MATH 8090:
Course Information

Time Series Analysis

Whitney Huang

CLEMSON UNIVERSITY

About the Instructor

About Me

- **Current role:** Associate Professor of Statistics. I primarily teach in the Data Science and Analytics program, along with a Time Series course.
- **Background:** Born in Laramie, Wyoming, and raised in Taiwan.

- **Academic path:** Started with a B.S. in Mechanical Engineering and transitioned to Statistics for graduate studies.
- **Doctorate:** Ph.D. in Statistics, 2017, from Purdue University. Completed a postdoc before joining Clemson University.

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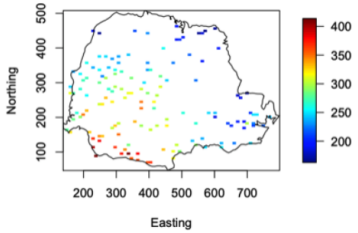
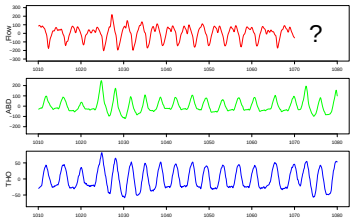
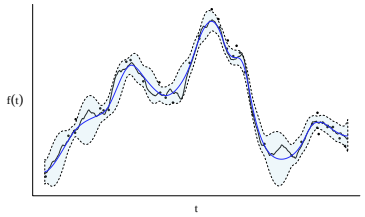
Overview of My Research

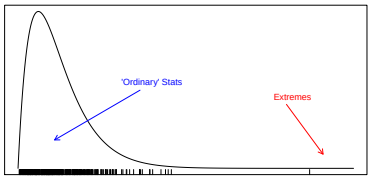
- Spatio-temporal statistics

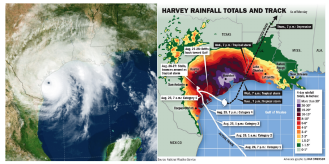






- Extreme value analysis



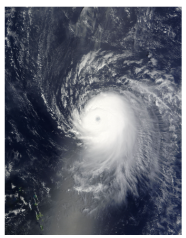


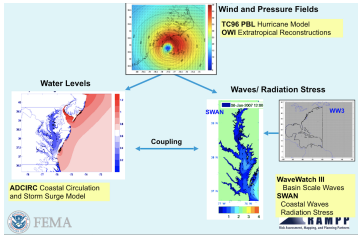
Source: NASA (Left); National Weather Service (Right)

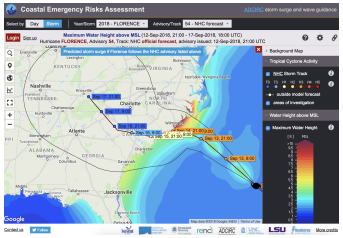
- Surrogate modeling of computer experiments

$$\boldsymbol{x} \in \mathcal{X} \qquad \eta : \mathcal{X} \mapsto \mathcal{Y} \qquad y = \eta(\boldsymbol{x})$$

Input → Model → Output







How to Reach Me?

- **Email:** wkhuang@clemson.edu

  Please include [MATH 8090] in your email subject line.

- **Office:** O-221 Martin Hall

- **Office hours:** Monday 9:00 AM–10:00 AM, Thursday 1:30 PM–2:30 PM, and by appointment.

Class Policies

Logistics

- There will be **8 homework assignments**:
  - Homework must be uploaded to Canvas by 11:59 PM ET on the due date
  - The lowest homework grade will be dropped
- **In addition to the 8 homework assignments**, you will be responsible for scribing 3–4 lecture notes using the provided LaTeX template
- There will be two 60-minute exams. The tentative dates are Wednesday, Sep. 23, and Friday, Oct. 30
- There will be a final project. It could be a **data analysis**, a **simulation study**, **methodological or theoretical research**, or a **report on a research article** of interest to you
- Project topics must be approved by me no later than Nov. 12

Evaluation

Grades will be weighted as follows:

Homework	20%
Exam I	25%
Exam II	25%
Final Project	30%

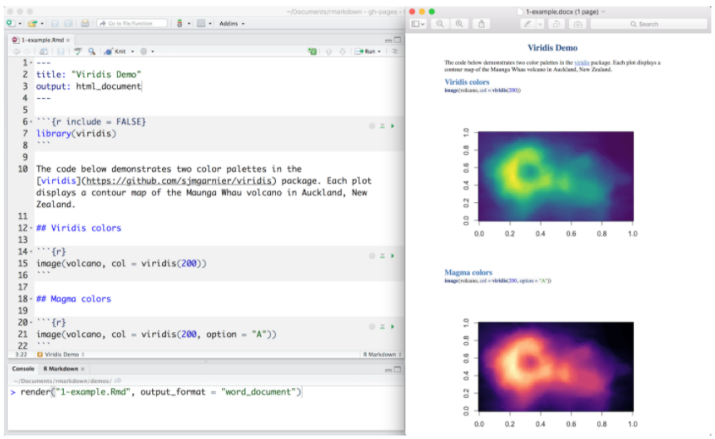
Final course grades will be assigned using the following grading scheme:

≥ 90.00	A
88.00–89.99	A-
85.00–87.99	B+
80.00–84.99	B
78.00–79.99	B-
75.00–77.99	C+
70.00–74.99	C
68.00–69.99	C-
≤ 67.99	F

Computing

We will primarily use `R/RStudio` for statistical computing:

- `R` is a free, open-source language for statistical computing
- Download: `R` (`https://www.r-project.org/`) and `RStudio` (`https://posit.co/download/rstudio-desktop/`)
- **R Markdown** is strongly recommended for homework



Other languages (e.g., Python) are welcome, but support may be limited

Course Materials on Canvas

- Course syllabus and announcements
- Lecture slides, notes, and videos
- `R` code
- Data sets

Course Website

Link: https://whitneyhuang83.github.io/MATH8090/Schedule.html

MATH 8090 Time Series Analysis, Forecasting and Control

Contact Information

Instructor: Whitney Huang
Email: wkhuang@clemson.edu
Office Hours:Monday 9:00 AM-10:15 AM, Tuesday 9:00 AM-10:15 AM, and Thursday 1:50 PM-2:30 PM, and by appointment
Syllabus:Link

Announcements

- Welcome to MATH 8090!

Schedule

Week	Date	Topic	Slides	Notes with R Code	Homework Assignments/Labs	Exam/Project
1	Aug. 21	Course Overview and Review of Statistical Concepts	Course information; Slides 1	R Session 1		
2	Aug. 26 and Aug. 28	Modeling Trend and Seasonality with Regression Techniques	Slides 2	R Session 2	HW 1 Due: Aug. 31	
3	Sep. 2 and Sep. 4	Stationary Processes: Properties, Mean, and Covariance Functions	Slides 3	R Session 3		
4	Sep. 9 and Sep. 11	Estimating Mean and Covariance of Stationary Processes	Slides 4	R Session 4	HW 2 Due: Sep. 14	
5	Sep. 16 and Sep. 18	ARMA Models: Properties, Model Selection, and Diagnostics	Slides 5	R Session 5	HW 3 Due: Sep. 21	
6	Sep. 23 and Sep. 25	ARMA Models: Prediction, Estimation, and Inference	Slides 6	R Session 6	HW 4 Due: Sep. 28	Exam I: Sep. 25
7	Sep. 30 and Oct. 2	ARMA Case Study and ARIMA Models	Slides 7	R Session 7		
8	Oct. 7 and Oct. 9	Seasonal Models: SARIMA	Slides 8	R Session 8		
9	Oct. 16	Regression with Time Series Errors and Related Topics	Slides 9	R Session 9	HW 5 Due: Oct. 19	
10	Oct. 21 and Oct. 23	GARCH Models and Their Applications in Financial Time Series	Slides 10	R Session 10		
11	Oct. 28 and Oct. 30	Frequency-Domain Analysis of Time Series	Slides 11	R Session 11		Exam II: Oct. 30
12	Nov. 4 and Nov. 6	Estimation in the Frequency Domain	Slides 12	R Session 12	HW 6 Due: Nov. 9	
13	Nov. 11 and Nov. 13	Introduction to State-Space Models	Slides 13	R Session 13		Final Project Proposal Due: Nov. 13
14	Nov. 18 and Nov. 20	State-Space Models and Multivariate Time Series Models	Slides 14	R Session 14	HW 7 Due: Nov. 21	
15	Nov. 25	Multivariate Time Series Models and Spatial-Temporal Models	Slides 15	R Session 15		
16	Dec. 2 and Dec. 4	Review and Further topics	Slides 16			Final Project Presentation Dec. 5 5:30pm - 7:30pm
17	Dec. 8-12	Final Project				Final Project Due

Reference Books

- *Introduction to Time Series and Forecasting*, 3rd Edition, **Peter Brockwell and Richard Davis, 2016**.
  Springer link
- *Time Series Analysis and Its Applications with R Examples*, 4th Edition, **Robert Shumway and David Stoffer, 2017**.
  Book website
- *Time Series Analysis with Applications in R*, 2nd Edition, **Jonathan Cryer and Kung-Sik Chan, 2008**.
  Springer link
- *Time Series Analysis: Forecasting and Control*, 5th Edition, **George Box, Gwilym Jenkins, Gregory Reinsel, and Greta Ljung, 2015**.
  Wiley link
- *Analysis of Financial Time Series*, 3rd Edition, **Ruey Tsay, 2010**.
  Wiley link

Tentative Schedule

Week	Topic
1	Course overview and review of statistical concepts
2	Modeling trend and seasonality with regression techniques
3	Stationary processes: properties, mean, and covariance functions
4	Model-free estimation of stationary means and covariances
5	ARMA models: properties, identification, and estimation
6	ARMA models: inference, diagnostics, and model selection
7	ARMA models: prediction, forecasting, and modeling case study
8	Seasonal models: SARIMA
9	Regression with time-series errors and related topics
10	GARCH models and applications in financial time series
11	Frequency-domain analysis of time series
12	Estimation in the frequency domain
13	Introduction to state-space models
14	State-space models and geostatistics
15	Spatio-temporal models
16	Review and further topics
17	Final project