DS 401 – Time Series and Forecasting (3 credits)
SYLLABUS - Spring 2021 - Online - Asynchronous

Instructor:	Dr. Abolfazl Saghafi	**Office**:	STC 209	
Email:	A.Saghafi@USciences.edu	**Phone**:	(215) 596-7240	
Lectures:	Recorded lectures are available on D2L			

Office Hours: I will meet with each student individually to review their progress and answer their questions. If you needed more assistance outside that schedule, send me an email to schedule a Zoom meeting plz.

I. **Recommended Textbook:**
   Main: Chatfield & Xing, The Analysis of Time Series: An Introduction with R, 7tn Ed, CRC Press, 2019.
   Supplementary: Shumway & Stoffer, Time Series Analysis in R, 4th Ed, Springer, 2017.

II. **Course Description:**
   The course will provide students with basic understanding of time series data and various components that could be present in data gathered through time. Common statistical methods and corresponding theory to model time series data are discussed and practiced with real and simulated data. Model selection and parameter estimation is discussed in conjunction with checking model assumptions. An adequate model is then used to make forecasts.

III. **Technology:**
   R codes will be provided along with lectures. Instructions on how to use R is available in handouts on D2L.

   D2L also contain the syllabus, weekly practice problems with solutions, weekly quizzes, bi-weekly homework assignments, lectures, handouts, and other course related materials. Check D2L frequently for updates.

IV. Learning Objectives:
1. Identify and visualize time series data
2. Understand different components of time series data
3. Assess various statistical models and choose an adequate model
4. Perform parameter estimation for selected models
5. Perform model validation and residual analysis
6. Use adequate models for forecasting
7. Simulate time series data
8. Learn to use statistical softwares for time series analysis and forecasting

V. Grading Rubric:
There are weekly quizzes worth 40% and bi-weekly homework assignments worth 40% of your total grade; 20% for a project. Up to 3% extra credit is awarded at an end-of-the-semester assessment test (3% for scoring ≥70, 2% for ≥60, 1% for ≥50). Course grade is assigned according to the following table:

Grade ≥ 97	A+		73 ≤ Grade < 77	C
93 ≤ Grade < 97	A		70 ≤ Grade < 73	C-
90 ≤ Grade < 93	A-		67 ≤ Grade < 70	D+
87 ≤ Grade < 90	B+		63 ≤ Grade < 67	D
83 ≤ Grade < 87	B		60 ≤ Grade < 63	D-
80 ≤ Grade < 83	B-		Grade < 60	F
77 ≤ Grade < 80	C+			

Incomplete Grade: An "I" grade will be given only in cases of extreme hardship, only if a written explanation from a physician or other relevant person is provided. Poor performance in the course is not grounds for an incomplete.

VI. Makeup Exams:
There are no exams! If you are stock with assignments and cannot proceed, email me ASAP. Depending on your progress and the situation, I might extend your assignment due date.

VII. Graded Assignments:

1. Quiz (Q)
- A quiz with up to five questions is posted at the end of each week's material. It is best if you practice with practice problems before answering quiz questions.
- You have three attempts to answer the quiz questions, the highest grade is stored.

2. Homework Assignments (HW)
- There are six bi-weekly homework assignments. They are released on D2L periodically with their due dates written on the assignment sheet.
- All homework assignments that require coding should be written in R markdown or Python Notebook and submitted on D2L by due dates. No late homework or homework sent via email will be accepted.

- You are encouraged to work in groups on homework assignments and problems; however, you must write your own answers.
- Answers will be provided after the due dates on D2L. I strongly recommend polishing your coding expertise by investigating answers.

3. Project (PR)
- The topic of the project is related to materials discussed in the class and will be distributed at week 8.
- Each student is required to submit a final project report as well as a video giving oral presentation on the last week of the classes. The report will be checked for plagiarism by
- More details are provided on project descriptions.

VIII.   IMPORTANT DATES
Given in detail in the university Academic Calendar:

Drop/Add Deadline:	Fri, Feb 5, 2021
Withdrawal Deadline:	Fri, Apr 2, 2021
Reading Day:	Wed, May 5, 2021

IX.   COURSE POLICIES: Student Expectations
Attendance Policy: Attendance at class meetings is essential to academic success. Full time attendance to every class is expected. For online students, I hold meetings periodically to check on your progress and expect your attendance.

Professionalism Policy: Students are expected to follow course material on a routine schedule. Questions and issues can be discussed in individual meetings. It is highly recommended to keep your phone away when you are following lectures at home.

Academic Integrity: Academic integrity is at the center of the educational experience at USciences. Students are therefore expected to uphold the highest standards of academic integrity and not engage in nor tolerate academic dishonesty. Academic dishonesty includes, but is not limited to, fabrication, cheating or plagiarism and unauthorized collaboration. Any violation of academic integrity will be investigated and, where warranted, the student will receive appropriate sanctions through the University's Student Conduct Process. Please familiarize yourself with the current USciences Student Handbook https://www.usciences.edu/student-life/student-handbook.html. In particular, adherence to the Student Conduct Policy and Academic Integrity Policy will help to ensure that you're learning and living experiences are founded on integrity.

Students with Disabilities Act (ADA) Compliance Statement: USciences supports the educational endeavors of all students, including students with disabilities. ADA defines a disability as a mental or physical impairment that substantially limits one or more major life activities. If you believe that you have a disability that may impact your ability to fulfill your course or degree requirements, and you would like more information on applying for an accommodation under ADA, please contact the Program Coordinator of Student Accommodations who serves as 504 Coordinator at 215-596-8758 or OSA@usciences.edu

Mental Health Wellness Statement: USciences encourages students to recognize that academic success requires students to be emotionally and physically well. If you are having difficulty coping with stress associated with the classroom or are experiencing other personal issues, please go to

USciences Health and Counseling (SHAC) located on the first floor of Whitecar Hall or call 215.596.8536, or email shac@usciences.edu. Additional emotional support is available 24/7 and can be obtained by contacting the National Suicide Prevention Hotline at 800.273.8255 or by texting "Go" to the Crisis Text Line 741-741. The services listed above are all free and confidential. Please remember- getting help for yourself or your loved ones is smart and courageous.

Class Recording: All unauthorized distribution of class material is prohibited. Pre-recorded lectures are made available on D2L.

X. **COVID-19 statement**
As we continue to navigate the COVID-19 pandemic it is important to remember that all students must:
- wear a mask while on campus unless alone in a room, such as a residence hall room
- pay close attention to the entrance/exit signage designed to help maintain social distancing
- practice good hygiene by frequently washing hands
- conduct a daily health check before coming to campus

If we all follow the rules, we will help to ensure our learning environment is as safe as possible.

Students who are ill, regardless of symptoms or diagnosis, should not come to campus for classes or activities and should contact Student Health and Counseling - SHAC (shac@usciences.edu). If students are ill, but able to virtually participate in courses they may do so. Students should not contact the Office of Student Health for "sick notes."

The COVID-19 pandemic has refocused the need for both mental and physical personal wellness. The University encourages students who are ill to take the time to focus on their health. Additionally, if needed, students may reach out to their college dean's office to inquire about leave of absence options including short-term leave of absence (up to 10 business days), a personal leave of absence, or a medical leave absence. We firmly believe to learn you must be healthy.

Time Series and Forecasting - In-Class + Online
Spring 2021 Tentative Sequence of Activities

Week	Subjects	Assignments Due
Week 1	Time Series Components & Stationarity Describing Time Series, Introducing Trends, Seasonality, Stationarity	Quiz
Week 2	Estimating & Removing Trends White Noise, Estimating Trends using Regression, MA Filtering, Differencing	Quiz
Week 3	Estimating & Removing Seasonality Introducing Seasonality, Estimating Seasonality, Residual Analysis	Quiz / HW1 Due
Week 4	Autocorrelation & Partial Autocorrelation Functions Introducing ACF, Computing ACF for various model	Quiz
Week 5	Moving Average (MA) Time Series	Quiz / HW2 Due
Week 6	Autoregressive (AR) Time Series	Quiz
Week 7	Autoregressive Moving Average (ARMA) Time Series	Quiz / HW3 Due
Week 8	Non-stationary Time Series	Quiz
Week 9	Model Identification using ACF and PCF	Quiz / HW4 Due
Week 10	Parameter Estimation	Quiz
Week 11	Simulating Time Series	Quiz / HW5 Due
Week 12	ARCH and GARCH Models	Quiz
Week 13	Machine Learning in Time Series	HW6 Due
Week 14	Machine Learning in Time Series Project Presentation	
Finals Week		Project Due