



BAYLOR UNIVERSITY
DEPARTMENT OF STATISTICAL SCIENCE
STATISTICS NEWS

2020-
2021



LETTER FROM THE CHAIR

Dr. James Stamey

Friends and Alumni,

We hope this letter finds you healthy and safe. 2020 has been quite a year at Baylor and in the Department of Statistical Science. Beginning with the hiring of two new faculty and ending with social distancing and virtual classes and meetings, I am incredibly proud of our faculty's hard work. I'm especially grateful for their response to the pandemic, quickly transitioning to virtual class delivery, readily meeting a large demand for summer online courses, and effectively offering a full schedule of classes this fall via a mixture of face-to-face, hybrid, and online formats. The students have shown similar resilience, as they have had to make numerous adjustments in the face of considerable uncertainty. While currently the spring looks much like the fall, we are hopeful to return to a normal campus environment as soon as possible.

Our undergraduate program continues to expand, both in terms of number of students and in course offerings. We have new courses in data science and continue to grow our actuarial science track.

We have also expanded the PhD program in response to high demand for our graduates in both industry and the academy, even during the pandemic. Similar to the undergraduate program, we created new courses and now have concentrations in biostatistics and data science. We continually seek to be open and flexible in meeting the needs of numerous departments across the university by offering an ever-growing slate of graduate-level service courses.

Finally, we recognize the retirement of Dennis Johnston in May after 17 years of service as a professor at Baylor and over 30 years at M.D. Anderson. Dennis' significant contributions to the department include teaching at both the undergraduate and graduate levels, mentoring PhD students, and research and service in the department, the university, and the broader community. Fortunately, Dennis is not going far and already generously taught a course in multivariate statistics to our upper level undergraduate students this fall. His investment to our department is greatly appreciated. He will be missed.

We wish you the true joy and peace of Christ during this long-awaited Christmas season!

Inside this issue

Letter from the Chair

Undergraduate Program Update

Graduate Program Update

New Faculty

Consultant's Corner

Faculty Research Spotlight:

Dr. Amanda Hering

Dr. Joon Jin Song

Grad Student Spotlights:

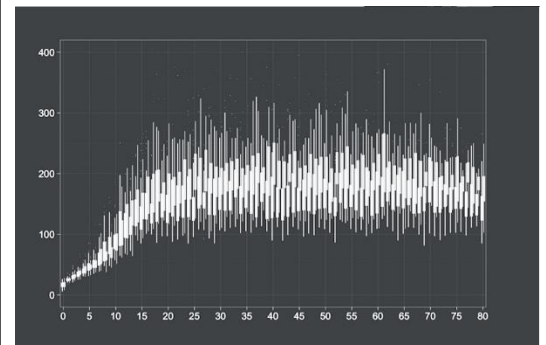
Briceon Wiley

Purvi Prajapati

Undergrad Student Spotlight

Jacob Moore

Kevin Gibson



UNDERGRADUATE PROGRAM UPDATE

Dr. Jeanne Hill

There is much to report from the undergraduate program. We have developed and offered several new courses. In the spring, we offered our Introduction to Data Science for the first time. The class is part of an NSF grant with Mandy Hering as the PI and was developed by an interdisciplinary team. In addition to our majors, it is intended to introduce students across campus to R programming, data wrangling, graphics, and modeling. It was team-taught with faculty from Baylor and the Colorado School of Mines. Dr. Josh Patrick's new course in Statistical Machine Learning was very popular this summer and will become a crucial part of a data science emphasis within our major. This fall, our new undergraduate multivariate analysis class was offered for the first time. Dr. Dennis Johnston generously came out of his brief retirement to teach this course.

Despite finishing the spring semester online, the undergraduates in the Department of Statistical Science still had a successful semester. Three of our actuarial science track students took Exam P, and all three passed! Congratulations John Davis, Kevin Gibson, and Jacob Moore! Several of our undergraduates also took part in the summer program related to the NSF grant on data science.

We currently have over 55 undergraduate majors, secondary majors, and minors. We had 10 students graduate in May. Many of our graduates have gone on to pursue graduate work at institutions such as Rice, Vanderbilt, Baylor, Columbia University, and the California Institute of Technology. Some students have moved directly from undergraduate school to careers with companies such as KPMG, Lincoln Financial, Nestle, Credera, and Merrill Lynch to name a few.

Our students are bright, motivated and really fun to be around. If you know of summer internships or want to share any of your professional experience, please contact me and we can set up a guest lecture, either virtual or in-person.

GRADUATE PROGRAM UPDATE

Dr. Jane Harvill

Our Graduate Program is growing and changing, and we are always working to keep our curriculum fresh, modern, and challenging. Towards that end, two additions to our Ph.D. program are the Concentration in Data Science and the Concentration in Biostatistics. Students who graduate with their Ph.D. in Statistics and who have a minimal number of hours in designated classes can earn one or both of these concentrations. Last year, the Graduate School recognized our program by granting us more graduate assistantships. From that, our graduate student population will be increasing by five to ten students over the next few years. Recognizing the need for more graduate-level statistics courses at Baylor for students who are not majoring in statistics, we created several new classes covering a wide variety of statistical methods. There is a great deal of interest in these courses. Some of them are even included as requirements or elective courses in new Ph.D. and M.S. proposals for other programs.

Because last year was cut short by the COVID-19 pandemic, there was a delay in recognizing our outstanding students, who were awarded last month. Choosing an exceptional student from among an extremely strong 2019-20 incoming class was not a simple task. In the end, Ms. Cathy Xie earned the "Outstanding First Year Student Award." Mr. Will Best, a third-year, earned the "Outstanding Teaching Assistant Award" for his excellence in the classroom as a teacher of record for STA 1380. Finally, for her continual outstanding contributions and exceptional performance, Dr. Molly Klanderman was selected to receive the "Outstanding Overall Student Award."

This December, every member of the first-year class will be graduating with their M.S. in Statistics degrees. Those students include Ms. Rachel Dillmann, Mr. Ryan Hebdon, Ms. Zoe McCluskey, Mr. James Otto, Mr. Rory Samuels, Mr. Derek Weix, and Ms. Cathy Xie. In August 2020, Molly Klanderman graduated with her Ph.D. under the direction of Dr. Mandy Hering. Currently, Dr. Klanderman is working as a post-doctoral assistant with Dr. Hering. In December 2020, Purvi Prajapati and Briceon Wiley will be graduating with their Ph.Ds. Dr. Prajapati completed her Ph.D. under the direction of Dr. James Stamey and Dr. John Seaman. She is now working as a research scientist at Eli Lilly. Dr. Wiley completed his Ph.D. under the supervision of Dr. Dean Young and Dr. James Stamey and is now a post-doctoral research fellow with the Interinstitutional Graduate Program in Biostatistics for Cancer Research between Rice University and MD Anderson Cancer Center.

We are continually seeking ways to improve our graduate programs for our students and for those we serve. If you have any suggestions or ideas, or if you know of any good students to send our way, please be in touch!

New Faculty member Rodney Sturdivant, Ph.D.

I am excited to join the Baylor faculty and direct the Statistical Consulting Center. I will begin by briefly introducing myself. I am a retired U.S. Army Colonel and served on active duty for 27-years and completed my military service at West Point after I was selected as an Academy Professor. During this time, I founded and directed the West Point Center of Data Analysis and Statistics (CDAS) and earned the academic rank of Professor of Applied Statistics. After retirement I spent time as Associate Professor of Clinical Public Health in the Biostatistics Division of the College of Public Health at The Ohio State University, where I also served briefly as Chair for Biostatistics. I then took a position as Professor at Azusa Pacific University, building and directing a new M.S. in Applied Statistics and Analytics. Most recently, I worked as a research biostatistician for the Henry M. Jackson Foundation for the Advancement of Military Medicine supporting research at the Uniformed Services University of Health Sciences. It is a pleasure to return to the role of directing a consulting center. I felt a very strong calling to come to Baylor and my passion is to serve God while I am here by supporting the research efforts of Baylor students and faculty.



New Faculty member Michael Gallagher, Ph.D.

I was born and raised in Hamilton, Ontario, Canada. I recently completed my Ph.D. at McMaster University, where I held a Vanier Canada Graduate Scholarship, and worked under the supervision of Dr. Paul McNicholas. While awaiting the start of my position at Baylor in January, I currently hold a Banting Postdoctoral Fellowship from the Natural Sciences and Engineering Research Council of Canada.



My research interests are primarily in the area of clustering and classification, which is the foundation of machine learning. I am particularly interested in clustering techniques for matrix data, and during my postdoctoral fellowship I have looked at extensions to tensor variate (multi-way) data. Other topics of interest include clustering techniques for mixed type data, clickstream data, very high dimensional data, cluster weighted models, and outlier detection in clustering. Outside of academia, I enjoy playing several musical instruments including piano, violin, and pipe organ, as well as playing golf and tennis. I very much look forward to being at Baylor!



Baylor University

COLLEGE OF ARTS & SCIENCES

Statistical Science

Consultant's Corner

Fall 2020 is an exciting time of establishing new collaborations and procedures in the Statistical Consulting Center. As part of this effort, we developed a new mission and vision statement for the center.

The **mission** of the Baylor Statistical Collaboration Center is to enhance the quality of research involving statistical methods conducted at Baylor University and with external partners. Specific goals for the center are: 1) to provide meaningful educational experiences for statistics students in working on applied research, 2) to act as a hub which facilitates collaborative research at the university, and 3) as a “Center that learns” to promote efforts to expand the overall level of knowledge of statistical methods used in research.

The **vision** for the center aligns with the Baylor vision to “equip individuals to understand life as a divine calling and thus serve society and the world in the name of our Lord Jesus Christ”, aspiring to the principles found in Colossians 3:23-24:

“Whatever you do, work at it with all your heart, as working for the Lord, not for men, since you will receive an inheritance from the Lord as a reward.”

Opportunities to apply the mission and vision have already begun. This semester five of our outstanding Ph.D. students have worked as consultants: **Jerry Ma, Shannon Ciccarello, Cathy Xie, Robert Hernandez and Yuhan Ma**. A few of the projects and support provided so far include:

- Support for the Baylor Collaborative on Hunger and Poverty (BCHP), with **Dr. David Kahle** as faculty advisor
- Data analysis on programs offered by Advancing Nurse Coaching, a local organization
- Advising and help for Baylor students working on projects or a thesis from programs including biology, nutrition, athletic training, human science and design and several others.
- Analysis and a paper, working with Debra Harris, Ph.D. from the Baylor Human Sciences and Design program on the viability of SARS-CoV-2 on indoor surface materials

We also have a number of projects and collaborations that are just beginning. One example is a collaboration with faculty from the Baylor Hankamer School of Business on a partnership to support research with Airrosti, a company that provides alternatives to standard methods for relief of muscle or joint pain. Another involves work with faculty and students from the Baylor School of Nursing studying the efficacy of a see-through mask for use by medical personnel to improve patient interactions.

Anyone interested in statistical support can email Rodney_Sturdivant@baylor.edu to learn more about the services provided by the consulting center.

Faculty research spotlight

Mandy Hering, Ph.D.

Baylor University has partnered with four national laboratories and more than a dozen universities in a research alliance that submitted a proposal to the Department of Energy (DOE) to compete for a \$100 million grant lasting five years. The team, called the National Alliance of Water Innovation, was one of a handful to groups to submit a proposal. Their goal is to address the nation's water security issues through desalination technologies. In September 2019, at the WEFTEC conference in Chicago, former DOE secretary Rick Perry announced that NAWI would be the recipient of the award.

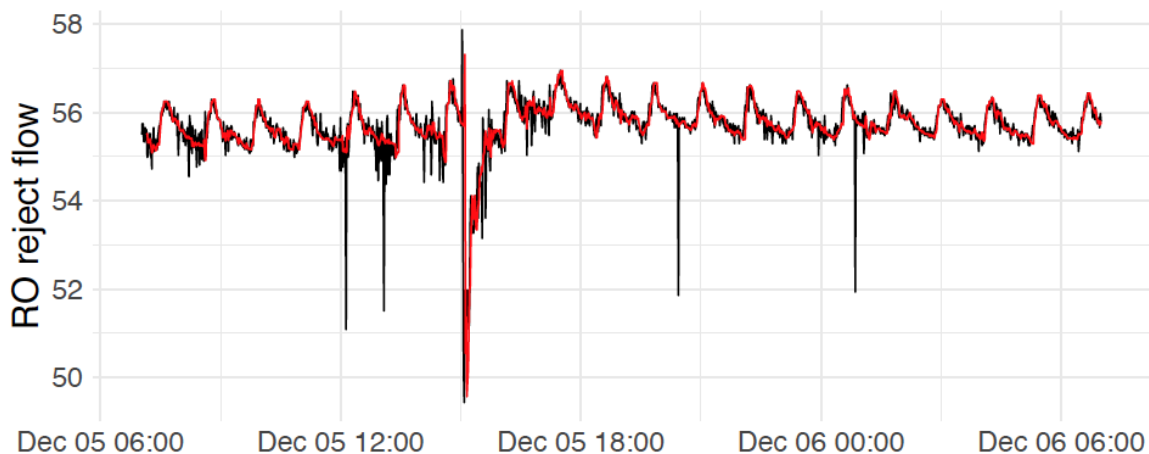


I became involved with the NAWI team in 2017, as the team began to identify team members and important water treatment research areas. My close colleague, Tzahi Cath who is an environmental engineering professor at Colorado School of Mines, asked if I would like to get involved. He and I have been working together for many years to apply and develop data-driven methods to data generated from his decentralized wastewater treatment facility to improve its operation. As with any large research effort, he knew that much data would be generated if NAWI were selected and that the skills of a statistician could prove useful. Thus, I began to attend conferences and workshops to help support the effort and to learn more about the data and analysis needs of this team.

As a DOE innovation hub, NAWI will conduct research and also develop a road map to prioritize the highest impact technology options, then identify and solicit projects to support those priorities. They have already begun to release solicitations, but a few projects were designated to begin in the first year, and I am a part of one of those teams.

The first-year project's goal is to develop an easily transferrable approach to control methods for water treatment systems. My part in the project is to oversee the development of a rapid method for online data denoising by removing univariate and multivariate outliers and high-frequency noise (see graphic below). When the sampling rate for variables being monitored in a water or wastewater treatment system is very high (e.g., on the order of seconds), electrical surges and small variations in noise can occur, but these should not be fed back into the control system. In other words, the system's control should be based on the overall pattern in the data rather than on local, anomalous variations. Furthermore, the filtering process must occur in fractions of a second, requiring computational speed.

This project currently supports one PhD graduate student in the Department of Statistical Science and partially supports one postdoctoral researcher, and we hope to continue our involvement in this and other NAWI research projects in future years by working to build a strong and interdisciplinary team.



Faculty research spotlight

Joon Jin Song, Ph.D.



My research focuses on developing statistical methods for spatial-temporal data, functional data, and observational studies and solving research problems in a wide range of application areas with them. Below I describe two areas in which I am directing student research.

Precipitation is an essential climate element that can directly affect our lives, and quantitative precipitation estimation (QPE) is one of the most important tasks in many applications such as atmospheric science, hydrology, and environmental science. However, the estimation is a challenging problem due to complexity of the nature and uncertainties in the physical process. Nevertheless, the acceleration in recent climate change makes the need of more accurate precipitation estimation methods that more important. To this end, I am developing statistical methods for properly fusing precipitation datasets collected at different spatial resolutions. The ground-based monitoring networks provide highly accurate data at the point level, generally treated as the ground truth. However, the stations are sparsely deployed in large areas and their spatial coverage is limited due to point measurement at a site. Furthermore, it is rarely possible to collect the monitoring network data over oceanic and mountainous regions. To overcome this limitation, remote sensing instruments, such as weather radar and satellites, are commonly used to provide precipitation information at high spatial resolution. A weather radar is superior in spatial resolution by densely covering the entire area, but typically requires a post-processing calibration. Since both network and radar data have their own strengths, it is natural to combine the data sets to take advantage of two data types.

Due to accessibility and cost, researchers in clinical and public health sectors are increasingly using observational data to study the effect of treatment (or exposure) that cannot be studied through randomized experiments. However, estimating causal treatment effects from observational studies poses a unique problem because subjects are not randomized to treatment groups, so treatment assignment is conditional on covariates, which leads to bias. Propensity scores are widely used to control for this bias, acting as a balancing score. Traditionally, the propensity score, a subject's probability of treatment assignment, is estimated with logistic regression and used directly in an outcome model. This two-step approach ignores the uncertainty in the propensity score estimates, resulting in understated uncertainty estimates for the outcome model parameters. A natural solution is to fit the propensity score model and the outcome model simultaneously in a Bayesian framework. Another common problem in observational study is measurement error due to either an imperfect diagnostic test or a sensitive question asked in a survey. For example, a woman may not answer yes when she truly experiences physical violence from her husband. It is well known that this error leads to biased inference. I am interested in studying Bayesian causal inference when observation studies are prone to error.

Grad Student spotlight:

Briceon Wiley, Ph.D.

I joined the Baylor Statistics graduate program after hearing about it from Dr. Stamey during a meeting with Dr. Hill when I was in undergrad. I was a business major with a concentration in mathematics, and by my senior year I had earned most of my math credits in the statistics department. After speaking with Dr. Stamey, I decided to pursue statistics because I really enjoyed the applicability and tangibility of the subject compared to some of the more theoretical things I studied in my other math courses. That was one of the greatest decisions I ever made because I then spent the next four years learning under and with truly amazing people. I loved the support of all of the professors and the community that Baylor Stats has built among its graduate students. One of my favorite things about being a student was the emphasis on working together to conquer problems, rather than working against each other. This was especially helpful in many of the classes that we took with Dr. Young where we were encouraged to really dig in deep and break a sweat so that we could come to understand what we were doing. During the program, my favorite classes were the computational classes that Dr. Kahle taught. He is a magnificent professor, and learning how to code well really played a role in helping me truly grasp what I was doing in my research. Those classes still serve me well to this day as I work as a postdoctoral fellow at Rice University and MD Anderson Cancer Center here in Houston. I'm hoping that when my program finishes, I'll be able to move into a full-time faculty position. For any students that are coming into the program, my biggest piece of advice would be to stay the course when things get tough. Anything that's worth doing in life is going to be difficult, and that is definitely true about earning this PhD. It's completely normal for the material to be unclear and impossible up front. However, if you keep at it, before you know it you'll be so good at stats that you're figuring out problems in your sleep! And when you're not working on stats, be sure to just get out and walk around campus and town. Both Baylor and Waco are small enough that you can get almost anywhere easily, but big enough that there's always something new to discover!

**Grad Student spotlight:**

Purvi Prajapati, Ph.D.

For my undergraduate studies, I attended my top choice, Baylor, and obtained a degree in applied mathematics with a concentration in pre-medicine. Towards the end of my first four years at Baylor, I began taking statistics courses, and fell in love with the subject. After completing my undergraduate studies, I took a year off from school and applied to Baylor's statistics program on the recommendation of one of the professors. During the year off, I interned as a biostatistician at Baylor Scott & White Health. My time there showed me that I could apply my fondness of statistics to the medical field and solidified my decision to pursue a career in statistics. After my year off, I returned to Baylor to complete my Ph.D. in statistics. There were many reasons why I choose to go back to Baylor. The students and professors are so friendly and welcoming, plus the program had many benefits, such as the opportunities to network, and the ability to complete in four years. My favorite memories from the program are the random conversations I would end up having with the professors and other students in the cubicles. My favorite courses would have to be the two computational courses taught by Dr. Kahle and the Bayes series taught by Dr. Seaman. The computational courses helped me improve my coding skills and challenged the way I usually think of coding. The Bayes courses changed everything I knew about statistics and opened me to a new way of thinking. Aside from statistics, I liked attending sporting events and going to Farmer's market on Saturdays. During these COVID times, I was fortunate enough to get a job with Eli Lilly & Co. as a research scientist. My advice to current and future students would be to take advantage of your time at Baylor and build relationships with the professors and your graduate students. Those relationships will not only help you through grad school but will last beyond it too.



Undergrad Student Spotlight

Jacob Moore, Statistics Major, Actuarial Track, Junior



What led to your choice of majoring in statistics?

I've always really liked statistics and mathematics and the logic that's behind them. I chose statistics because I felt like I would have many job opportunities in the future while continuing to do something that I have a passion for with a degree in statistics. Right now, I plan on becoming an actuary when I graduate.

Which statistics classes have you enjoyed the most?

Mathematical Statistics with Dr. Hill was one of the most challenging yet rewarding statistics classes that I've taken at Baylor. With STA 4385/4386, I felt like I had a much better and deeper understanding of some of the most common techniques in statistics.



Kevin Gibson, Double major in Statistics and Mathematics, Senior

How did you choose Baylor for your studies?

I chose Baylor because I was looking for a University that provided a top of the line education through a biblical worldview as well as a power 5 athletic program. Baylor is extremely unique in its commitment to excellence while maintaining a faith-based environment.

What led to your choice of majoring in statistics?

I chose to major in statistics because data is more available than ever before and statistics allow us to analyze this information and rethink the way we solve problems in business, sports and other real-world applications.

Which statistics classes have you enjoyed the most?

Probability models with Dr. Harvill and Math Stat with Dr. Hill were my two favorite classes. Both of these classes intertwined my passion for algebra and calculus to solve real-world problems. I have seen the applications of expected value and probability used in other classes such as finance.



Help Support the Department!

The mission of the Department of Statistical Science is to provide quality statistics instruction at all levels, to make significant contributions to the discovery and dissemination of statistical knowledge, and to develop, within a Christian environment, ethical scholars, skilled professionals, and educated leaders who are sensitive to the needs of society.

Your financial support will help the Department realize the mission and impact student's lives. Giving to the Department of Statistical Science will support students in need, provide research and internship opportunities, program dollars to enhance the learning experience.

A gift from you will play a foundational role in helping to build the Department's future, for the students that choose Baylor in the coming years.

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