DSC425 Time Series Analysis and Forecasting
2019 Winter quarter

Instructor

Dr. John McDonald
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Office Hours: Tuesday & Wednesday, 3:30-5:00pm in my office, CST-831

Course Web page: http://d2l.depaul.edu

Summary of Course

The course presents statistical methods for time series analysis and forecasting with a focus on financial data analysis. The course will place great emphasis on applications. The course topics include linear time series analysis, stationarity and autocorrelation functions, autoregressive and moving average models, and their generalizations, conditional heteroschedastic (ARCH/GARCH) models to describe markets volatility. Alternative models for financial markets volatility will be discussed. If time permits, we'll discuss non-linear models, and non-parametric tests to address non-linearity problems in financial time series.

Prerequisites

CSC423 or consent of instructor.

Learning Outcomes

- At the end of the course, the students will be able to:
- Informally define and explain terminology used to describe time series, including trend, seasonal effects, cyclical effects, outlier and white noise.
- Apply the concepts of stationarity and auto-correlation to the analysis of time series data.
- Apply and interpret linear time-series models and regression models for time series, and compute forecasts for the time series data.
- Explain the concept of seasonality, and apply models for seasonal variation, including additive and multiplicative models.
- Apply GARCH-type models for the analysis of heteroscedastic time series data.
- Use existing R functions and packages for time series analysis and write your own code to compute the appropriate analysis.

Textbooks and Printed Resources

***Required Text*:** Time Series Analysis with Applications in R" by Jonathan Cryer and Kung-Sik Chan. Publisher: Springer; 2nd edition, 2010.

Introductory notes for R will be posted on the course website.

Statistical software:

In class, I will teach R to compute the statistical analyses. However students have the option of using SAS if they are familiar with the SAS statistical software, but please note that instructor support will only be given for R.

Both SAS 9.3 and R are available in the CDM labs, and SAS is available in all DePaul labs. If you prefer to install the software on your own machine:

- R is freely available at http://cran.rstudio.com/ .
- SAS is available on DePaul's VirtualLab. For information see https://offices.depaul.edu/information-services/services/Software/Pages/Software-for-Personal-Computers.aspx.

Grading Policy
The final grade has the following components:

- *Homework and Programming assignments (30%).* There will be four or five assignments. Assignments and due dates will be posted on the D2L course site. Assignments more than a five days late will not be accepted. Notice that a 25% point penalty will be applied for late submissions, so even if you are struggling with some topics, **turn in what you have by the due date!** Extensions may only be granted for exceptional reasons, and must be requested **BY EMAIL and BEFORE** the due date**.**
- *Test (35%).* In-class exam is scheduled on Tuesday, February 12th (week 6). Details about the exam will be provided during the course. **Online students must schedule their exam** using the Proctored Exam link at the D2l website during the time frame specified by your instructor. Students living within the Chicago land area are expected to take their exams at a DePaul University campus. Time slots vary by campus and day. They can also take the exam with the other in-class students at the official exam time. Online students living outside the Chicago land area (*remote*) will have their exams administered by a qualified proctor. You will need to find an acceptable proctor in your area before you register for your exam. Detailed information about online exams is at http://blogs.cti.depaul.edu/colwiki/Wiki%20Pages/How%20Do%20I%20Take%20My%20Exams.aspx
- *Group project (35%).* Final project due at the end of the quarter. Details will be provided later in class. The final project will be presented **in the 10th week of class** and each group will be given a punch list for completing the analysis before submitting the final report by the day of the usual final exam.

A note about final project groups and non-performance as a team-member on a project:

The final project in this course is very broad in its scope allowing your group to focus on a wide range of dataset types for visualization, and on a wide range of techniques for visualizing the data. Group members are expected to participate fully and equitably in the group, and part of the final project grading rubric will be a peer evaluation that will form part of the final project grade.

Usually, the peer evaluation and documentation, including the meeting minutes, in addition to an overall desire for excellence, is sufficient motivation for individuals to contribute a fair share to the team project. However, in extreme cases, individuals have been known to completely cease contributing to a team project. If this is the case, a team has the right to notify the instructor **unanimously (other than the individual being sanctioned)** that the individual is no longer contributing and the team no longer wants the individual on the team.

It is expected that a team will be able to show significant effort towards reconciling the issue prior to such an extreme action. Note also that this is not a decision to be made lightly, as expulsion from a team will result in **the loss of 40% of the of the final project grade**, i.e. the group portion of the grade, for the person expelled. Because this is such a serious decision, any team that makes this decision will also experience a deduction of **10% of the final project grade**.

What to Expect:
In this class you should expect to spend a significant amount of time outside of class reviewing course materials and topics and working on homework problems. Throughout the course, I may distribute handouts of notes on various topics, and certain in-class materials including sample programs will be available on the class website. But please do be aware that a great deal of material will be presented orally and on the white-board in this course. Therefore, you are expected to take comprehensive notes during class and to review those notes in preparation for the next class and for exams. **It will not be sufficient to simply review the Powerpoints.**

Attitude and Civil Discourse:
A professional and academic attitude is expected throughout this course. Measurable examples of non-academic or unprofessional attitude include but are not limited to: talking to others when the instructor is speaking, mocking another's opinion, cell phones ringing, emailing, texting or using the internet whether on a phone or computer. If any issues arise a student may be asked to leave the classroom. The professor will work with the Dean of Students Office to navigate such student issues.
DePaul University is a community that thrives on open discourse that challenges students, both intellectually and personally, to be Socially Responsible Leaders. It is the expectation that all dialogue in this course is civil and respectful of the dignity of each student. Any instances of disrespect or hostility can jeopardize a student's ability to be successful in the course. The professor will partner with the Dean of Students Office to assist in managing such issues.

Cell Phones/On Call:
If you bring a cell phone to class, it must be off or set to a silent mode. Should you need to answer a call during class, students must leave the room in an undisruptive manner. Out of respect to fellow students and the professor, texting is never allowable in class. If you are required to be on call as part of your job, please advise me at the start of the course.

Information for all students
Students are encouraged to contact the instructor for any question related to the course. You can see me in my office (room 831 of CDM building) during contact hours, or by appointment at other times.

The best way to contact me is through email at jmcdonald@cdm.depaul.edu. Most emails will be answered within 24 hours, if you don't get a response after 24 hours, just send me a courteous reminder, or come see me in office hours.

All students are expected:

- To read this document in full!
- To attend all classes (online students are expected to watch each lecture). If you miss a class, it is your responsibility to watch the lecture recording and to get copies of the notes or documents handed out in class. All lecture recordings are linked to the course website at http://d2l.depaul.edu

- To participate actively to class discussions and activities and to work on the in-class problems and exercises that are designed to improve students' understanding of the class topics.
- To be familiar with all the course documents and notes posted at the course website.
- To read all the sections in the textbook relevant to the lecture before coming to class. The reading assignments are listed in the schedule included in this syllabus. Lecture notes are meant to complement the course textbook NOT TO REPLACE IT.
- To strictly adhere to the University Academic Integrity Policy, that is published in the Student Handbook or at the Academic Integrity site at DePaul University (http://academicintegrity.depaul.edu).
  Violations of the University Academic Integrity Policy include (but are not limited to): (a) using or providing unauthorized assistance or materials on course assignments; (b) possessing unauthorized materials during an examination; (c) submitting as one's own any material that is copied from published or unpublished sources such as the Internet, print, computer files without proper acknowledgement that it is someone else's; (d) submitting as one's own work a report, examination, paper, computer file, lab report or other assignment which has been prepared by someone else. If you are unsure about what constitutes unauthorized help on an exam or assignment, or what information requires citation and/or attribution, please ask your instructor. If proven, violations may result in the failure of the assignment, failure of the course, and/or additional disciplinary actions.

Tutors: Unfortunately there aren't tutors for this course. The tutors' schedule is at:
http://www.cdm.depaul.edu/advising/Pages/TutoringProgram.aspx
Remember that I am your "best tutor", and you should not hesitate to contact me and to come and see me for any question regarding the assignments.

For online students
Recordings of each lecture will be available a few hours after the "live" class, and can be found at the course website https://d2l.depaul.edu. Online students are expected to watch the lectures every week and to keep up with the course information posted on the course website.

Students are encouraged to contact the instructor through email at rsettimi@cdm.depaul.edu, phone (312 3625556) or skype (skype id: raffasw). Most emails will be answered within 24 hours.

Tentative schedule and reading assignments

The following schedule is tentative. The reading assignments are from the course textbook "Time Series Analysis with Applications in R" by Cryer and Chan. This schedule may change as the course progresses.

Week	Topic	Reading assignment
1	Review of some statistical concepts: exploratory data analysis, correlation and regression analysis. Introduction to financial time series and their properties, distribution of returns. Introduction to R.	Chapter 1: Sections 1.1 - 1.4
2	Distribution of returns and empirical properties. Stationarity, correlation and autocorrelation	Chapter 2: Sections 2.1, 2.2, 2.3.

	function. White noise series and introduction to linear time series.	Chapter 3: Section 3.1, 3.3, 3.4
3	Linear Time series: Simple autoregressive models and moving average models.	Chapter 4: Sections 4.1, 4.2, 4.3
4	Simple ARMA models. Estimation and identification of correct ARMA model.	Chapter 4: sections 4.4, 4.5 Chapter 5: section 5.1
5	Unit root non stationarity and ARIMA models, Exponential smoothing.	Chapter 5: sections 5.2, 5.3, 5.4 Chapter 6: section 6.2
6	In class test	
7	Time trend models and seasonality (SARIMA models).	Chapter 10: sections 10.1, 10.2, 10.3, 10.4
8	Regression models with time series errors. The GARCH model to analyze market volatility	Chapter 12: sections 12.1, 12.2, 12.3, 12.5.
9	Advanced GARCH models. High frequency data.	Chapter 12: sections 12.6, 12.7
10	Final project presentation	
11	Final project report due	

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Changes to Syllabus

This syllabus is subject to change as necessary during the quarter. If a change occurs, it will be thoroughly addressed during class, posted under Announcements in D2L and sent via email.

Online Course Evaluations

Evaluations are a way for students to provide valuable feedback regarding their instructor and the course. Detailed feedback will enable the instructor to continuously tailor teaching methods and course content to meet the learning goals of the course and the academic needs of the students. They are a requirement of the course and are key to continue to provide you with the highest quality of teaching. The evaluations are anonymous; the instructor and administration do not track who entered what responses. A program is used to check if the student completed the evaluations, but the evaluation is completely separate from the student's identity. Since 100% participation is our goal, students are sent periodic reminders over three weeks. Students do not receive reminders once they complete the evaluation. Students complete the evaluation online in CampusConnect.

Academic Integrity and Plagiarism

This course will be subject to the university's academic integrity policy. More information can be found at http://academicintegrity.depaul.edu/. If you have any questions be sure to consult with your professor.

Academic Policies

All students are required to manage their class schedules each term in accordance with the deadlines for enrolling and withdrawing as indicated in the University Academic Calendar. Information on enrollment, withdrawal, grading and incompletes can be found at: cdm.depaul.edu/enrollment.

Students with Disabilities

Students who feel they may need an accommodation based on the impact of a disability should contact the instructor privately to discuss their specific needs. All discussions will remain confidential.
To ensure that you receive the most appropriate accommodation based on your needs, contact the instructor as early as possible in the quarter (preferably within the first week of class), and make sure that you have contacted the Center for Students with Disabilities (CSD) at: csd@depaul.edu.
Lewis Center 1420, 25 East Jackson Blvd.
Phone number: (312)362-8002 Fax: (312)362-6544 TTY: (773)325.7296