New York University Tandon School of Engineering
Department of Finance and Risk Engineering
Course syllabus FRE 6351 **Time Series Analysis**
Spring 2020
Professor David Rios
FRE GY6351 at Friday 2pm; Rodgers Hall, Room 302

Contact information: dr29@nyu.edu
Office hours: TBA

Course Description:
The course will introduce students to time series analysis. We will cover ARMA models, frequency models and ARCH / GARCH models.

Course Objectives:
Students will review basic probability, include random variables, means, expectations, Weak Law of Large Numbers and the central limit theorem. We will then cover the standard normal based statistical models including Z/T tests, Chi-Squared, Linear Regression and ANOVA. These tests will be covered from both a mathematical background and 'boot-strapping'. In addition we will cover basic time series modeling and compare with linear regression, as well as an introduction to ARCH and GARCH models. For time series the bootstrapping will be the main methodology. The final topic we will cover will be a simple example of stochastic control to give the students and understanding of hedging as opposed to value investing.

Course Structure
The course will consist of lectures, homework assignments, and a final project. The assignments will consist of both mathematics and coding exercises, designed for practical applications.

Readings
The required readings will be the course slides and other texts uploaded to NYU Classes.

Course Requirements
Students will be required to study the course slides and other texts uploaded to NYU Classes.

Course Pre-requisites
A basic knowledge of computer programming. Any language is fine

Grading
Grading will be based on homework assignments and the final exam. Each homework and test will be graded and assigned a numerical score, based on its difficulty and on the correctness of the solution. The final course letter grade will be derived from the cumulative numerical scores obtained for all the homeworks and tests.

Lecture topics

Lecture #1: Introduction to time series

- Examples
- Time Series vs Brownian motion
- Autocorrelation function
- Stationary

Lecture #2: Looking at data

- Autocorrelation function from data
- Detrending
- Seasonality
- Analysis of Residuals

Lecture #3: ARMA models

- AR models
- MA models
- ACF of an ARMA function
- Causal and Invertible

Lecture #4: Prediction / Estimation

- PACF
- Best Linear Predictor
- Innovations Algorithm
- Estimation of parameters

Lecture #5: ARCH / ARCH.

- Motiativation for GARCH
- Mathematical justification
- Simulation and calculation of VAR with and without ARCH effect

Lecture #6: Frequency Models

- Periodic Functions
- Spectral Density Function

Lecture #7:

- Student Presentations

Moses Center Statement of Disability

If you are student with a disability who is requesting accommodations, please contact New York University's Moses Center for Students with Disabilities (CSD) at 212-998-4980 or mosescsd@nyu.edu. You must be registered with CSD to receive accommodations. Information about the Moses Center can be found at www.nyu.edu/csd. The Moses Center is located at 726 Broadway on the 2nd floor.

NYU School of Engineering Policies and Procedures on Academic Misconduct

A. Introduction: The School of Engineering encourages academic excellence in an environment that promotes honesty, integrity, and fairness, and students at the School of Engineering are expected to exhibit those qualities in their academic work. It is through the process of submitting their own work and receiving honest feedback on that work that students may progress academically. Any act of academic dishonesty is seen as an attack upon the School and will not be tolerated. Furthermore, those who breach the School's rules on academic integrity will be sanctioned under this Policy. Students are responsible for familiarizing themselves with the School's Policy on Academic Misconduct.

B. Definition: Academic dishonesty may include misrepresentation, deception, dishonesty, or any act of falsification committed by a student to influence a grade or other academic evaluation. Academic dishonesty also includes intentionally damaging the academic work of others or assisting other students in acts of dishonesty. Common examples of academically dishonest behavior include, but are not limited to, the following:

1. Cheating: intentionally using or attempting to use unauthorized notes, books, electronic media, or electronic communications in an exam; talking with fellow students or looking at another person's work during an exam; submitting work prepared in advance for an in-class examination; having someone take an exam for you or taking an exam for someone else; violating other rules governing the administration of examinations.
2. Fabrication: including but not limited to, falsifying experimental data and/or citations.
3. Plagiarism: intentionally or knowingly representing the words or ideas of another as one's own in any academic exercise; failure to attribute direct quotations, paraphrases, or borrowed facts or information.
4. Unauthorized collaboration: working together on work that was meant to be done individually.

5. Duplicating work: presenting for grading the same work for more than one project or in more than one class, unless express and prior permission has been received from the course instructor(s) or research adviser involved.
6. Forgery: altering any academic document, including, but not limited to, academic records, admissions materials, or medical excuses.