

SMSS First Year Graduate Student Seminar

Whitney Huang



wkhuang@clemson.edu

February 15, 2022

Agenda

About Myself

My Research

Some General Advice

Who am I?

- ▶ **Third year** Assistant Professor of Applied Statistics and Data Science
- ▶ Born in Laramie, Wyoming, grew up in Taiwan



- ▶ Got a B.S. in Mechanical Engineering, switched to Statistics in graduate school
- ▶ Got a Ph.D. in Statistics, 2017 at Purdue; did a SAMSI/CANSSI Postdoc before moving to Clemson



samsi
NSF Duke NCSU UNC

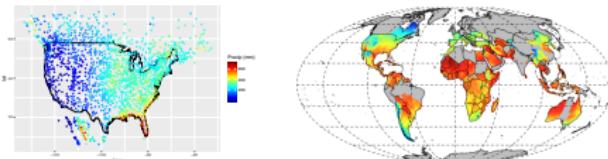


**University
of Victoria**



Overview of My Research

► Spatio-Temporal Statistics



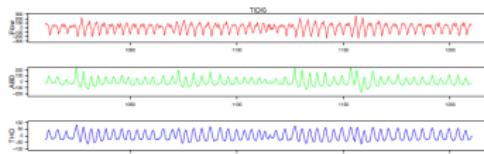
► Extreme Value Analysis



► Design & Analysis of Computer Experiments (a.k.a. UQ)



► High-Frequency Physiological Waveform Signal Analysis



Spatio-Temporal Data

Function Estimation

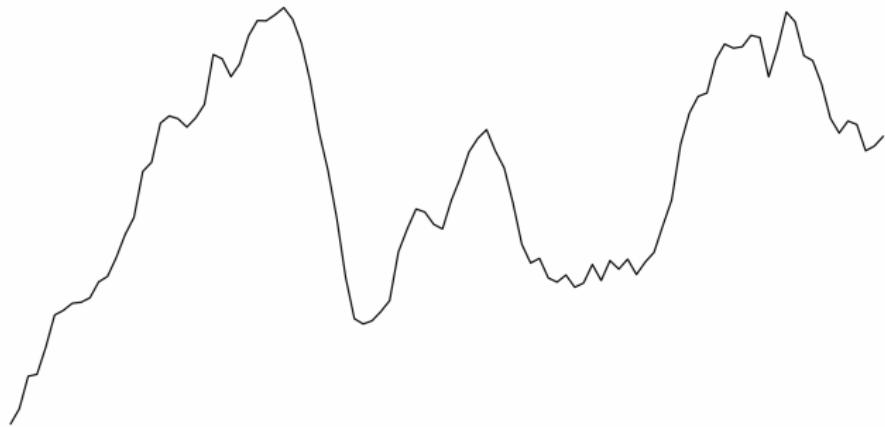


Figure: Courtesy of Matthias Katzfuß

Consider a function

Function Estimation

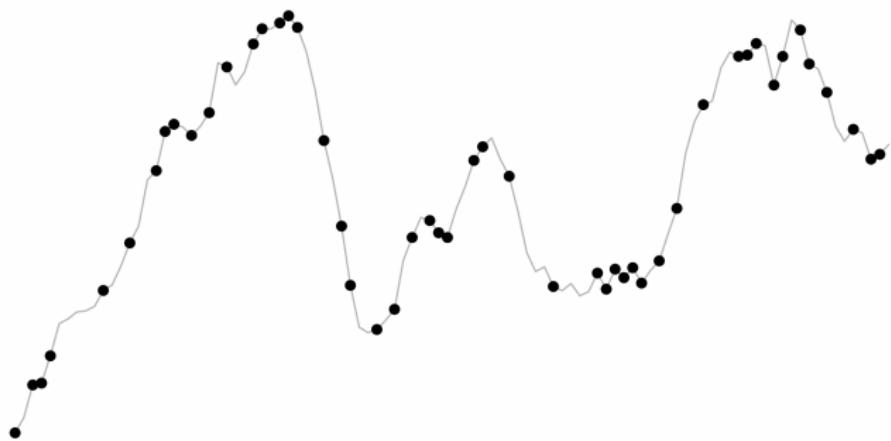


Figure: Courtesy of Matthias Katzfuß

Consider a function, observed incompletely

Function Estimation

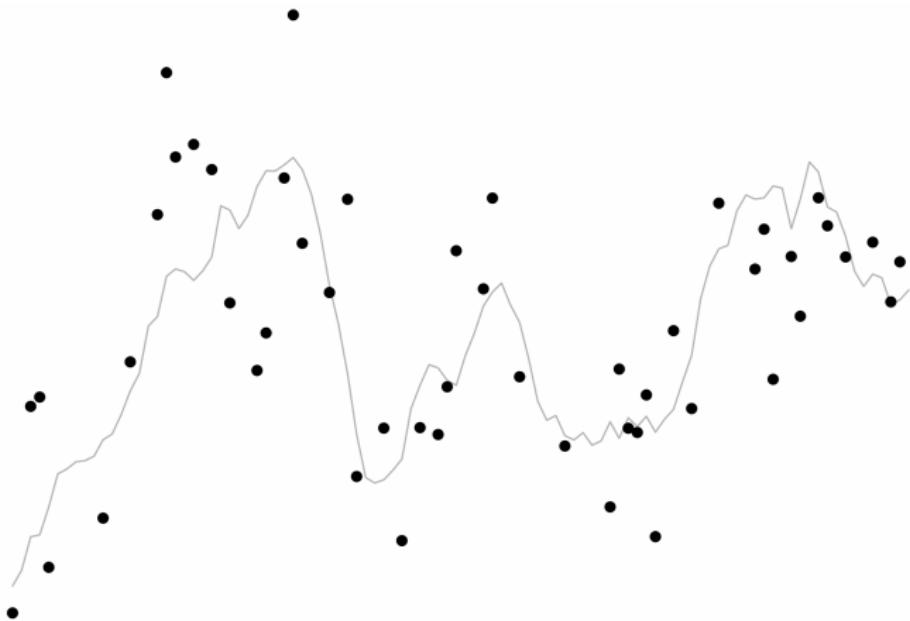


Figure: Courtesy of Matthias Katzfuß

Consider a function, observed incompletely, and with noise

Gaussian Processes (GPs): Probabilistic Function Estimators

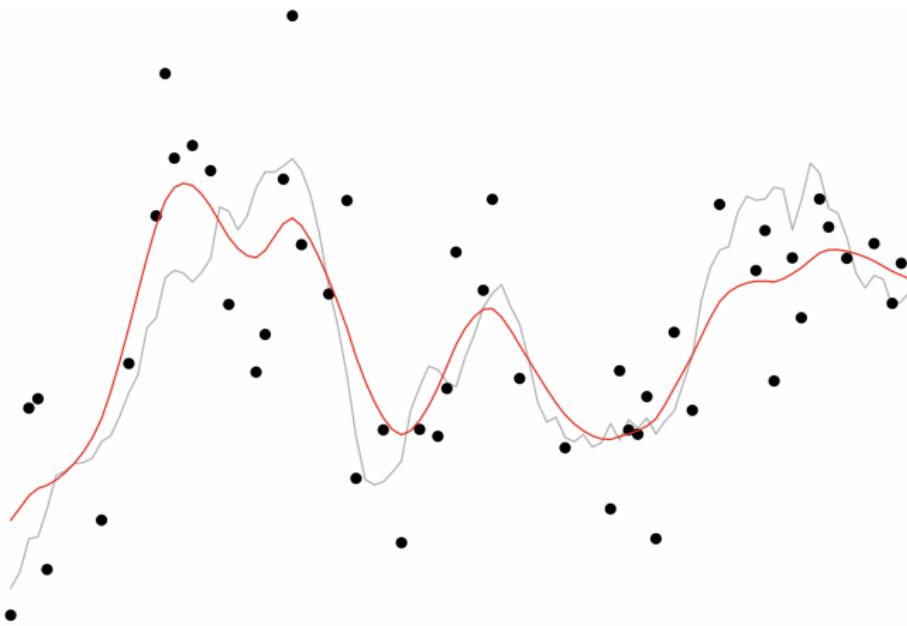


Figure: Courtesy of Matthias Katzfuß

Gaussian Processes (GPs): Probabilistic Function Estimators

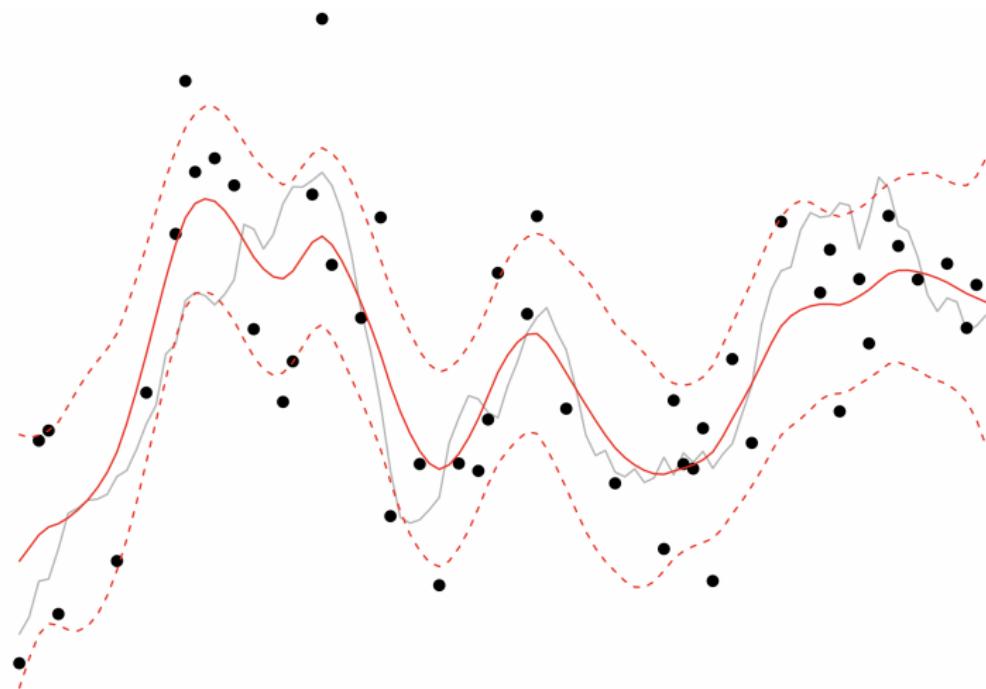


Figure: Courtesy of Matthias Katzfuß

Estimating Extreme Surges: Physical-Statistical Approach

- **Goal:** Estimate high quantile of storm surge in coastal region
- Analysis based on historical storm surge observations alone can be unreliable due to limited data in space and time
- We take a physical-statistical approach:

$$x \in \mathcal{X}$$

$$\eta : \mathcal{X} \mapsto \mathcal{Y}$$

$$y = \eta(x)$$



TC Characteristics

- Records are more complete than surge levels
- **Input** to simulate storm surge levels

Computer Model

- Simulate high fidelity surge response
- computationally extensive

Surge Level

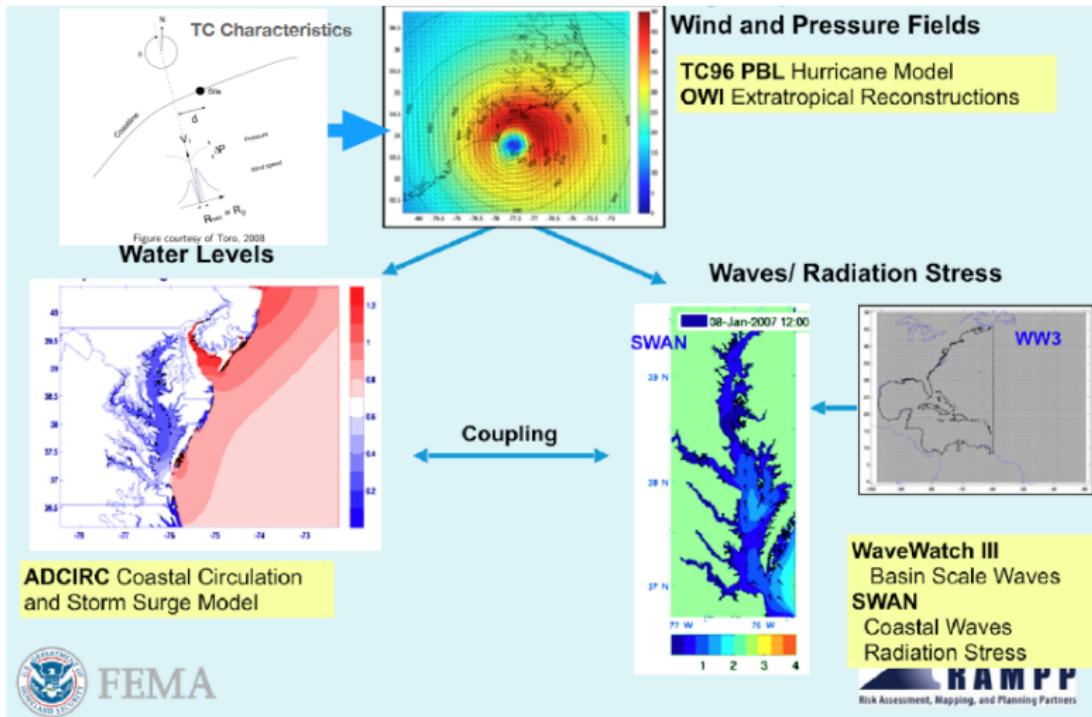
- simulate synthetic storms
- generate surge response for risk analysis

Task: Estimating $f(x)$

Task: Estimating $\eta(x)$

Task: Estimating y_r

Computer Model Linking Input to Output $\eta : x \mapsto y$

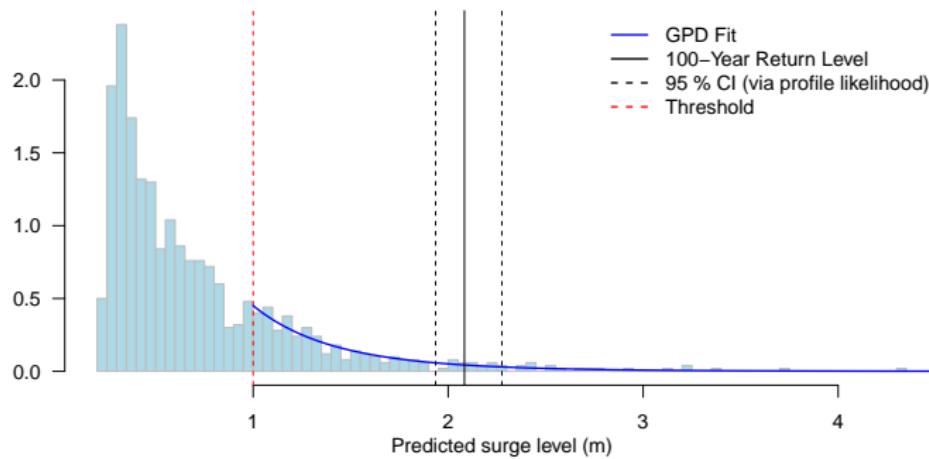


Courtesy of Gangai (Dewberry) & Danforth (FEMA)

Estimating Extreme Surges: Extreme Value Analysis¹

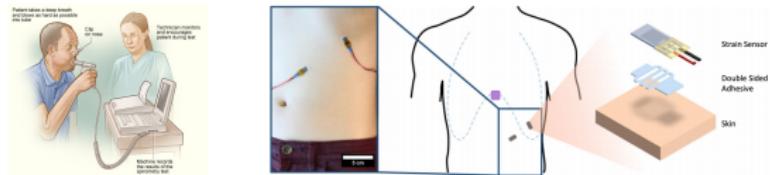
We employed the peaks-over-threshold method [Davison and Smith, 1990] to estimate the r-year return levels

- ▶ Assuming upper tail follow a generalized Pareto distribution (GPD)
- ▶ Using profile likelihood method to construct confidence interval (CI), which gives asymmetric interval

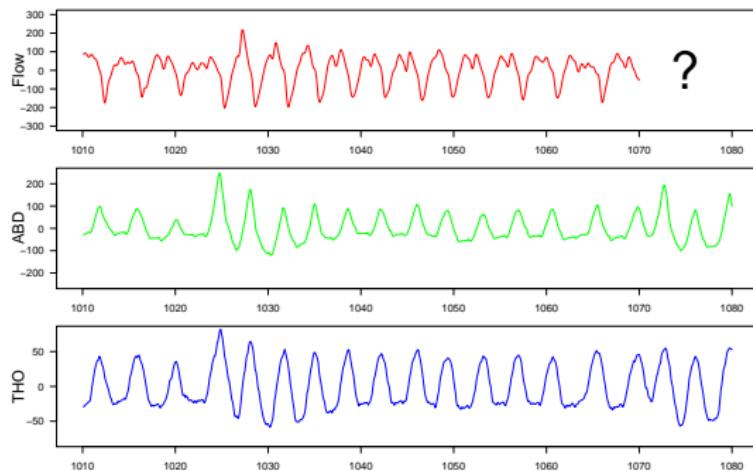


¹There will be a 3-day short course on Extreme Value Analysis this summer given by myself and Dr. Russell

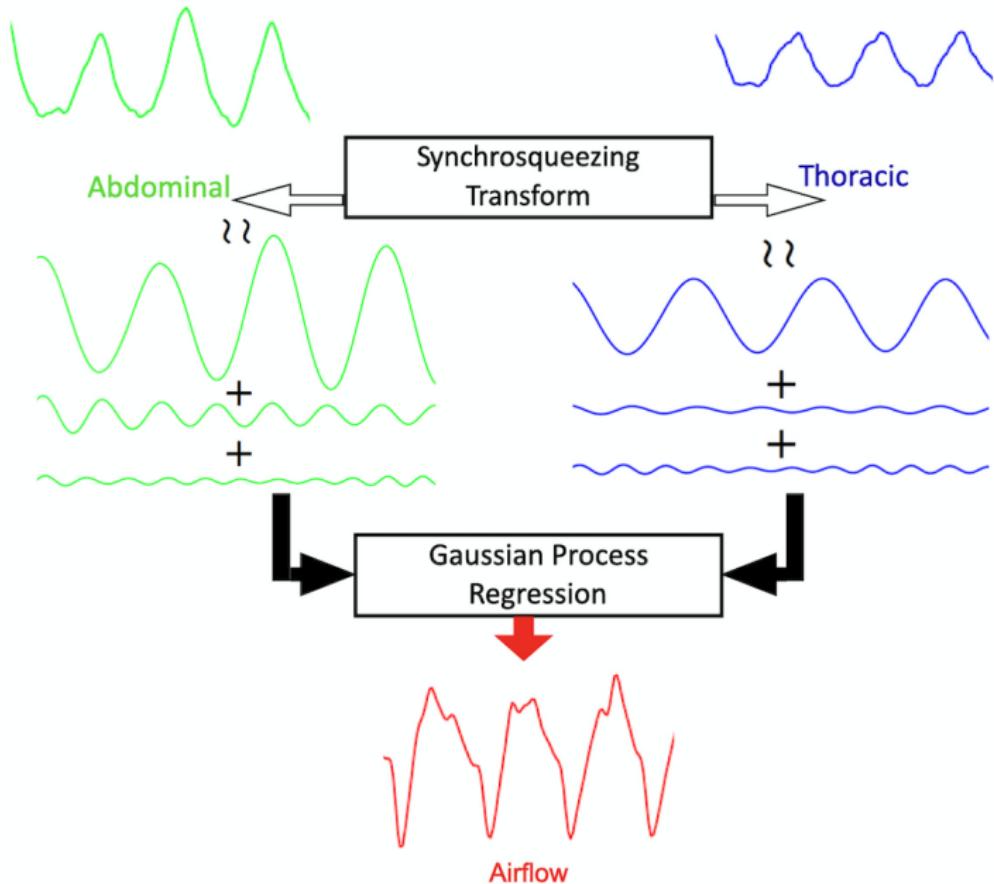
Biomedical Signal Analysis [joint with YM Chung (Eli Lilly), YB Wang (Clemson), Jeff Mandel (UPenn), and HT Wu (Duke)]



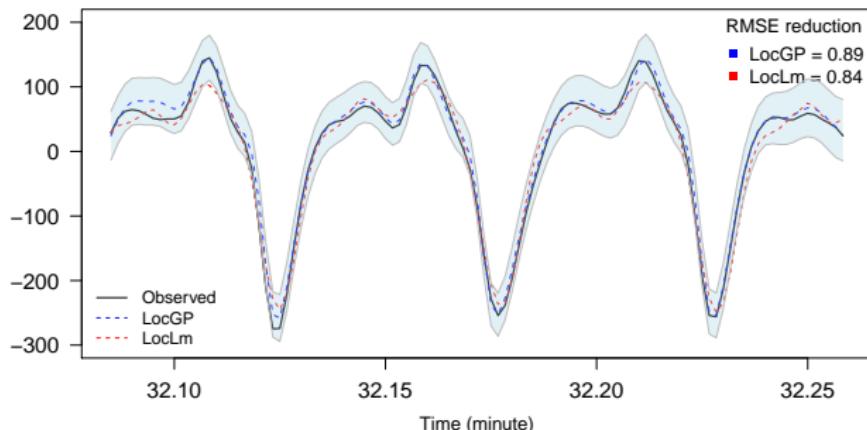
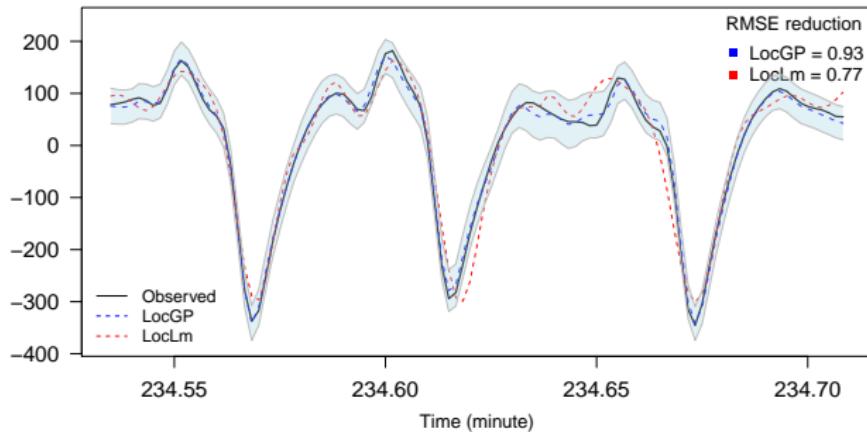
Source: <https://www.sciencedirect.com/topics/neuroscience/central-sleep-apnea> (Left); Chu et al. 2019 Fig. 1a (Right)



Our Proposal



An Example of Airflow Prediction



My Students

- ▶ Andrew Bellucco “*Estimating Financial Risk*” (Co-advised with Dr. Gallagher, Graduated Dec. 2019. Current position: Recommendation Analytics at Credit Karma, Charlotte, NC)
- ▶ Emily Tidwell “*A Combined Physical-Statistical Approach for Estimating Storm Surge Risk*” Graduated May 2021. Current position: Dynetics, Huntsville, AL
- ▶ Adam Diaz, MS, “Contributions to Statistical Analysis of Wildfires”
- ▶ Eva Murphy, PhD, Estimating Spatio-Temporal Variation of Wind Speed and Wind Direction
- ▶ Kanon Kamronnaher, PhD, On Estimating Value at Risk and Expected Shortfall
- ▶ Katherine Kreuser, MS, “Volatility Modeling Using GARCH-X Models”
- ▶ Jiyun Huang, PhD (Co-advised with Dr. Russell), TBD

Reading/Working Groups

We meet every Monday 10am - 11am via zoom

- ▶ Spatio-Temporal Statistics: joint with Drs. Brook Russell, Pulong Ma, Shyam Ranganathan, and Xinyi Li

Link:

<https://whitneyhuang83.github.io/ENVR/ClemsonENVR.html>

- ▶ Uncertainty Quantification (UQ): joint with Drs. Andrew Brown and Qiong Zhang, Pulong Ma

Link:

<https://whitneyhuang83.github.io/UQ/ClemsonUQ.html>

Some General Advice

Being a Graduate Student

- ▶ “How to Succeed in Graduate School” by Marie desJardins
<http://www.ai.sri.com/~marie/papers/advice-summary.html>
- ▶ “Notes on the PhD Degree” by Douglas Comer
<https://www.cs.purdue.edu/homes/dec/essay.phd.html>
- ▶ “Writing and Presenting your Thesis or Dissertation” by S. Joseph Levine
<http://www.learnerassociates.net/dissthes/>

Some Useful Computing Skills

- ▶  (<https://www.r-project.org>),  R Studio (<https://www.rstudio.com>), and R markdown (<http://rmarkdown.rstudio.com>)
- ▶  and  Overleaf (<https://www.overleaf.com/project>)
- ▶ Python and  jupyter (<https://jupyter.org/>)

Attend Seminars!

- ▶ Graduate Student Seminars
<http://siam.people.clemson.edu/gss/schedule.php>
- ▶ Research Seminars
- ▶ School Colloquia

Attend Workshops!

- ▶ NSF-CBMS Regional Research Conferences in the Mathematical Sciences
<https://www.cbmsweb.org/regional-conferences/>
- ▶ National Science Foundation (NSF) funded mathematical sciences institutes <https://mathinstitutes.org/>
- ▶ Confronting Global Climate Change, September 19 — December 9, Institute For Mathematical And Statistical Innovation (IMSI)
<https://www.imsi.institute/activities/confronting-global-climate-change/>

Attend Conferences!

- ▶ Joint Mathematics Meetings (JMM): [January](#)
- ▶ Society for Industrial and Applied Mathematics (SIAM) Annual Meeting: [July](#)
- ▶ Institute for Operations Research and the Management Sciences (INFORMS) Annual Meeting: [October or November](#)
- ▶ Joint Statistical Meetings (JSM): [Late July or early August](#)
- ▶ Neural Information Processing Systems (NIPS) Conference: [December](#)

How to React Me?

- ▶ **Websites** 🖥: <https://whitneyhuang83.github.io/>
- ▶ **Email** ✉: wkhuang@clemson.edu
- ▶ **Office:** O-221 Martin Hall



Go Tigers!

How to React Me?

- ▶ **Websites** 🖥: <https://whitneyhuang83.github.io/>
- ▶ **Email** ✉: wkhuang@clemson.edu
- ▶ **Office:** O-221 Martin Hall



Go Tigers!