Kennesaw State University
Analytics and Data Science Institute
Annual Report 2017 – 2018
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WELCOME LETTER FROM THE INSTITUTE DIRECTOR
JENNIFER PRIESTLEY, PH.D., ASSOCIATE DEAN OF THE GRADUATE COLLEGE AND EXECUTIVE DIRECTOR, ANALYTICS & DATA SCIENCE INSTITUTE

This annual report reflects the first year of operation (2017–18) of Kennesaw State University’s Analytics and Data Science Institute (ADSI). The Institute was established in August 2017 in recognition of Kennesaw State University’s leadership role in graduate study in analytics and data science, its current (and ever-increasing) integration in degree programs across the University, and the need for an innovative and interdisciplinary home capable of embracing and supporting computational analytics across the University’s twelve (12) academic colleges and related programs. The Institute also serves as a vehicle for innovative private/public sector collaboration advancing cutting-edge techniques and methodologies related to the translation of data into information.

Offering students the opportunity to work on research in data science, the Institute’s Center for Statistical and Analytical Research (CSAR) houses faculty-led labs, pursuing both funded research opportunities and unfunded research providing a public benefit. CSAR provides an infrastructure to collaboratively engage faculty and leading institutional data users in relevant research and practice in data science. The labs also provide learning opportunities in applied data science for some of the University’s highest-performing master’s-level students. Many of the research products and students highlighted in this report are financially supported through work in the research labs. As you can see from the enclosed report, in its first year of operation, CSAR secured $483,000 in external research funding, much of which went directly to financial support for faculty and students working in the Ph.D. program. The Institute is already a regional leader in research relating to the new — and seemingly boundless — world of “Big Data.” This year’s Ph.D. student and faculty projects ranged from working with the Cobb County Fire Department to optimize response time to emergency calls to a student-led collaboration between the Institute, the University of New Hampshire, and Cornell Medical School examining patient response data in physician reviews in the 10 largest cities in the United States.

We are also pleased with the Institute’s efforts to be an engaged contributor within and beyond campus. This includes

- Launching the Women in Data Science initiative at KSU. The initiative engages and supports students navigating the path to analytics professionals. It is a hub for female professionals in data science in our region, bringing together promising students and accomplished leaders.

- Establishing an intercollege collaboration among the University’s faculty working in computational and analytical-dependent disciplines. In 2017–18, this included Information Systems, Computer Science, Information Technology, Applied Statistics, Health Management and Informatics, and the Master of Business Administration program. This group meets regularly to discuss analytics curricula, conferences, and collaborative research opportunities.

- Providing analytical services at no cost to Cobb County government, non-profit entities, and other efforts contributing to the public good.

The last year was a period of great accomplishment for the Institute. We look forward to a progressively brighter future.
AT A GLANCE

9% ACCEPTANCE RATE

18 PH.D. STUDENTS WORKING WITH

13 AFFILIATED FACULTY FROM

7 ACADEMIC DEPARTMENTS AND

4 COLLEGES.
MISSION STATEMENT

The Analytics and Data Science Institute at Kennesaw State University prepares the next generation of leading data scientists. With affiliated faculty from a wide range of disciplines across the University, the Institute fosters relevant and authentic collaboration between the University and leading institutional data users to advance cutting-edge techniques and methodologies enhancing the human ability to productively and ethically translate data into information, improving decision-making and related outcomes.

CORE STATEMENT

The success of the Institute depends upon a symbiotic and dynamic relationship between education, research, and service, ensuring relevance in research, informing authenticity in education, and efficacy in service.
Serving as director of the Analytics and Data Science Ph.D. program in The Graduate College at Kennesaw State University is both a great honor and a responsibility. I see my duty as taking a vibrant new program in a juggernaut field and ensuring the students and faculty have the infrastructure and support they need to thrive in years to come. In its first three years, the program has been in “startup mode” with all of the accompanying excitement and growing pains. In 2017, the six students of Cohort 1 completed their comprehensive exams, one student defended his dissertation proposal, and the Ph.D. students produced 23 publications as well as one patent. In Spring 2018, students from the program presented and won awards at local, regional, and national conferences. Students also worked with faculty on projects that made significant impacts on local government and non-profits. Successfully navigating “firsts” like comps and proposals are key milestones in the development of any new program; however, these milestones coupled with intensive research productivity demonstrate an impressive level of accomplishment new Ph.D. programs typically do not develop for many years.

One of the hallmarks of the program is the weekly “Research Review Meetings,” which highlights the work of students, faculty and external partners. Students have utilized these meetings to develop working drafts into conference presentations and then into published papers. Faculty and external partners access the insights of innovative students and showcase their work to attract students for collaborative research, which is the hallmark of high-performing Ph.D. programs. Added to the accomplishments of 2017, in 14 months, Ph.D. students have generated 34 published research pieces including journal publications, book chapters, and conference proceedings. This is an average of 2.43 research products per month — an impressive total! An immediate task for me in January 2018 was to quickly constitute and charge an Admissions and Curriculum Committee. We now have a committee of seven dedicated faculty, who represent four departments in three colleges.

These faculty members have done amazing work helping to create an admissions rubric, evaluating over 80 applications for admissions and selecting students for the incoming fourth cohort, to begin Fall 2018. The Committee conducted a review of the current Ph.D. curriculum making recommendations to streamline core courses, enhance comprehensive exams, providing more space for students to both develop concentrations in course work and conduct research, and making the curriculum more responsive.

Those watching the program closely should be pleasantly surprised with some of the proposed changes to the curriculum in future years. All of these accomplishments reiterate that the focus of the program is high quality, interdisciplinary research and teaching — contributing to the recognition of KSU as a leader in Analytics and Data Science.

Our key goals for the program in 2019 include:

1. Graduating the first cohort.
2. Overseeing the successful completion of comprehensive exams for the second cohort.
3. Admitting a high-quality, competitive fifth cohort.
4. Continuing to produce high-quality research publications, with specific emphasis on research productivity for the second and third cohorts.
5. Integrating a course in law and ethics in data science into the program.
THE PH.D. STUDENTS

- CUNY Brooklyn
- Rutgers University
- Academy of Economic Studies (Moldova)
- Southern Polytechnic University
- Georgia Tech
- Kennesaw State University
- North China University
- East Tennessee State University
- Hanoi University (Vietnam)
- Marshall University
- San Diego State University
- Virginia Tech
- Anna University (India)
- North Carolina State University
- Indiana University
- China Pharmaceutical University
- University of Georgia
- Central South University (China)
- University of Tennessee
- Chongqing University (China)
- Georgia State University
- William and Mary
- Emory University
- Jawaharlal Nehru Technological University (India)
- University of Dhaka
- Clemson University
- University of New Hampshire
- Nanjing University of Information Science and Technology
THE PH.D. STUDENTS

COHORT 1

Edwin Baidoo
Sergiu Buciumas
Bogdan Gadidov
Jie Hao
Linh Le
Bob Vanderheyden

COHORT 2

Shashank Hebbar
Jessica Rudd
Yan Wang
Lili Zhang
Yiyun Zhou

COHORT 3

Sanjoosh Akkineni
Andrew Henshaw
Liyuan Liu
Mohammad Masum
Dianna Spence
Lauren Staples
RESEARCH AND PUBLICATIONS

STUDENT HIGHLIGHTS 2017–2018

Linh Le
Degrees: BS Network Engineering (Hanoi University, Vietnam) & MS Information Systems, Marshall University

Year: Cohort 1, started 2015
“I’ve spent half of my life waiting for my models to converge...I love the interdisciplinary science of data that I have been exposed to. And the external projects and research are cool.” — Linh Le

Highlighted Recent Publications/Presentations:


Jessica Rudd
Degrees: BS Anthropology & MS Epidemiology, Emory University

Year: Cohort 2, started 2016
“The PhD program for me is about being surrounded by an amazing group of innovative thinkers who encourage excitement about our role in data science and its’ impact on our community.” — Jessica Rudd

Highlighted Recent Publications/Presentations:


Yiyun Zhou
Degrees: B.S Mathematics, Nanjing University of Information Science and Technology, M.S. Analytics, Georgia State University

Year: Cohort 2, started 2016
“I am inspired by the other students in my cohort and the brilliant professors. It's a great program on the cutting-edge of research to make the world better.” — Yiyun Zhou

Highlighted Recent Publications/Presentations:


ADDITIONAL REPRESENTATIVE STUDENT AND FACULTY SCHOLARSHIP

(*GRANT SUPPORTED)


AFFILIATED FACULTY OF THE ANALYTICS AND DATA SCIENCE INSTITUTE

COLES COLLEGE OF BUSINESS

Joe Demao, Ph.D.
Professor of Computational Mathematics and Data Science

College of Computing and Software Engineering

Xiao Huang, Ph.D.
Associate Professor of Economics

College of Science and Mathematics

Lin Li, Ph.D.
Assistant Professor of Industrial Engineering

Southern Polytechnic College of Engineering and Engineering

Will Hakes, Ph.D.
Senior Affiliate and Advisor of the Institute

Mingon Kang, Ph.D.
Assistant Professor of Computer Science

Xuelei (Sherry) Ni, Ph.D.
Professor of Statistics

Erik Westlund, Ph.D.
Professor of Mathematics

Ying Xie, Ph.D.
Professor of Information Technology
The Advisory Board for the Analytics and Data Science Institute includes business and thought leaders in the Finance, Retail, Hospitality, Technology, Management Consulting, and Energy Sectors. This Board meets two times a year with the leadership of the Institute to provide insights related to the relevancy and the quality of the contributions of the Institute. The Board supports the academic program accountability of the Institute by providing guidance and feedback and serving as partners in research and in community collaborations. While the Institute has requested members to serve for a minimum of three years, most members have been affiliated with the Analytics programs at Kennesaw State University for close to a decade.

Bill Franks  
Chief Analytics Officer, International Institute for Analytics

Will Hakes  
Senior Affiliate and Advisor of the Institute

Don Hayes  
SAS Enterprise Architect, DLL Consulting Inc.

Peter Maynard  
Senior Vice President of Enterprise Analytics, Equifax

Chris Nickerson  
Manager of Customer Analytics, Southern Company Services

Jerry L. Oglesby  
Senior Director of Global Academic Programs and Global Certification, SAS

Eric Schmidt  
Global Director for Revenue Management Optimization and Innovation, InterContinental Hotels Group (IHG)

Mike Stefanick  
Executive Director for Enterprise Data, Analytics and Digital Platforms, EY

Spencer Taft  
Analytics and Business Intelligence Leader, Cox Enterprises

Alex Vayner  
North American Data Science Practice Leader, CapGemini
Welcome to the Center for Statistics and Analytical Research or CSAR (pronounced “Caesar”). It is a very exciting time for CSAR, which houses the research infrastructure of the Analytics and Data Science Institute. CSAR brings together faculty, students, and other stakeholders to solve data-centric problems. Most of the work done in CSAR is completed through one of our many research laboratories.

The research labs employ different staffing models, but all are great examples of private (or public) sector/university collaboration. Each lab includes, at a minimum, a faculty principal investigator, a Ph.D. student, and the lab sponsor. Some labs include graduate students from the affiliated analytics and computational master degree programs such as the Master of Science in Computer Science, Master of Science in Applied Statistics, Master of Science in Information Systems, and the Master of Science in Healthcare Management and Informatics. The structure of the research labs ensures interdisciplinary, applied research, resulting in both publishable findings and actionable insights. Since the formation of CSAR in 2017, we have launched seven corporate sponsored research laboratories resulting in one patent application, many conference presentations, peer review publications, and invaluable experiences for the students and faculty involved.

The key goals for CSAR in 2019 include

1. Increasing the number of sponsored research labs.
2. Securing external funding of $1 million.
3. Increasing the number of departments and colleges engaged in interdisciplinary research with our Ph.D. students through our labs.
4. Producing an ongoing “Research Series in Data Science” to summarize and disseminate the work completed in the labs.
# DATA SCIENCE PRO BONO PUBLICO

## COMMUNITY ENGAGEMENT

<table>
<thead>
<tr>
<th>PROJECTS</th>
<th>FINANCIAL VALUE OF SERVICES</th>
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<tbody>
<tr>
<td><strong>01</strong> COBB COUNTY FIRE DEPARTMENT</td>
<td><strong>$55,000</strong></td>
</tr>
<tr>
<td>The Cobb County Fire Department approached the Analytics and Data Science Institute to help them reduce the time needed to respond to emergency calls. The team of Ph.D. students led by Dr. Joe DeMaio, professor of Applied Mathematics and Data Science, developed solutions related to equipment allocation, traffic patterns, and vehicle routing, which lead to an almost 20 percent decrease in response time — contributing to an improvement in emergency personnel responsiveness for the local community.</td>
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</tr>
<tr>
<td><strong>02</strong> BERT'S BIG ADVENTURE</td>
<td><strong>$38,000</strong></td>
</tr>
<tr>
<td>Bert's Big Adventure is a non-profit organization that provides support for children with chronic and terminal illnesses to visit Walt Disney World with their families. On March 28th, 2018, Jersey Mike's Subs gave 100 percent of their sales to support the charity. The Analytics and Data Science Institute partnered with the lead radio show hosts of The Bert Show to determine how the two hosts could visit each of 37 the Jersey Mike Sub shops in metropolitan Atlanta in one day to promote the event. The team of Ph.D. students led by Dr. Joe DeMaio developed an optimal solution from the 13.8 tredecillion possible options. In total, $165,667 was raised on that one day for the charity.</td>
<td></td>
</tr>
<tr>
<td><strong>03</strong> ONLINE PATIENT REVIEWS</td>
<td><strong>$25,000</strong></td>
</tr>
<tr>
<td>In a project led by Ph.D. student Yiyun Zhou, the Analytics and Data Science Institute, in partnership with faculty from the University of New Hampshire and the Cornell Medical School, extracted 223,715 reviews of 41,104 physicians from 10 of the largest cities in the United States to determine if patients rated their doctors the same way the doctors evaluated their peers. We found that for four medical specializations — family medicine, allergists, internal medicine and pediatrics — patient ratings and doctors' peer reviewed ratings were in agreement. However, ratings were not in agreement for other medical specializations, including cardiologists, endocrinologists, gastroenterologists, oncologists, neurologists, ophthalmologists, and urologists. The published results contribute to the growing body of knowledge related to helping patients make more informed decisions related to health care.</td>
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Cobb County Fire Department

A core component of ADSI’s mission is our commitment to using research to benefit the communities we serve. This past year, we had an opportunity to work with the local fire department to reduce the response time of emergency vehicles.

BACKGROUND

Getting emergency vehicles to an incident is critical in saving lives and property. The Cobb County Fire Department’s (CCFD) eight-minute emergency response time doubles the National Fire Protection Association’s (NFPA) four-minute standard, measured at the 90th percentile of all emergencies. Currently, there are 29 fire stations and 272 fire zones within Cobb County, with each fire station being responsible for a pre-defined set of fire zones. The goal of the project was to reduce the response time by reallocating some of the existing zones to new stations.

APPROACH

We investigated whether fire zones and stations can be realigned to reduce travel times by analyzing historical response time data from September 2011 to August 2016. The historical data contained approximately 200,000 incidents over this time frame. To perform this analysis, Google Maps was used to consider the geography, roadways and traffic congestion of Cobb County as it is today. The Google Maps Distance Matrix API was accessed to retrieve the real time traveling times and analyze historical incidents to find cases where a different fire station than the historically used station could lead to faster response times, by comparing current traveling times. For any historical incident, the Google time was first checked for the corresponding station. Then neighboring fire stations were also checked to see if any other stations could respond faster than the corresponding fire station to the incident. The comparisons of these times were used to drive recommendations on which zones should be reassigned to overall decrease traveling times.

RESULTS

We recommended that 12 of the 272 fire zones be reassigned to different fire stations. In these zones, there was a positive reduction in the average response time by reassigning incidents in these zones to a different fire station. The recommendation reduced average response time by almost two minutes — potentially saving lives and property.
BERT’S BIG ADVENTURE

BACKGROUND

The Bert Show is a popular morning show on Atlanta's Q100 radio station. They host a non-profit organization that provides a "magical, all-expenses-paid, five-day journey to Walt Disney World for children with chronic and terminal illnesses and their families" called "Bert's Big Adventure." On March 28, 2018, 37 locations of Jersey Mike's Subs participated in their Jersey Mike's Day of Giving, where 100 percent of sales in Metro Atlanta go to support Bert's Big Adventure. The goal was to have two popular radio hosts — Bert and Kristin — visit each of the stores personally for photo opportunities and to promote the event. The question posed to the Institute was "How can two people driving in two separate cars visit a total of 37 locations across Atlanta in one day?"

APPROACH

The problem had 13.8 tredecillion possible solutions. We developed an analytical approach which integrated the Multiple Traveling Salesman Problem that pairs a custom genetic algorithm with Google's combinatorial optimization solver. In our program, the genetic algorithm determines the assignment of locations for each of the two radio hosts while the combinatorial solver generates an optimal route for each assignment from the genetic algorithm.

RESULTS

Our methodology produced the optimal solution in only 900 generations (less than 15 minutes of run time). The solution we found divided the locations into groups of 19 and 18 locations. With a budget of 10 minutes to spend at each location, we estimated the completion time for the two routes to be 8 hours and 33 minutes and 8 hours and 51 minutes. With most Jersey Mike's opening at 10 a.m. and closing at 9 p.m., these solutions provided optimal routes with time to spare.

CONCLUSIONS

In the end, the radio hosts were able to visit each location well within the budgeted time. The Jersey Mike's Day of Giving raised $165,557 for Bert's Big Adventure. The Ph.D. students are working with their faculty supervisor, Dr. Joe DeMaio, to expand this work into additional applications.
How Valid Are Online Patient Reviews?
A Comparison of Physician Peer Review and Online Patient Ratings

BACKGROUND
Over 84 percent of all US adults use online ratings sites to inform their product or service purchase decisions. The same is true for health care — patients increasingly access online ratings sites to inform their healthcare decisions, with online ratings emerging as the most influential factor for choosing a physician — 53 percent of physicians and 39 percent of patients reported visiting a health care rating website at least once. In this study we sought to determine the validity of online patient ratings through comparison with physician peer review — defined in this study through Castle Connolly Medical.

APPROACH
Through Healthgrades.com, Vitals.com, and RateMD.com, we extracted 223,715 reviews of 41,104 physicians from 10 of the largest cities in the United States, including 1,142 physicians listed as “America’s Top Doctors” from Castle Connolly Medical — a private consumer research firm that distinguishes top providers both nationally and regionally through a peer nomination process that involves over 50,000 providers and hospital and healthcare executives. Differences in mean online patient ratings were tested for physicians who were listed as a “Top Doctor” and those who were not.

RESULTS
Differences in online patient ratings between physicians listed or not listed as “Top Doctors” varied greatly by specialization. For four medical specializations — family medicine, allergists, internal medicine, and pediatrics — we saw patient ratings that “agreed” with physician peer review. Specifically, patient ratings of physicians listed as a “Top Doctor” were statistically higher for these specializations versus patient ratings of physicians not listed as a “Top Doctor.” Other medical specializations, including cardiologists, endocrinologists, gastroenterologists, oncologists, neurologists, ophthalmologists, and urologists, did not see differences in patient ratings between those physicians listed as a “Top Doctor” or not.
TOP FIVE RESEARCH INITIATIVES

Over the past year, the Center for Statistics and Analytical Research led dynamic research initiatives, which generated $483,000 in external funding. These research grants were managed by faculty Principal Investigators from Computer Science, Information Technology, Statistics and Analytical Sciences, Economics Finance, and Quantitative Analysis. Each grant engaged a combination of graduate students at the masters and Ph.D. levels.

$ 98,000
ERMAS DATA SCIENCE RESEARCH LAB

**Principal Investigator:** Herman “Gene” Ray, Ph.D., Director, CSA  
**Lab Sponsor:** Soon Tan, Principle, Ermas Consulting  
**Students:** Lili Zhang and Mohammed Masum

The Ermas Data Science Lab has two components. First, the lab is actively researching anti-money laundering and fraud analytical models for banking and insurance industries. Second, the lab is assisting with the development of an analytics software solution that has a cloud-based backend. The solution supports development of modules in SAS, R, or Python.

$ 75,000
EQUIFAX DATA SCIENCE RESEARCH LAB

**Principal Investigator:** Ying Xie, Ph.D., Professor of Information Technology  
**Lab Sponsor:** Mike McBurnett, Senior Director, Equifax  
**Students:** Linh Le, Yiyun Zhou, Sanjoosh Akkineni, and Liyuan Liu

The Equifax Data Science Research Lab is conducting research on cutting-edge machine learning techniques to be applied both to structured and unstructured data to improve consumer’s access to credit.

$ 70,000
NOVELIS DATA SCIENCE RESEARCH LAB

**Principal Investigator:** Paul Story, Ph.D.  
**Students:** Liyuan Liu

The Novelis Data Science Research Lab's will study and visualize the data related to personnel, performance metrics and Human Resource related initiatives. The lab will incorporate theory from the Industrial and Organizational (IO) Psychology with cutting-edge data science techniques such as test mining to create high-quality analytics and visualizations. The primary objective is to create a data-driven culture grounded in appropriate IO theory within the HR functionality.
$50,000
FORTIVA DATA RESEARCH LAB

**Principal Investigator:** Sherry Ni, Ph.D., Professor of Statistics
**Lab Sponsor:** Brian Stone, Chief Risk Officer, Fortiva Financial
**Students:** Yan Wang and Soujanya Mandalapu (MSAS)

The Fortiva Data Science Research Lab is investigating the accuracy of various classification techniques and comparing them to a benchmark technique. They are also attempting to find new attributes based on the findings of the classification research that can be used in the traditional techniques.

$45,000
GE POWER DATA RESEARCH LAB

**Principal Investigator:** Mingon Kang, Ph.D., Assistant Professor of Computer Science
**Lab Sponsor:** Girish Mogdil, Senior Director, Data and Analytics, GE
**Students:** Mohammad Masum and Sai Chandra Kosaraju (MSCS student)

The GE Power Data Science Research Lab is investigating text analytics and extraction methods and developing automatic responses to questions based on the specific text analyzed using both supervised and unsupervised techniques.
Funded Research by Dollar Amount and Sector FY 2018

<table>
<thead>
<tr>
<th>Sector Funding</th>
<th>Number of Funding Awards</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Services</td>
<td>4</td>
<td>$314,000</td>
</tr>
<tr>
<td>Healthcare</td>
<td>1</td>
<td>$14,000</td>
</tr>
<tr>
<td>Engineering</td>
<td>3</td>
<td>$130,000</td>
</tr>
<tr>
<td>Energy</td>
<td>2</td>
<td>$25,000</td>
</tr>
<tr>
<td><strong>Total External Funding</strong></td>
<td><strong>10</strong></td>
<td><strong>$483,000</strong></td>
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</tbody>
</table>
Funded Research

2017-2018 in Numbers

For the Fiscal Year Period of July 1, 2017 to June 30, 2018

<table>
<thead>
<tr>
<th></th>
<th>Funded Research</th>
<th>Direct Instructional Expenses of Project</th>
<th>Other Expenses Related to Project</th>
<th>Institutional, University, and Other Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Grant</td>
<td>$50,888.89</td>
<td>$32,357.41</td>
<td>$11,068.53</td>
<td>$7,462.96</td>
</tr>
<tr>
<td>Median Grant</td>
<td>$50,000.00</td>
<td>$28,824.72</td>
<td>$9,512.16</td>
<td>$3,513.30</td>
</tr>
<tr>
<td>Research Grants</td>
<td>$458,000.00</td>
<td>$291,216.66</td>
<td>$99,616.74</td>
<td>$67,166.60</td>
</tr>
<tr>
<td>Institute Sales and Service</td>
<td>$25,000.00</td>
<td>$6,650.00</td>
<td>$9,604.50</td>
<td>$8,745.50</td>
</tr>
<tr>
<td><strong>INSTITUTE TOTAL</strong></td>
<td><strong>$483,000.00</strong></td>
<td><strong>$297,866.66</strong></td>
<td><strong>$109,221.24</strong></td>
<td><strong>$75,912.10</strong></td>
</tr>
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