more games. We started the analysis by constructing boxplots for each variable. Then we investigated the correlation between each variable. A chi-square test was completed and we concluded that there was no significance to SMSU playing at home. Lastly, a logistic regression was completed and we were able to find a statistically significant model based on game statistics to predict the chance of winning the game. Utilizing these results will hopefully assist the team in producing better results, thus translating into victories!

A Markov Chain Approach to Strategic Baseball

Austin Nordike
University of Sioux Falls

Markov chains have a wide variety of applications to fields dealing with information with discrete properties. They are stochastic and memoryless, which make them useful for simulating random processes. One such application for Markov chains is their ability to model the game of baseball. The presentation will briefly discuss the theory behind Markov chains and develop a Markov model that

is useful for a variety of applications within baseball. The developed model's main focus is to give insight of situations where strategy could be used to improve a team's odds of winning. The presentation will close by comparing founded results with empirical data.

Queueing Theory: Designing a Better Line

Emily Ortmann and Laura Schuck
Dakota State University

Everyone has experienced waiting in lines, whether it is at the airport, the grocery store, or somewhere in-between. Queueing theory has an obvious application to people waiting in lines (e.g., airports and customs); however, it also has applications in networking, telecommunications, and hospital scheduling. By developing queueing simulations based on mathematical models of airport security and customs, we explore a variety of questions related to optimal queue design with respect to efficiency, feasibility, priority, and other prescribed/variable constraints.

Using Tiered Modeling Problems As a Math Pedagogical Tool in Secondary Education

Taylor Stacey
Augustana University

Mathematical modeling applies the robust complexity of mathematics to express real-world phenomena and to analyze its results. We considered mathematical modeling done in the high school setting; including in-depth definition of mathematical modeling, tiered sets of real life modeling problems, lesson plans for the teachers coupled with assessments. The benefit from mathematical modeling for students is that they can apply the iterative problem solving process they develop to areas of interest that need further explanation or can be simplified through modeling.

University of Sioux Falls