ECON 5660, TIME SERIES ECONOMETRICS & FORECASTING
UNIVERSITY OF NORTH TEXAS
SPRING 2023

Classroom and time: Gateway 141; Thursdays, 6:30 PM to 9:20 PM
Instructor: Dr. Margie Tieslau
Office: Wooten Hall 343
e-mail: Margie.Tieslau@unt.edu
Office Hours: Wednesdays, 12 PM (noon) to 3:15 PM in Wooten Hall 343
Thursdays, 2 PM to 5 PM in Wooten Hall 343
Office hours also available by Zoom, at your request.

COURSE DESCRIPTION:
This course has two parts; the first part focuses on applied univariate and multivariate forecasting models and evaluating forecast accuracy, while the second part focuses on advanced theoretical time series topics. In addition, some attention is given to communicating and presenting results in a manner that can be understood by someone who is not an expert in the field. The class will focus on issues most commonly encountered in the fields of accounting, economics, and finance, with an emphasis on the following topics: stationary AR, MA and ARMA models; non-stationarity and tests for unit roots; ARCH and GARCH; vector autoregression and impulse response functions; and cointegration and error correction. The primary software package for empirical applications is the Statistical Analysis System (SAS).

COURSE PRE-REQUISITES:
The pre-requisites for this course are grades of "B" or better in ECON 5640 (Multivariate Regression Analysis) and ECON 5600. In particular, students are expected to have a solid background in: multiple regression; ideal conditions for OLS (the Gauss-Markov assumptions); correlation and covariance; t- and F-tests; significance levels; sums of squares & analysis of variance; matrix algebra; the concepts of unbiased, consistent & efficient; maximum likelihood estimation (including Wald, LM and LR tests), simultaneous equations estimation, probability limits; derivatives & partial derivatives; constrained & unconstrained optimization; difference equations; and infinite series.

TEXT:
The text for this course is *Applied Econometric Time Series* by Walter Enders, 4th edition (2014), published by Wiley. It also is acceptable to use the 3rd edition (2009) of this text. Be advised that many sections of this book are quite advanced and so you will not be expected to comprehend all material in the text. However, there are some sections in this text that may provide an excellent complement to the lecture material.
COURSE STRUCTURE:
Part of each class will be allocated to lecture, and part to computer lab work. You are required to work on material from the lecture during the lab period of class. In addition, you are expected to spend a considerable amount of time outside of class working in a computer lab.

GRADING:
Grades for the course will be based on the total points accumulated on four homework assignments, a research paper and a final exam. The distribution of points is as follows:

<table>
<thead>
<tr>
<th>Points possible</th>
<th></th>
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<tbody>
<tr>
<td>Homework #1</td>
<td>20</td>
</tr>
<tr>
<td>Homework #2</td>
<td>20</td>
</tr>
<tr>
<td>Homework #3</td>
<td>20</td>
</tr>
<tr>
<td>Homework #4</td>
<td>40</td>
</tr>
<tr>
<td>Research Paper</td>
<td>100</td>
</tr>
<tr>
<td>Final Exam</td>
<td>120</td>
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<tr>
<td>total</td>
<td>320</td>
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</table>

In order to earn a grade of "A" for the course, students must accumulate at least 90% of the total points available; to earn a grade of "B," students must accumulate 80% to 89% of the total points available.

Homework Assignments:
The four homework assignments, when put together, will comprise a complete research paper where you will forecast a variable that Dr. T will choose. You will have to determine whether or not this variable is stationary by applying unit root tests (this is homework #1). After so doing, you will analyze the stationary version of your variable to find the best-fitting univariate model to explain that variable (this is homework #2). You then will use that model to produce a forecast of the variable, and assess the accuracy of your forecast (this is homework #3). Then you will write up your findings as if presenting them to a group of non-experts (this is homework #4).

Research Paper:
The structure of the research paper is identical to the four homework assignments except that YOU will select the variable and you will collect your data set (and clean it up if necessary). As with the four homework assignments, you will determine whether or not your variable is stationary, you will find the best-fitting model to explain the stationary version of your variable, you will then use that model to produce a forecast of the variable, and you will assess the accuracy of your forecast. Then you will write up your findings as if presenting them to a group of non-experts. More details on the research paper will be supplied on April 6th.

Final Exam:
The final exam will be cumulative in nature and will take place on Saturday, May 6th, 2023, from 1:30 PM to 3:30 PM in Gateway 141. Except for those with official university-approved excuses (with appropriate documentation provided), everyone will be required to take the final exam at the scheduled time. The exam will be "closed book" and "closed notes," and a limited formula sheet will be provided.
CLASS HANDOUTS:
All class handouts will be made available on Canvas approximately three days before class meets. YOU are responsible for bringing a copy of the handout with you each night. The handout that you should bring to class will be called something such as: "Lecture outline for topic X.pdf," or "Lecture outline for topic X part 1.pdf," or "Lecture outline for topic X part 2.pdf," where X refers to the topic number. You might be able to print the handout once you are in the classroom, but there is no guarantee that the printers will be working. In addition, it is imperative that you **DO NOT PRINT ONCE CLASS BEGINS!**

ATTENDANCE POLICY:
Although you will not be graded on attendance, **class attendance is not optional.** If you miss class it is YOUR responsibility to find out what was covered on that night and make up the missed material before the next class meeting.

INTERNET RESOURCES:
Be forewarned: If you use the internet as a source to learn material for this class, you are strongly cautioned to do so at your own risk! There is a wealth of information on the internet that is NOT correct, even though it appears to be. If you collect information from sources other than refereed journal articles, that information might be incorrect and it might cost you points on graded assignments.

CLASSROOM POLICIES:
Masks/face coverings are optional. Please respect the decisions of your classmates regarding whether or not they wear a mask.

During class, students are forbidden to have or use electronic devices such as tablets, cell phones, headphones, earphones, ear buds or the like (except in special cases where students have a verified need that requires such devices).
### COURSE SCHEDULE, SPRING 2023

<table>
<thead>
<tr>
<th>DATE</th>
<th>TOPIC OF DISCUSSION:</th>
<th>READINGS*:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. 19</td>
<td>Topic #1: Intro to Time Series Analysis &amp; SAS</td>
<td>Class handout</td>
</tr>
<tr>
<td>Feb. 2</td>
<td>Topic #2, Part 2</td>
<td>Chapters 1 &amp; 2</td>
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<tr>
<td>Feb. 9</td>
<td>Topic #3, Part 1: Non-Stationarity and Tests for Unit Roots</td>
<td>Chapter 4</td>
</tr>
<tr>
<td>Feb. 16</td>
<td>Topic #3, Part 2</td>
<td>Chapter 4</td>
</tr>
<tr>
<td>Feb. 23</td>
<td><strong>Receive homework #1</strong></td>
<td>Unit Root Primer (article)</td>
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<tr>
<td>March 2</td>
<td><strong>Receive homework #2</strong></td>
<td>Chapter 3</td>
</tr>
<tr>
<td>March 9</td>
<td><strong>Homework #2 due; Receive homework #3</strong></td>
<td>Chapter 3</td>
</tr>
<tr>
<td>March 16</td>
<td><strong>SPRING BREAK</strong></td>
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<tr>
<td>March 23</td>
<td>Topic #5, Part 2: Stata and ARCH &amp; GARCH</td>
<td>Chapter 3</td>
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<tr>
<td>March 30</td>
<td>Topic #6: Vector Autoregression and Impulse Response Functions</td>
<td>Chapter 3</td>
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<tr>
<td>March 30</td>
<td><strong>Homework #3 due; Receive homework #4</strong></td>
<td>Chapter 5</td>
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<tr>
<td>April 6</td>
<td><strong>Homework #4 due</strong></td>
<td>Chapter 6</td>
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<tr>
<td>April 13</td>
<td>Topic #7: Long-Run Relationships, Cointegration and Error Correction</td>
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<tr>
<td>April 20</td>
<td>Topic #8: Reading Dated Data</td>
<td>Handout</td>
</tr>
<tr>
<td>April 27</td>
<td>Open lab period.</td>
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<tr>
<td>May 4</td>
<td>Q &amp; A session for final exam.</td>
<td>Everything above</td>
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<tr>
<td><strong>Saturday, May 6</strong></td>
<td><strong>FINAL EXAM, 1:30 PM – 3:30 PM</strong></td>
<td>Everything above</td>
</tr>
<tr>
<td>May 11</td>
<td>Research papers due.</td>
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</table>

*Readings refer to both the 3rd and 4th editions of the Enders text.*
SOFTWARE:
The software package used in this course is PC SAS, version 9.4 (or higher). **If you want to get the maximum benefit from this class, you should put a tremendous amount of effort into learning this software package!** You can use the lab run by the College of Arts & Sciences in room 330 of the GAB. This lab should be open on the following days and times: Mondays through Thursdays, 8 AM to 10 PM, Fridays from 8 AM to 5 PM, and Saturdays & Sundays from 12 PM (noon) to 8 PM. The lab is closed during spring break.

Directions on how to use the lab remotely can be found at: [https://itservices.cas.unt.edu/covid-19/labs](https://itservices.cas.unt.edu/covid-19/labs).

You also can access SAS through “desktop streaming” (for students of the College of Liberal Arts & Sciences) or “virtual lab” (for students in the College of Business). You should be able to do this either through a web browser or through the VMware Horizon Client. It might be easier and less cumbersome to use the VMware method since, by this method, you have a separate program for accessing the software, rather than working within a web browser. To do that, go to: [https://view.euc.untsystem.edu/portal/webclient/index.html#/](https://view.euc.untsystem.edu/portal/webclient/index.html#/). Detailed instructions on how to access “desktop streaming” and “virtual lab” are available at: [https://itservices.cas.unt.edu/services/computers/articles/access-desktop-streaming](https://itservices.cas.unt.edu/services/computers/articles/access-desktop-streaming).

Note that “virtual lab” offers a much better experience so if you have that access, you should use it.

Note that when working with SAS via desktop streaming, it only is possible to work with data, programs, or log files when the files are stored on a share drive (such as the H drive) or on OneDrive. SAS cannot work with files that are stored locally (on your laptop or desktop or home computer). Also, files saved in local directories will be lost upon logging off. This means that you must use your OneDrive account to save your work. This drive usually is mapped to the O: (oh) drive on the computer that you are using. In addition, SAS is a bit slow when using desktop streaming so be patient! It will work eventually, but it will take longer than you are accustomed to.

COMMUNICATION EXPECTATION:
If I need to contact you to convey class-related information, in keeping with University policy, I will use Canvas and your OFFICIAL UNT email address ONLY. Thus, it is YOUR responsibility to check your UNT email and the Canvas announcements for this class on a regular basis.

If you send an email to me, please only use your official UNT email account. In addition, I typically receive a large volume of emails each day so it might not be possible to respond to all emails right away. To maximize the probability that I will read and respond to your email in a timely manner, please: (1.) use the words "ECON 5660" in the subject heading; (2.) include your full name in the "from" line; (3.) sign your email using your full name.

**If you email me a question about your SAS work, please cut and paste the contents of your log window into a Word file and send that to me.**
A WORD OF WARNING ABOUT THIS CLASS CONVERTING TO REMOTE DELIVERY:

It is possible that this class will be converted into an on-line format at some point. If that happens, all lectures will be delivered at the normal class time via Zoom. Therefore, you must have access to a computer with a camera, microphone, and a quiet place to view the lecture. Information on how to be successful in a remote learning environment can be found at https://online.unt.edu/learn.

COVID-19 IMPACT ON ATTENDANCE:

While attendance is expected as outlined above, it is important for all of us to be mindful of the health and safety of everyone in our community in light of COVID-19, the flu, and other such conditions. If you are sick, it may be in the best interests of everyone for you not to attend class. If you are experiencing any symptoms of the flu or COVID-19, please seek medical attention from the Student Health and Wellness Center (940-565-2333 or askSHWC@unt.edu) or your health care provider PRIOR to coming to campus. While attendance is an important part of succeeding in this class, your own health, and those of others in the community, is more important.

A NOTE REGARDING CLASS RECORDINGS:

In the event that class recordings are made and distributed to you, these recordings are reserved exclusively for use of students in this class, and are to be used for educational purposes only. The recordings should not be shared outside the class in any form. Failure to follow this restriction is a violation of the UNT Code of Student Conduct and could lead to disciplinary action.

HOUSE RULES:

1. No food or drink in the lab.
2. Turn off cell phones and all electronic devices during class time.
3. **DO NOT WORK ON YOUR COMPUTER DURING LECTURE.**
4. Question everything! Always ask "Why?" and "Does this make sense?" Be curious!
UNT POLICIES:

Academic Integrity Policy:
Academic Integrity Standards and Consequences. According to UNT Policy 06.003, Student Academic Integrity, academic dishonesty occurs when students engage in behaviors including, but not limited to cheating, fabrication, facilitating academic dishonesty, forgery, plagiarism, and sabotage. A finding of academic dishonesty may result in a range of academic penalties or sanctions ranging from admonition to expulsion from the University.

ADA Policy:
UNT makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide a student with an accommodation letter to be delivered to faculty to begin a private discussion regarding one’s specific course needs. Students may request accommodations at any time, however, ODA notices of accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information see the ODA website at disability.unt.edu.

Emergency Notification & Procedures:
UNT uses a system called Eagle Alert to quickly notify students with critical information in the event of an emergency (i.e., severe weather, campus closing, and health and public safety emergencies like chemical spills, fires, or violence). In the event of a university closure, please refer to Canvas for contingency plans for covering course materials.

Acceptable Student Behavior:
Student behavior that interferes with an instructor’s ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom and the instructor may refer the student to the Dean of Students to consider whether the student's conduct violated the Code of Student Conduct. The University's expectations for student conduct apply to all instructional forums, including University and electronic classroom, labs, discussion groups, field trips, etc. The Code of Student Conduct can be found at deanofstudents.unt.edu/conduct.

Access to Information – Eagle Connect:
Students’ access point for business and academic services at UNT is located at: my.unt.edu. All official communication from the University will be delivered to a student’s Eagle Connect account. For more information, please visit the website that explains Eagle Connect and how to forward e-mail: eagleconnect.unt.edu/
Technical Assistance:
At some point, it might be necessary for us to convert to remote delivery of this class. If that happens, here are some resources for you to help ease the inconveniences and frustration that can arise when technology breaks down or does not perform as expected. Here at UNT we have a Student Help Desk that you can contact for help with Canvas or other technology issues.

UNT Help Desk: [UIT Student Help Desk site](http://www.unt.edu/helpdesk/index.htm)
Email: helpdesk@unt.edu
Phone: 940-565-2324
In Person: Sage Hall, Room 130
Walk-In Availability: 8 AM to 9 PM
Telephone Availability:
- Sunday: noon to midnight
- Monday-Thursday: 8 AM to midnight
- Friday: 8 AM to 8 PM
- Saturday: 9 AM to 5 PM
Laptop Checkout: 8 AM to 7 PM

For additional support, visit [Canvas Technical Help](https://community.canvaslms.com/docs/DOC-10554-4212710328)

Rules of Engagement:
Rules of engagement refer to the way students are expected to interact with each other and with their instructors. Here are some general guidelines:

- While the freedom to express yourself is a fundamental human right, any communication that utilizes cruel and derogatory language on the basis of race, color, national origin, religion, sex, sexual orientation, gender identity, gender expression, age, disability, genetic information, veteran status, or any other characteristic protected under applicable federal or state law will not be tolerated.
- Treat your instructor and classmates with respect in any communication online or face-to-face, even when their opinion differs from your own.
- Ask for and use the correct name and pronouns for your instructor and classmates.
- Speak from personal experiences. Use “I” statements to share thoughts and feelings. Try not to speak on behalf of groups or other individual’s experiences.
- Use your critical thinking skills to challenge other people’s ideas, instead of attacking individuals.
- Avoid using all caps while communicating digitally. This may be interpreted as “YELLING!”
- Be cautious when using humor or sarcasm in emails or discussion posts as tone can be difficult to interpret digitally.
- Avoid using “text-talk” unless explicitly permitted by your instructor.
- Proofread and fact-check your sources.
- Keep in mind that online posts can be permanent, so think first before you type.

See [Engagement Guidelines](https://clear.unt.edu/online-communication-tips) for more information.
Sexual Assault Prevention:
UNT is committed to providing a safe learning environment free of all forms of sexual misconduct, including sexual harassment, sexual assault, domestic violence, dating violence, and stalking. Federal laws (Title IX and the Violence Against Women Act) and UNT policies prohibit discrimination on the basis of sex, and therefore prohibit sexual misconduct. If you or someone you know is experiencing sexual harassment, relationship violence, stalking, and/or sexual assault, there are campus resources available to provide support and assistance. UNT’s Survivor Advocates can assist a student who has been impacted by violence by filing protective orders, completing crime victim’s compensation applications, contacting professors for absences related to an assault, working with housing to facilitate a room change where appropriate, and connecting students to other resources available both on and off campus. The Survivor Advocates can be reached at SurvivorAdvocate@unt.edu or by calling the Dean of Students Office at 940-565-2648. Additionally, alleged sexual misconduct can be non-confidentially reported to the Title IX Coordinator at oeo@unt.edu or at (940) 565 2759.

Your Mental Health:
Just as with your physical health, your mental health is VERY important to me. We are living in stressful and uncertain times. A great deal of attention has been paid, lately, to our physical health, but I want to remind you that there is help for our mental health too. UNT’s Student Health & Wellness Center, the Counseling Center, and the Care Team are staffed with many wonderful people who wholeheartedly care for and are there for students in need, regardless of the nature of an issue or its severity. Please do not be afraid to reach to these caring professionals during this very difficult time; it really can help. DO NOT feel ashamed if you experience a crisis or if you are stressed out! Nearly everyone goes through some type of mental health issue at some point in their life—even the people who seem to be completely in control and who look totally “normal.” Begin with the links below:
Student Health & Wellness Center (https://studentaffairs.unt.edu/student-health-and-wellness-center)
Counseling and Testing Services (https://studentaffairs.unt.edu/counseling-and-testing-services)
UNT Care Team (https://studentaffairs.unt.edu/care)
UNT Psychiatric Services (https://studentaffairs.unt.edu/student-health-and-wellness-center/services/psychiatry)
Individual Counseling (https://studentaffairs.unt.edu/counseling-and-testing-services/services/individual-counseling)

Prohibition of Discrimination, Harassment & Retaliation:
Consistent with Policy 16.004, he University of North Texas (UNT) prohibits discrimination and harassment because of race, color, national origin, religion, sex, sexual orientation, gender identity, gender expression, age, disability, genetic information, veteran status, or any other characteristic protected under applicable federal or state law in its application and admission processes; educational programs and activities; employment policies, procedures, and processes; and university facilities. The University takes active measures to prevent such conduct and investigates and takes remedial action when appropriate.
Retention of Student Records:

Student records pertaining to this course are maintained in a secure location by the instructor of record. All records such as exams, answer sheets (with keys), and written papers submitted during the duration of the course are kept for at least one calendar year after course completion. Course work completed via the Canvas online system, including grading information and comments, is also stored in a safe electronic environment for one year.

Students have the right to view their individual record; however, information about student’s records will not be divulged to other individuals without proper written consent. Students are encouraged to review the Public Information Policy and the Family Educational Rights and Privacy Act (FERPA) laws and the University’s policy. See UNT Policy 10.10, Records Management and Retention for additional information.