FORECASTING AND TIME SERIES ANALYSIS

BACHELOR IN DATA AND BUSINESS ANALYTICS
Professor: BORJA GONZALEZ DEL REQUERAL GONZALEZ DEL CORRAL
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Academic year: 19-20
Degree course: SECOND
Semester: 1º
Category: COMPULSORY
Number of credits: 6.0
Language: English

PREREQUISITES
SUBJECT DESCRIPTION

Time series analysis comprise methods for analyzing time series data in order to extract meaningful statistics and other characteristics of the data. Forecasting involves taking models fit on historical data and using them to predict future observations.

Time series analysis and forecasting are one of the most applied data science techniques in business, finance, and supply chain management as well as in production and inventory planning. Examples of time series include the continuous monitoring of a person’s heart rate, hourly readings of air temperature, daily closing price of a company stock, monthly rainfall data, and yearly sales figures. It has a well-established theoretical grounding in statistics and dynamic systems theory.

In this context, this course will introduce the students to the concepts and applications of time series analysis and forecasting.
OBJECTIVES AND SKILLS
The main objective of this course is to provide students with a working methodology and a solid knowledge for the use of times series analysis and forecasting models and techniques in business and economics. At the end of the course; students should be able to:
- Identify patterns in correlated data—trends and seasonal variation;
- Understand and modeling time-series data;
- Use forecasting techniques to predict short-term trends from previous patterns;
- Be able to conduct intervention analysis to answer the question of how does a single event change the time series;
- Understand and model the stochastic mechanisms that gives rise to an observed series.
Additionally, the course will focus on the acquisition or reinforcement of generic skills:
- The ability to summarize and present information in a meaningful way;
- The ability to build an abstract model to address a time-related economic or social problem;
- The ability to quickly identify the tools that need to be used in time-series and forecasting situations.
METHODOLOGY
The course uses both theoretical and practical teaching sessions.

The conceptual sessions are delivered using Power Point presentations and focus on discussing the basic concepts underlying a statistical theory along with various examples. During the practical sessions, Python programming language will be used to solve specific questions presented in the context of case-studies. Review sessions can be both of theoretical and practical nature.

Bringing your laptop is mandatory to all sessions, although its use (or not) will be decided by the professor.

Prior to all sessions, you should read assigned textbook sections. Reading the textbook in advance will allow you to get the most out of each lecture. When reading the textbook sections prior to each lecture, you must look at the examples but you do not need to solve them.

Throughout the course, various case studies will be presented. These will reflect current and emerging problems/situations/phenomena. The students will be asked to work in group to address and solve these cases. Five to 10 mins will be given for them to present their findings. The cases concentrate on concrete problems which may cover more than one managerial area and thus give the students a broader perspective on the quantitative techniques used.

Brief quizzes covering previously taught material will be given. These quizzes are meant to test your overall understanding of the material and will help the professor assess the overall performance and evolution of the class.

The work developed outside the classroom is fundamental in order to understand and get confident with the method explained in class. In this context, students are encouraged to work in groups when solving homework problems. But, as evaluation will be strictly individual, it is highly recommended that each student try, at the same time, to solve problems by himself/herself.
<table>
<thead>
<tr>
<th>Teaching methodology</th>
<th>Weighting</th>
<th>Estimated time a student should dedicate to prepare for and participate in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>20.0 %</td>
<td>30 hours</td>
</tr>
<tr>
<td>Discussions</td>
<td>10.0 %</td>
<td>15 hours</td>
</tr>
<tr>
<td>Exercises</td>
<td>20.0 %</td>
<td>30 hours</td>
</tr>
<tr>
<td>Group work</td>
<td>30.0 %</td>
<td>45 hours</td>
</tr>
<tr>
<td>Other individual studying</td>
<td>20.0 %</td>
<td>30 hours</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100.0 %</td>
<td>150 hours</td>
</tr>
</tbody>
</table>

20th June 2019
PROGRAM

BRIEF NOTE
All the required readings are from the online textbook “Forecasting Principles and Practices. Reading a section means reading the text AND doing the examples.
Note: The following description of the material covered is tentative. An attempt will be made to cover all listed topics. However; the pace in the classes will depend on the group performance.

SESSIONS 1 - 3
INTRODUCTION & CONTEXT:
Topics: Introduction and presentation of the course syllabus and objectives. Time-series analysis and forecasting: compare and contrast. Main features of a time series. What to forecast? Forecasting data and methods.

SESSIONS 4 - 7
TIME SERIES GRAPHICS
Topics: Fundamentals of Time Series analysis. Key components used in time series forecasting, such as seasonality, trends, and cyclical patterns. Seasonal plots, scatterplots, lag plots, etc.

SESSIONS 8 - 11
THE FORECASTER TOOL BOX:

SESSIONS 12 - 14
TIME SERIES REGRESSION MODELS:

SESSIONS 15 - 16
Midterm EXAM

SESSIONS 17 - 19
TIME SERIES DECOMPOSITION:

SESSIONS 20 - 23
EXPONENTIAL SMOOTHING: ETS MODELS:

SESSIONS 24 - 27

ARIMA MODELS:

SESSION 28

Presentations and Group project

SESSIONS 29 - 30

FINAL EXAM
BIBLIOGRAPHY
RECOMMENDED
Title: Forecasting: Principle and Practice
Authors: Hyndman, R.J., & Athanasopoulos, G
Publisher / Edition / Year: OTexts: Melbourne, Australia / 2nd edition
This book can be accessed online at https://otexts.com/fpp2/index.html

Additional documents, including lecture slides, problem sets, extra readings, etc… will be posted on Campus Online throughout the semester.
EVALUATION CRITERIA

Your final grade in the course will be based on both individual and group work of different characteristics that will be weighted in the following way:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Percentage</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Participation</td>
<td>15%</td>
<td>Class participation, discussion &amp; case studies presentations</td>
</tr>
<tr>
<td>Quizzes</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Group Report</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Midterm</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>Final Exam</td>
<td>40%</td>
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</tr>
</tbody>
</table>

A. Class participation and discussion

Class participation will be evaluated based on the following criteria:

- Quality (not quantity) of your participation in class discussion: The most important dimension of participation concerns what it is that you are saying. A high quality comment reveals depth of insight, rigorous use of case evidence, consistency of argument, and realism. Frequency refers to the attainment of a threshold quantity of contributions that is sufficient for making a reliable assessment of comment quality. The logic is simple: if contributions are too few, one cannot reliably assess the quality of your remarks. However, once threshold quantity has been achieved, simply increasing the number of times you talk does not automatically improve your evaluation. Beyond the threshold, it is the quality of your comments that must improve. In particular, one must be especially careful that in claiming more than a fair share of “airtime”, quality is not sacrificed for quantity. Finally, your attempts at participation should not be such that the instructor has to “go looking for you”. You should be attempting to get into the debate on a regular basis.

You might want to avoid being classified as one of the following types of students:

- Repeaters, i.e., students that, consciously or unconsciously, make comments that are really just repeats/rephrasing of what has already been said (by other students, or you). This wastes time and adds nothing to learning.
- Ramblers, i.e., students that take a lot of time to say simple things or they may tell long personal/professional stories, or they roam into topics that are not relevant, or simply make low-quality comments just to participate. They waste valuable time and prevent other students from being able to participate.
- Students that have been distracted (by Facebook, etc.) or who have stopped paying attention and then, later on, when they realized they have missed a term or concept, they ask you about it.

B. Group report and presentation

The group project is an integral part of this course. It consists of the identification of a real-world problem, the formulation of appropriate hypotheses, the collection and statistical analysis of data, and the presentation and interpretation of obtained results.

At the end of the semester, you must submit the full report including all sections. The final version should include edited versions of the previously submitted sections following the recommendations of your professor. In addition, each group will be asked to prepare a short video (3-4 min) that will be uploaded on youtube.

Information (description, specifics, etc.) related to each section as well as the final report (format, content, etc.), presentation (time, format, content, etc.) and video are detailed in “Statistics Project: Description & Instructions” file, which is already available on Campus Online/Documents.

C. Exams
There will be one midterm and one final exam. For these exams, you must bring your own simple calculator (phones, tablets, laptops and other electronic devices are not allowed). You are also allowed to bring up one-sided A4 SHEET paper for the midterm (two sides in the final exam) with any formulae that you think could be helpful. NO QUESTIONS ARE ALLOWED DURING THE EXAMS. THE CHEAT-SHEET ALONG WITH ANY SCRAP PAPER WILL BE COLLECTED AND STAPLED TO YOUR EXAMS.

In order to pass the course, you need a minimum grade of 3.5 in the final exam. If your grade in the final exam does not reach the threshold value of 3.5, you will fail the course, even in the case in which your weighted average (computed using the table above) exceeds 5.0.

Notice that the date of the midterm could change and need to be considered with flexibility. The precise date will be communicated to students two weeks ahead of time.

PROFESSOR BIO
Professor: BORJA GONZALEZ DEL REGUERAL GONZALEZ DEL CORRAL  
E-mail: bgonzalezdelregueral@faculty.ie.edu

Within his almost 20 years of professional experience Borja combines both work at world’s largest companies, his own business and a unique research in energy sector. Working for British Petroleum (BP) he led global operations transformation projects, developed innovation and digital strategies. Prior to BP, he worked at Iberdrola in its international expansion, M&As, post-merger integrations, regulatory strategy and designing incentive mechanisms and regulatory frameworks for the electricity and natural gas markets. He has founded two companies, researched on thermoeconomics, written books and articles and patented processes. Borja is an international speaker on technology and innovation, member of the Executive Council of CIO Spain, advisor to international companies on digital transformation and active member of tech and international innovation groups.

OFFICE HOURS; CONTACT INFORMATION

- Office hours: After-class (upon appointment)
- Contact details: bgonzalezdelregueral@faculty.ie.edu

OTHER INFORMATION

As per University Policy:

Each student has 4 chances to pass any given course distributed in two consecutive academic years (regular period and July period).

It is mandatory to attend 100% of the classes. Students who do not comply with at least 70% attendance will lose their 1st and 2nd chance, and go directly to the 3rd one (they will need to enroll again in this course the next academic year).

Grading for retakes will be subject to the following rules:

1. Those students who failed the subject in the first regular period will have to do a retake in July (except those not complying with attendance rules who are banned from this possibility).
2. Dates and location of the July retakes will be posted in advance and will not be changed. Please take this into consideration when planning your summer.
3. The maximum grade that a student may obtain in the 2nd exam session is 8 out of 10. Those students in the 3rd call will be required to attend 50% of the classes. If due to schedule overlap, a different option will be discussed with the professor in order to pass the subject.

Attendance:

Attendance at all scheduled classes is mandatory and essential for success in the course. If you miss class for any reason, you are responsible for getting notes from classmates. If you have questions about any assignment please send me an email. Under most circumstances, students who miss a class in which a presentation, mid-term, or final exam is held will not be granted an exception or given an opportunity to do a make-up assignment or exam. However, if illness or other circumstances prevent you from adhering to the assignment/presentation due dates stated in this syllabus, an exception may be granted at the discretion of the professor. In all cases, the student must provide official documentation (e.g., from a medical doctor, counsellor) to the professor within 24 hours of the missed due date.

Students with Special Needs:

To request academic accommodations due to a disability, please contact Rafif Srour via email at: Rafif.Srour@ie.edu.

Student Privacy Statement:

20th June 2019
At times, students may disclose personal information through class discussions. It is expected that all members of the class will respect the privacy of their classmates. This means that the information disclosed in the class will not be repeated or discussed with other students outside of the course.

Decisions about Grades:
Decisions about grades are made very carefully, and are final at the end of the course. If you have questions regarding a certain grade or you would like to receive personal feedback, you must request a meeting with me to discuss grades on specific assignments before the last class of the course. Any disputes regarding grades must be resolved before the final exam. “Extra credit” or makeup assignments will only be allowed under extenuating circumstances at the sole discretion of the course professor.

ACADEMIC INTEGRITY

Unless you are specifically instructed to work with other students in a group, all of your assignments, papers, projects, presentations, and any work I assign must reflect your own work and thinking.

What is academic integrity? When you do the right thing even though no one is watching. The core values of integrity, both academic and otherwise include: honesty, fairness, respect, responsibility, and trust. Academic Integrity requires that all students within Instituto de Empresa (IE) act in accordance with these values in the conduct of their academic work, and that they follow the rules and regulations concerning the accepted conduct, practices and procedures of academic research and writing. Academic Integrity violations are defined as Cheating, Plagiarism or other violations of academic ethics.

Cheating and plagiarism are very serious offenses governed by the IE student code of conduct. Any student found cheating or plagiarizing on any assignment or component of this course will at a minimum receive a “0” on the affected assignment. Moreover, the student will also be referred to the University Judicial System for further action. Additional penalties could include a note on your transcript, failing the class, or expulsion from the university.

It is important to note that, while the list below is comprehensive, it should not be considered exhaustive.

Cheating includes:

a. An act or attempt to give, receive, share, or utilize unauthorized information or unauthorized assistance at any time for assignments, papers, projects, presentations, tests or examinations. Students are permitted to mentor and/or assist other students with assignments by providing insight and/or advice. However, students must not allow other students to copy their work, nor will students be permitted to copy the work of other students. Students must acknowledge when they have received assistance from others.

b. Failure to follow rules on assignments, papers, projects, presentations, tests or examinations as provided by the course professor and/or as stipulated by IE.

c. Unauthorized co-operation or collaboration.

d. Tampering with official documents, including electronic records.

e. The impersonation of a student on presentations, exercises, tests or an examination. This includes logging onto any electronic course management tool or program (e.g. Black Board, etc.) using someone else’s login and password.

Plagiarism includes:

a. Using the work of others and attempting to present it as your own. For example, using phrases or passages from books, articles, newspapers, or the internet and not referencing them properly in your document. This includes using information from others without citing it, misrepresentation of cited work, and misuse of quotation marks.

b. Submitting an assignment or paper that is highly similar to what someone else has written (i.e., minimal changes in wording, or where the sentences are similar, but in a different order).
c. You don’t have to commit “word for word” copying to plagiarize – you can also plagiarize if you turn in something that is “thought for thought” the same as someone else.

Other violations of academic ethics include:

a. Not acknowledging that your work or any part thereof has been submitted for credit elsewhere.

b. Misleading or false statements regarding work completed.

Knowingly aiding or abetting anyone in committing any form of an Academic Integrity violation.
CODE OF CONDUCT IN CLASS

1. **Be on time:** Students arriving more than 5 minutes late will be marked as “Absent”. Only students that notify in advance in writing that they will be late for a specific session may be granted an exception (at the discretion of the professor).

2. **If applicable, bring your name card and strictly follow the seating chart.** It helps faculty members and fellow students learn your names.

3. **Do not leave the room during the lecture:** Students are not allowed to leave the room during lectures. If a student leaves the room during lectures, he/she will not be allowed to re-enter and, therefore, will be marked as “Absent”. Only students that notify that they have a special reason to leave the session early will be granted an exception (at the discretion of the professor).

4. **Do not engage in side conversation.** As a sign of respect toward the person presenting the lecture (the teacher as well as fellow students), side conversations are not allowed. If you have a question, raise your hand and ask it. If you do not want to ask it during the lecture, feel free to approach your teacher after class.

If a student is disrupting the flow of the lecture, he/she will be asked to leave the classroom and, consequently, will be marked as “Absent”.

5. **Use your laptop for course-related purposes only.** The use of laptops during lectures must be authorized by the professor. The use of Social Media or accessing any type of content not related to the lecture is penalized. The student will be asked to leave the room and, consequently, will be marked as “Absent”.

6. **No cellular phones:** IE University implements a “Phone-free Classroom” policy and, therefore, the use of phones, tablets, etc. is forbidden inside the classroom. Failing to abide by this rule entails expulsion from the room and will be counted as one absence.

7. **Escalation policy: 1/3/5.** Items 4, 5, and 6 above entail expulsion from the classroom and the consequent marking of the student as “Absent.” IE University implements an “escalation policy”: The first time a student is asked to leave the room for disciplinary reasons (as per items 4, 5, and 6 above), the student will incur one absence, the second time it will count as three absences, and from the third time onward, any expulsion from the classroom due to disciplinary issues will entail 5 absences.