Kaela W. Nelson

Department of Mathematics
Email: kaelanelson@byu.net
Github: https://github.com/kaelanelson

Brigham Young University
888 East 820 North, Apt. 3
Provo, UT 84606

RESEARCH INTERESTS

Exploring machine learning and probabilistic modeling methods in health analytics. Developing data mining algorithms to discover interesting trends within complex, multi-modal data sets. Utilizing deep learning methods for image recognition.

EDUCATION

BS, Brigham Young University — Expected April 2019
Major in *Mathematics*, Concentration in *Applied and Computational Mathematics*,
Emphasis in *Predictive Modeling*

- Cumulative GPA: 3.8/4.0
- *Selected Coursework:* Algorithm Design and Optimization, Mathematical Analysis, Modeling with Uncertainty and Data, Modeling with Dynamics and Control, Calculus of Variations, Perturbation Theory, Deep Learning, Data Visualization

RESEARCH EXPERIENCE

Institute of Applied Computational Sciences, Harvard University — June 2017 - August 2017
National Science Foundation Research Experience for Undergraduates Intern
Advisors: Dr. Gary Adamkiewicz, Dr. Weiwei Pan & Dr. Pavlos Protopapas, Harvard University

- Research goal: To utilize spatio-temporal modeling for predicting intra-urban air pollution.
- Worked with a team of five undergraduates to model the intra-urban air pollution of the city of Boston using spatial Land Use Regression models and spatio-temporal Gaussian Processes models.
- Collected, cleaned and rastered country-wide land use, weather, and air quality data sets.
- Implemented an interactive web interface for the general public to intuitively visualize the results of our modeling process using D3.

Department of Electrical and Computer Engineering, Brigham Young University — January 2018 - Present
Research Assistant
Advisor: Dr. Willie Harrison, Brigham Young University

- Research goal: To investigate the likelihood that a receiver successfully encodes an encrypted message without interference from eavesdroppers.
- Applied methods in information theory, probability theory, and abstract algebra to determine code security.

Institute of Applied Computational Sciences, Harvard T.H. Chan School of Public Health, Harvard University — June 2018 - Present
Undergraduate Research Fellow
Advisors: Dr. Francesca Dominici, Dr. Weiwei Pan & Dr. Pavlos Protopapas, Harvard University

- Research goal: To determine the causal effect of PM 2.5 exposure in 2010 on the re-hospitalization of patients with cardiovascular disease within the Medicaid population in 2011.

- Created automated scripts to convert and bin ICD-9 codes within Medicaid data.
- Computed treatment effect of PM 2.5 within Medicaid population and adjusted for confounding variables through incorporation of inverse probability weights in Cox Proportional Hazards Model.
- Implemented a Non-negative Matrix Factorization model to discover statistically interesting subgroups within Medicaid population.

PAPERS AND SENIOR PROJECTS

Nelson K*, Dephino A*, Ippolito T*, Liang B*, O-Toole A*, Pan W, Adamkiewicz G, Protopapas P. *Predicting Boston Air Quality.* 2018 Senior Project for Modeling with Uncertainty and Data Class. *These authors contributed equally.

Nelson K*, Thompson S*, Wahl C*, Ward J*. *Inverted Pendulum Optimal Control.* 2018 Senior Project for Modeling with Dynamics and Control Class. *These authors contributed equally.

Nelson K*, Thompson S*, Wahl C*, Ward J*. *Lunar Lander Optimal Control.* 2018 Senior Project for Modeling with Dynamics and Control Class. *These authors contributed equally.

Harrison W, **Nelson K***, Dye S*. *Physical-Layer Security for Aeronautical Telemetry.* International Telemetry Conference. Glendale, Arizona. January 2018. *These authors contributed equally.

ORAL PRESENTATIONS

Nelson K*, Dephino A*, Ippolito T*, Liang B*, O-Toole A*, Pan W, Adamkiewicz G, Protopapas P. *"What's in the Air? Using Mathematical Models to Predict Boston Air Quality"*. Conference for Undergraduate Women in Mathematics. University of Lincoln-Nebraska, Lincoln, Nebraska. January 2018.

AWARDS AND HONORS

- National Honors Society, Notre Dame Academy 2013
- 1st High School Student Representative, National Association of Foreign Student Advisers Advocacy Day 2014
- 1 of 3 selected out of 300 students for Excellence in Mathematics Award 2014
- Academic Scholarship Recipient, Brigham Young University 2015, 2016, 2018
- Career in Mathematics Panelist, Brigham Young University Fall 2017, Fall 2018
- 4th out of 68 teams, BYU ACM Programming Competition November 2017
- 2nd out of 33 teams, BYU ACM Programming Competition March 2018
- 1st out of 63 teams, BYU ACM Programming Competition November 2018

PROFESSIONAL MEMBERSHIPS

Phi Eta Sigma

TEACHING EXPERIENCE

Academic Student Center May 2014 - June 2014
Mathematics Tutor

Program Manager: Chad Desharnais

- Tutored a student in calculus 1 and in calculus 2 consistently 2 hours per week for 6 weeks (2 hours of additional preparation time per week).

Brigham Young University September 2017 - April 2019
Calculus Grader and Assistant
Teacher: C.J. Bott

- Graded and provided detailed feedback on homework for two calculus 2 classes consisting 20 and 35 students, respectively.
- Helped teach students concepts via email discussions upon request.

STEM OUTREACH

Y-Serve, Brigham Young University January 2016 - January 2017
Volunteer Mathematics Tutor

- Tutored 5 undergraduate students 30 plus hours in calculus and linear algebra to promote their confidence in analytic skills.

Math Circles, Brigham Young University September 2017 - April 2018
6th Grade Mathematics Teacher

- Taught mathematics lessons and American Mathematics Competitions (AMC) preparatory materials to community of 10 - 15 students in Utah Valley Region.
- Invested 1 - 2 hours of preparation and 1 hour of teaching each week.

SKILLS AND QUALIFICATIONS

- **Computing:** Experience with Python, C++, Pytorch, Git, and LaTeX. Knowledge in regular expressions, web-scraping, MongoDB, and parallel computing (iPyParallel and MPI). Experience in implementing HTML, CSS, and D3 for building a web interface.
- **Statistics:** Exploratory data analysis; probabilistic modeling; sampling methods including importance, rejection, Gibbs, and Metropolis Hastings; machine learning including regression, classification, clustering, dimensionality reduction, and sentiment analysis.
- **Dynamics and Control Theory:** Knowledge in numerical methods for initial value problems, SIR modeling, lorenz equations, conservation laws and heat flow. Experience in solving the inverted pendulum problem and optimal re-entry problem using control theory.
- **Asymptotic Analysis:** Dimensional analysis; perturbation and asymptotic expansion methods including the WKB method and Poincaré–Lindstedt Method.