Time Series Analysis
Math 5075/6820-001, Spring 2020

Instructor: Sung Chan Choi, (Office: JWB 121)
Class meets: 01/07/2020 to 04/21/2020
Time: T Th 04:30PM-06:00PM
Place: LCB 215. See https://map.utah.edu/
Email: choi@math.utah.edu
Office Hours: T, Th 6:00PM-7:00PM in JWB 121


Prerequisites: Math 2270 (Linear Algebra), Math 5010 (Introduction to the Probability) and Math 5080/5090 (Statistical Inference I & II).

Topics covered, if time permits:

1. Characteristics of Time Series
   (a) The Nature of Time Series Data
   (b) Time Series Statistical Models
   (c) Measures of Dependence
   (d) Stationary Time Series
   (e) Estimation of Correlation
   (f) Vector-Valued and Multidimensional Series

2. Time Series Regression and Exploratory Data Analysis
   (a) Classical Regression in the Time Series Context
   (b) Exploratory Data Analysis
   (c) Smoothing in the Time Series Context

3. ARIMA Models
   (a) Autoregressive Moving Average Models
   (b) Difference Equations
   (c) Autocorrelation and Partial Autocorrelation
   (d) Forecasting
   (e) Estimation
   (f) Integrated Models for Nonstationary Data
   (g) Building ARIMA Models
(h) Regression with Autocorrelated Errors

4. Additional Time Domain Topics

(a) Long Memory ARMA and Fractional Differencing
(b) Unit Root Testing
(c) GARCH Models

5. Spectral Analysis and Filtering

(a) Cyclical Behavior and Periodicity
(b) The Spectral Density
(c) Periodogram and Discrete Fourier Transform
(d) Nonparametric Spectral Estimation
(e) Parametric Spectral Estimation
(f) Multiple Series and Cross-Spectra
(g) Linear Filters
(h) Lagged Regression Models
(i) Signal Extraction and Optimum Filtering

Grade Distribution:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>20%</td>
</tr>
<tr>
<td>Quiz</td>
<td>20%</td>
</tr>
<tr>
<td>Final Project (04/21 (T))</td>
<td>10%</td>
</tr>
<tr>
<td>Midterm Exam 1 (2/27 (Th)</td>
<td>15%</td>
</tr>
<tr>
<td>Midterm Exam 2 (04/09 (Th)</td>
<td>15%</td>
</tr>
<tr>
<td>Final Exam (04/23 (Th))</td>
<td>25%</td>
</tr>
</tbody>
</table>

Grading Scale:

| [93, 105] | A | [73, 78] | C |
| [90, 93]  | A-| [70, 73] | C-|
| [88, 90]  | B+| [68, 70] | D+|
| [80, 83]  | B-| [60, 63] | D-|
| [78, 80]  | C+| [0, 60]  | E |

Course Policies:

- General
  - Exams and quizzes are closed book, closed notes.
  - If you cheat on any homework, quiz or exam, I will automatically give you a zero for that grade.
  - No makeup exams and quizzes will be given except in the case of a documented emergency. Please contact the instructor ASAP, or at least two classes ahead of time so that the instructor and student can make arrangements to make up the test. I reserve the right to make makeup exams more difficult than the scheduled test.
– There will be **no retakes** of exams and quizzes . . . ever. Your score is what you get.

**Final Project**

– Any topic about time series is allowed.
– You must type.
– The due is 04/21 (T).
– **Written component:** All projects must include the following key components.
  1. You must use real data sets.
  2. An explanation of the methods and the ideas behind them so that the others can understand.
  3. Include some figures and tables.
  4. All R code must be included.

**Homework**

– Homework assignments can be found on the course Canvas page.
– **Late homework will not be accepted.**
– You may work with others on assignments but you must submit individually.
– **3 lowest scores** will be dropped.

**Quizzes**

– Quiz will be given for **every class** during this semester.
– A quiz will cover the topic of the previous class. A study guide can be found on the course Canvas page.
– 10-15 minutes will be given.
– **3 lowest scores** will be dropped.

**Midterms**

– There will be two in-class midterm exams.
– **02/27(Th) and 04/09(Th)** in the regular classroom.

**Final**

– The comprehensive final exam will be on **April 28 (T), 6:00 PM - 8:00 PM.** The location will be announced in class.
• Other Policies

– There will be no retakes of exams ... ever. Your score is what you get.

– You may take an alternate exam if you submit a documented verification about it to me first and explain the extenuating circumstances that make it necessary. Needing to work, babysitting your siblings, oversleeping, or needing more time to study do not pass as acceptable reasons.

– I will demand respectful behavior in my classroom. Examples of disrespect include reading a newspaper or magazine in class, social chatting with your friend in class, text-messaging your buddies during class or cuddling with your girl/boyfriend in class.

– There will be no cursing nor negative ranting (for example, “math sucks”) on any written work turned in. The penalty for such things on your written work will be a zero score on that assignment or test!

– You need to have a valid email address registered with Campus Information System.

– You need to check CANVAS everyday.

– Student Responsibilities: All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. You have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, collusion, fraud, theft, etc. Students should read the Code carefully and know you are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee. See http://regulations.utah.edu/academics/6-400.php

– I reserve the right to change my policies stated in this syllabus at some point in the semester. If I do make a change to a policy, I will announce it in class and send the change in email.

Important Dates:

• Holidays

  – 03/08 (Sun) - 03/15 (Sun): Spring Break

• 01/17 (F): Last Day to Add, Drop (Delete), Elect CR/NC, or Audit Classes

• 03/06 (F): Last Day to Withdraw from classes

• See http://registrar.utah.edu/academic-calendars/spring2020.php
**Student Names and Personal Pronouns:**
Class rosters are provided to the instructor with the students legal name as well as Preferred first name (if previously entered by you in the Student Profile section of your CIS account). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class, on papers, exams, group projects, etc. Please advise me of any name or pronoun changes (and update CIS) so I can help create a learning environment in which you, your name, and your pronoun will be respected. If you need assistance getting your preferred name on your U-ID card, please visit the LGBT Resource Center Room 409 in the Olpin Union Building, or email bpeacock@sa.utah.edu to schedule a time to drop by. The LGBT Resource Center hours are M-F 8am-5pm, and 8am-6pm on Tuesdays.

**ADA:**
The American with Disabilities Act requires that reasonable accommodations be proved for students with physical, cognitive, systemic learning, and psychiatric disabilities. The student needs to have such a disability approved by the Disability Service Office (162 UNION, 581-5020) in order to have the accommodations provided. The instructor need to be informed about such a disability and approved accommodations at the beginning of the semester.

**Veterans Center:**
If you are a student veteran, the U of Utah has a Veterans Support Center located in Room 161 in the Olpin Union Building. Hours: M-F 8-5pm. Please visit their website for more information about what support they offer, a list of ongoing events and links to outside resources: veteranscenter.utah.edu/. Please also let me know if you need any additional support in this class for any reason.

**University Safety Statement:**
The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.

**Addressing Sexual Misconduct:**
Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veterans status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).
Wellness Statement:
Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student’s ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at www.wellness.utah.edu or 801-581-7776.