

# **Econ174**

## **Time Series Analysis**

### **Fall 2022**

**Professor:** Dr. Ruxandra Prodan-Boul, [rprodanboul@scu.edu](mailto:rprodanboul@scu.edu), Lucas 321 S

**Time and Location:** MWF 11:45am-12:50pm, Lucas 206

**Office Hours:** Monday 1:00-2:00 pm or by appointment, via Zoom

#### **Course Description**

This course introduces students to the econometric analysis of time series data. We focus on the use of time series models to forecast economic and financial variables. Students will learn how to classify and represent a time series, how to estimate various times series models and how to test a variety of hypotheses involving time series data. We discuss different methods of forecasting and how they can be evaluated. The goal of this course is that, at the end, you can independently create quality forecasts of time series. It emphasizes hands-on experience and all students will acquire knowledge of the programming language R in the context of time series models and forecasting.

#### **Pre-requisites**

A grade of C- or better in (ECON 1 and ECON 2 and ECON 3) and ECON 115 and ECON 41 and ECON 42 or permission of instructor.

#### **Required Materials:**

- *Forecasting: principles and practice* by Hyndman and Athanasopoulos, available free online at [www.otexts.org/fpp2](http://www.otexts.org/fpp2)
- R and Rstudio (freely available statistical software)

#### **Other References**

- The **forecast** package for R - provides methods and tools for displaying and analyzing univariate time series forecasts including exponential smoothing and ARIMA modeling. The package is described in [Hyndman and Khandakar \(2008\)](#)
- A little book of R for Time Series [A Little Book of R For Time Series \(readthedocs.org\)](http://A Little Book of R For Time Series (readthedocs.org))

#### **Lecture Notes**

Copies of the lecture outlines, codes and additional material will be posted on Camino.

#### **Software Requirements**

Students are required to bring their laptops to class. You will have to download and install R, available at <https://cran.r-project.org/> and Rstudio, available at <https://www.rstudio.com/products/rstudio/download/> (the free Rstudio Desktop version). See also the appendix of the book <https://otexts.org/fpp2/appendix-using-r.html> or [A Little Book of R For Time Series \(readthedocs.org\)](http://A Little Book of R For Time Series (readthedocs.org)) for detailed instructions.

## **Grades**

Grades will be based on class participation, four homework assignments, one midterm exam, and a project, which will be presented in the last week, during class, and submitted in the end of the semester.

10% Class participation

40% Assignments

30% Midterm exam

20% Project (including presentation in final week)

**Class Participation:** You are expected to attend all scheduled classes. Please send me an email message beforehand if you will miss a class. To earn a good participation grade, you need to be prepared and engaged in class. Your participation grade will be calculated based on class work (you will have to send me your code and output after each class to receive full participation points).

**Homeworks:** There will be four assignments during the semester. They will be assigned more than a week prior to the deadline (the dates are specified in the outline). Assignments will largely consist of data manipulation and applying the methods learned in class to real world data using R. You will need to submit your homework online, via Camino. The homework should include the R code that you used to generate the output. R Markdown is preferred but not required. Students are allowed to work together on problem sets; however, all write-ups must be done individually.

**Project:** An applied project will be presented during the last week of class and will be handed in no later than Friday 12/09. You can work in a **group of two students and submit one project.** You will soon receive more detailed instructions about your projects, in class.

**COURSE OUTLINE\***

Date:	Topic	Assignment
Sept. 19 <sup>th</sup> (Mo)	Lecture 1 – Syllabus and Introduction	
Sept. 21 <sup>st</sup> (Wed)	Lecture 2 – Considerations for a successful forecast Introduction to R	
Sept. 23 <sup>rd</sup> (Fri)	Lecture 3 – Simple forecasting methods	
Sept. 26 <sup>th</sup> (Mo)	Lecture 3 – Simple forecasting methods	<b>Homework 1 is out</b>
Sept. 28 <sup>th</sup> (Wed)	Lecture 4 – Exponential Smoothing	
Sept. 30 <sup>th</sup> (Fri)	Lecture 4 – Exponential Smoothing	
Oct. 3 <sup>rd</sup> (Mo)	Lecture 4 – Exponential Smoothing	
Oct. 5 <sup>th</sup> (Wed)	Lecture 5 – Time Series Decomposition	<b>Homework 1, due Wed. 11 am</b>
Oct. 7 <sup>th</sup> (Fri)	<b>Presidential Inauguration - no class</b>	
Oct. 10 <sup>th</sup> (Mo)	Lecture 5 – Time Series Decomposition	<b>Homework 2 is out</b>
Oct. 12 <sup>th</sup> (Wed)	Lecture 5 – Time Series Decomposition	
Oct. 14 <sup>th</sup> (Fri)	Lecture 6 – Regression and Forecasting	
Oct. 17 <sup>th</sup> (Mo)	Lecture 6 – Regression and Forecasting	
Oct. 19 <sup>th</sup> (Wed)	Lecture 7 – ARIMA	<b>Homework 2, due Wed 11 am</b>
Oct. 21 <sup>st</sup> (Fri)	Lecture 7 – ARIMA	<b>Homework 3 is out</b>
Oct. 24 <sup>th</sup> (Mo)	Lecture 7 – ARIMA	
Oct. 26 <sup>th</sup> (Wed)	Lecture 7 – ARIMA	
Oct. 28 <sup>st</sup> (Fri)	Lecture 8 – Structural change	<b>Homework 3, due Friday 11 am</b>
Oct. 31 <sup>th</sup> (Mo)	Review	
Nov. 2 <sup>nd</sup> (Wed)	<b>Midterm**</b>	
Nov. 4 <sup>th</sup> (Fri)	Discuss the Project	
Nov. 7 <sup>th</sup> (Mo)	Lecture 9 - Dynamic Regression Models	<b>Homework 4 is out</b>
Nov. 9 <sup>th</sup> (Wed)	Lecture 10 - VAR	
Nov. 11 <sup>th</sup> (Fri)	Lecture 10 - VAR	
Nov. 14 <sup>th</sup> (Mo)	GARCH model/Applied Topics	
Nov. 16 <sup>th</sup> (Wed)	GARCH Model/Applied Topics	<b>Homework 4 due Wed 11 am</b>
Nov. 18 <sup>th</sup> (Fri)	Applied Topics	
Nov 21 <sup>st</sup> – Nov 25 <sup>th</sup>	<b>Thanksgiving week! No class</b>	
Nov. 28 <sup>th</sup> (Mo)	Project - In class Presentations	
Nov. 30 <sup>th</sup> (Wed)	Project - In class Presentations	
Dec. 2 <sup>nd</sup> (Fri)	Project - In class Presentations	
Dec. 9 <sup>th</sup> (Fri)	<b>Project due</b>	

\* Subject to small adjustments

\*\* If we need more time to get ready for the midterm or finish the material, Exam 1 will take place on Friday.

## University Policies

### **Academic Integrity**

The Academic Integrity pledge is an expression of the University's commitment to fostering an understanding of—and commitment to—a culture of integrity at Santa Clara University. The Academic Integrity pledge, which applies to all students, states:

*I am committed to being a person of integrity. I pledge, as a member of the Santa Clara University community, to abide by and uphold the standards of academic integrity contained in the Student Conduct Code.*

Academic integrity is part of your intellectual, ethical, and professional development. I expect you to uphold the principles of this pledge for all work in this class. I will clarify expectations on academic integrity as needed for assignments and exams. If you have questions about what is appropriate on any assignment, please let me know before you hand in work. For more resources about ensuring academic integrity in your work, including the appropriate use, of course, sharing sites such as Chegg, see this site created by the SCU Library at <https://libguides.scu.edu/academic-integrity> or visit [www.scu.edu/academic-integrity](http://www.scu.edu/academic-integrity).

### **Discrimination, Harassment, and Sexual Misconduct (Title IX)**

Santa Clara University is committed to providing all students with a safe learning environment free of all forms of discrimination, sexual harassment, and sexual violence.

Please know that as a faculty member, California law SB 493 requires me to report any information brought to my attention about incidents of sexual harassment or misconduct to the SCU [Equal Opportunity and Title IX Office](#) (408) 551-3043. This includes, but is not limited to, disclosures in writing assignments, class discussions, and one-on-one conversations.

Should you need support, SCU has dedicated staff trained to assist you in navigating campus resources, accessing health and counseling services, providing academic and housing accommodations, helping with legal protective orders, and filing a formal complaint with the University or with law enforcement. Please see the [Student Resources](#) page for more information about reporting options and resources. If you or someone you know has experienced sexual harassment or sexual violence and wishes to speak to a **confidential** resource who is not required to report, please contact one of the following SCU resources for support:

- Bree Van Ness, [Assistant Director for Student Survivor Advocacy and Campus Support](#), SCU Wellness Center, 852 Market St, (408) 551-3307, [bvanness@scu.edu](mailto:bvanness@scu.edu)
- [SCU Wellness Center](#)
- [CAPS](#)
- Any individual (clergy, counselors) acting in a professional capacity for which confidentiality is mandated by law

I am happy to help connect you with any of these resources.

### **Accommodations for Pregnant and Parenting Students**

Santa Clara University does not discriminate against any student on the basis of pregnancy or related medical conditions. Absences due to medical conditions relating to pregnancy and

childbirth will be excused for as long as deemed medically necessary by a student's doctor, and students will be given the opportunity to make up missed work. Students needing accommodations can often arrange accommodations by working directly with their instructors, supervisors, or departments. Students needing accommodations can also seek assistance with accommodations from the Office of Accessible Education (OAE) or from the Office of Equal Opportunity and Title IX Office. The following link provides information for students and faculty regarding pregnancy rights. <https://www.scu.edu/title-ix/resources/pregnancy>.

### **Office of Accessible Education**

If you have a documented disability for which accommodations may be required in this class, please contact the Office of Accessible Education [oea@scu.edu](mailto:oea@scu.edu), <http://www.scu.edu/oea> as soon as possible to discuss your needs and register for accommodations with the University. If you have already arranged accommodations through OAE, please be sure to request your accommodations through your my OAE portal and discuss them with me during my office hours within the first two weeks of class. To ensure fairness and consistency, individual faculty members are required to receive verification from the Office of Accessible Education before providing accommodations. OAE will work with students and faculty to arrange proctored exams for students whose accommodations include double time for exams and/or assistive technology.

Students with approved accommodations of time and a half should talk with me as soon as possible. The Office of Accessible Education must be contacted in advance (at least two weeks' notice recommended) to schedule proctored examinations or to arrange other accommodations.

In light of shifting health advisories related to COVID-19, exams may be administered online. Students with approved testing accommodations should contact me (at least two weeks' notice recommended) prior to the exam date to notify me of their intent to use their testing accommodations on the upcoming exam to ensure their accommodations are effectively implemented.

### **Safety Measures**

In order to meet our learning objectives, we will adhere to the highest standards for safety and mutual respect. I expect everyone to adhere to current university mask mandates at all times; to make their best attempt to make themselves heard when asking questions or contributing to discussions, and refrain from eating or drinking in class. It is expected that everyone will follow university guidelines about health and public safety measures outlined in this [email](#).

### **Use of Classroom Recordings**

All class meetings will be recorded and made available on Camino. As is stated in the [Student Conduct Code](#): "...Dissemination or sharing of any classroom recording without the permission of the instructor would be considered "misuse" and, therefore, prohibited. Violations of these policies may result in disciplinary action by the University. At the instructor's discretion, violations may also have an adverse effect on the student's grade."

### **Copyright Statement**

Materials in this course are protected by the United States copyright laws. I am the copyright holder of the materials I create, including notes, handouts, slides, and videos. You may make

copies of course materials for your own use and you may share the materials with other students enrolled in this course. You may not publicly distribute the course materials without my written permission.

### **Technology Support**

SCU can provide you with technical assistance, and you can also reach out to our providers directly for questions. For Camino (SCU's branded instance of Canvas) support, contact [caminosupport@scu.edu](mailto:caminosupport@scu.edu) or call 408-551-3572.

You can also use the help button within the Camino platform (on the left-hand navigation) for 24/7 support via chat or phone with our vendor.

For Zoom assistance, contact Media Services at [mediaservices@scu.edu](mailto:mediaservices@scu.edu) or 408-554-4520. You can also get support from the [Zoom Help Center](#) website.

For SCU network and computing support, contact the SCU Technology Help Desk at [techdesk@scu.edu](mailto:techdesk@scu.edu) or 408-554- 5700. They can provide support for MySCU Portal, Duo, eCampus, hardware and software issues, and more.

### **Land Acknowledgment**

Santa Clara University occupies the unceded ancestral homeland of the Ohlone and Muwekma Ohlone people.

### **Respect for Diversity**

It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength, and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, religion, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you.

### **Gender Inclusive Language**

This course affirms people of all gender expressions and gender identities. If you go by a name different from what is on the class roster, please let me know. Using correct gender pronouns is important to me, so I encourage you to share your pronouns with me and correct me if I make a mistake. If you have any questions or concerns, please do not hesitate to contact me. For more on personal pronouns see [www.mypronouns.org](http://www.mypronouns.org)

### **Wellness Statement**

I know you will do the best you can in this class (and all of your classes); however, it should never be at the expense of your own mental health, physical health, and/or well-being. Jesuit education is grounded in *cura personalis*, concern for the whole person—mind, body, and spirit. What does this mean for you? Be kind to others, and more importantly, be kind to yourself. Attend to your sleep (quantity *and* quality); drink lots of water; move; get outside; and pay attention to beauty that isn't coming to you on a screen. Eat good food; laugh; enjoy friends and family; look for opportunities to connect with others in new

ways; pray, meditate, or otherwise attend to your spirit. And ask for help, even if you don't think you need it. Lots of folks, including me, are here to support you. It's never too late to reach out, and I am committed to helping you.

SCU has many resources and programs to support you. These resources may be especially helpful:

**Wellness Center:** <https://www.scu.edu/wellness/>

The Wellness center provides resources to aid and promote student well-being across the eight dimensions of wellness, including student peer groups for healthful living, violence prevention, and recovery.

**CAPS:** <https://www.scu.edu/cowell/counseling-and-psychological-services-caps/>

Santa Clara students are provided confidential counseling sessions at no cost through Counseling and Psychological Services (CAPS). Students have access to clinically appropriate, short-term therapy; group therapy; and other resources for care. A new 24/7 support line is also available: **408-554-5220**.

**SCU Culture of Care:** <https://www.scu.edu/osl/culture-of-care/>

If you are concerned for the mental or physical welfare of one of your peers, the [Office of Student Life Culture of Care](#) website provides resources for recognizing and helping someone in distress.

### **Academic Concerns**

If you are concerned with your progress in this class, please contact me so that we can find solutions together. [Drahmann Center](#) can also offer support with issues regarding your academic progress more broadly.

SCU also has multiple options for free academic tutoring. Students can make appointments to discuss work in a range of courses:

- [Drahmann Tutoring](#) (Numerous courses in the College of Arts & Sciences including Natural Sciences, Modern Languages, Economics, and Computer Science)
- [The HUB Writing Center](#) (Writing and Public Speaking)
- [Mathematics Learning Center](#) (MATH 4, 6, 8, 11-14, 30-31, 35-36, 51, 53)