Practical Time Series Analysis

The State University of New York

**About this Course**

Welcome to Practical Time Series Analysis! Many of us are "accidental" data analysts. We trained in the sciences, business, or engineering and then found ourselves confronted with data for which we have no formal analytic training. This course is designed for people with some technical competencies who would like more than a "cookbook" approach, but who still need to concentrate on the routine sorts of presentation and analysis that deepen the understanding of our professional topics. In practical Time Series Analysis we look at data sets that represent sequential information, such as stock prices, annual rainfall, sunspot activity, the price of agricultural products, and more. We look at several mathematical models that might be used to describe the processes which generate these types of data. We also look at graphical representations that provide insights into our data. Finally, we also learn how to make forecasts that say intelligent things about what we might expect in the future. Please take a few minutes to explore the course site. You will find video lectures with supporting written materials as well as quizzes to help emphasize important points. The language for the course is R, a free implementation of the S language. It is a professional environment and fairly easy to learn. You can discuss material from the course with your fellow learners. Please take a moment to introduce yourself! Time Series Analysis can take effort to learn- we have tried to present those ideas that are "mission critical" in a way where you understand enough of the math to fell satisfied while also being immediately productive. We hope you enjoy the class!

[More](https://www.coursera.org/learn/practical-time-series-analysis/home/info)

* [](https://www.coursera.org/instructor/tsadigov)

**Taught by:**  [Tural Sadigov](https://www.coursera.org/instructor/tsadigov" \t "_blank), Lecturer

Applied Mathematics

* [](https://www.coursera.org/instructor/~508202)

**Taught by:**  [William Thistleton](https://www.coursera.org/instructor/~508202), Associate Professor

Applied Mathematics

|  |  |
| --- | --- |
| **Level** | Intermediate |
| **Language** | English  [Volunteer to translate subtitles for this course](https://www.coursera.org/learn/practical-time-series-analysis/home/info) |
| **How To Pass** | Pass all graded assignments to complete the course. |
| **User Ratings** | Average User Rating 4.6 |

Syllabus

**WEEK 1**

WEEK 1: Basic Statistics

During this first week, we show how to download and install R on Windows and the Mac. We review those basics of inferential and descriptive statistics that you'll need during the course.

12 videos, 4 readings

1. [**Video:**Course Introduction](https://www.coursera.org/learn/practical-time-series-analysis/lecture/pPtHq/course-introduction)
2. **Video:**Week 1 Welcome Video
3. **Reading:**Welcome to Week 1
4. **Reading:**Getting Started with R
5. **Video:**Getting Started in R: Download and Install R on Windows
6. **Video:**Getting Started in R: Download and Install R on Mac
7. **Video:**Getting Started in R: Using Packages
8. **Notebook:**Codes for Concatenation, Five-number summary, Standard Deviation
9. **Video:**Concatenation, Five-number summary, Standard Deviation
10. **Notebook:**Codes for Histogram
11. **Video:**Histogram in R
12. **Notebook:**Codes for Scatterplot
13. **Video:**Scatterplot in R
14. **Reading:**Basic Statistics Review (with linear regression and hypothesis testing)
15. **Video:**Review of Basic Statistics I - Simple Linear Regression
16. **Video:**Reviewing Basic Statistics II More Linear Regression
17. **Video:**Reviewing Basic Statistics III - Inference
18. **Reading:**Measuring Linear Association with the Correlation Function
19. **Video:**Reviewing Basic Statistics IV

**Graded:**Visualization

**Graded:**Basic Statistics Review

**WEEK 2**

Week 2: Visualizing Time Series, and Beginning to Model Time Series

In this week, we begin to explore and visualize time series available as acquired data sets. We also take our first steps on developing the mathematical models needed to analyze time series data.

10 videos, 1 reading

1. [**Video:**Week 2 Welcome Video](https://www.coursera.org/learn/practical-time-series-analysis/lecture/xs4Ty/week-2-welcome-video)
2. **Reading:**All slides together for the next two lessons
3. **Video:**Introduction
4. **Video:**Time plots
5. **Video:**First Intuitions on (Weak) Stationarity
6. **Video:**Autocovariance function
7. **Video:**Autocovariance coefficients
8. **Video:**Autocorrelation Function (ACF)
9. **Video:**Random Walk
10. **Video:**Introduction to Moving Average Processes
11. **Notebook:**Simulating MA(2) process - codes for the next video lecture
12. **Video:**Simulating MA(2) process

**Graded:**Noise Versus Signal

**Graded:**Random Walk vs Purely Random Process

**Graded:**Time plots, Stationarity, ACV, ACF, Random Walk and MA processes

**WEEK 3**

Week 3: Stationarity, MA(q) and AR(p) processes

In Week 3, we introduce few important notions in time series analysis: Stationarity, Backward shift operator, Invertibility, and Duality. We begin to explore Autoregressive processes and Yule-Walker equations.

13 videos, 7 readings

1. [**Video:**Week 3 Welcome Video](https://www.coursera.org/learn/practical-time-series-analysis/lecture/lKlTY/week-3-welcome-video)
2. **Reading:**Stationarity - Examples -White Noise, Random Walks, and Moving Averages
3. **Reading:**Stationarity - Intuition and Definition
4. **Reading:**Stationarity - ACF of a Moving Average
5. **Video:**Stationarity - Intuition and Definition
6. **Video:**Stationarity - First Examples...White Noise and Random Walks
7. **Video:**Stationarity - First Examples...ACF of Moving Average
8. **Reading:**All slides together for lesson 2 and 4
9. **Video:**Series and Series Representation
10. **Video:**Backward shift operator
11. **Video:**Introduction to Invertibility
12. **Video:**Duality
13. **Video:**Mean Square Convergence (Optional)
14. **Reading:**Autoregressive Processes- Definition and First Examples
15. **Video:**Autoregressive Processes - Definition, Simulation, and First Examples
16. **Reading:**Autoregressive Processes - Backshift Operator and the ACF
17. **Video:**Autoregressive Processes - Backshift Operator and the ACF
18. **Video:**Difference equations
19. **Video:**Yule - Walker equations
20. **Reading:**Yule - Walker equations - Slides

**Graded:**Stationarity

**Graded:**Series, Backward Shift Operator, Invertibility and Duality

**Graded:**AR(p) and the ACF

**Graded:**Difference equations and Yule-Walker equations

**WEEK 4**

Week 4: AR(p) processes, Yule-Walker equations, PACF

In this week, partial autocorrelation is introduced. We work more on Yule-Walker equations, and apply what we have learned so far to few real-world datasets.

8 videos, 3 readings

1. [**Video:**Week 4 Welcome Video](https://www.coursera.org/learn/practical-time-series-analysis/lecture/JMBaT/week-4-welcome-video)
2. **Reading:**Partial Autocorrelation and the PACF First Examples
3. **Video:**Partial Autocorrelation and the PACF First Examples
4. **Reading:**Partial Autocorrelation and the PACF: Concept Development
5. **Video:**Partial Autocorrelation and the PACF - Concept Development
6. **Reading:**All slides together for the next two lessons
7. **Video:**Yule-Walker Equations in Matrix Form
8. **Notebook:**AR(2) Simulation (Parameter Estimation)
9. **Video:**Yule Walker Estimation - AR(2) Simulation
10. **Notebook:**AR(3) Simulation (Parameter Estimation)
11. **Video:**Yule Walker Estimation - AR(3) Simulation
12. **Notebook:**Recruitment - model fitting
13. **Video:**Recruitment data - model fitting
14. **Notebook:**Johnson & Johnson-model fitting
15. **Video:**Johnson & Johnson-model fitting

Show less

**Graded:**Partial Autocorrelation

**Graded:**Yule-Walker in matrix form and Yule-Walker estimation

**Graded:**'LakeHuron' dataset

**WEEK 5**

Week 5: Akaike Information Criterion (AIC), Mixed Models, Integrated Models

In Week 5, we start working with Akaike Information criterion as a tool to judge our models, introduce mixed models such as ARMA, ARIMA and model few real-world datasets.

7 videos, 6 readings

1. [**Video:**Week 5 Welcome Video](https://www.coursera.org/learn/practical-time-series-analysis/lecture/OEkaq/week-5-welcome-video)
2. **Reading:**Akaike Information Criterion and Model Quality
3. **Video:**Akaike Information Criterion and Model Quality
4. **Reading:**ARMA Models and a Little Theory
5. **Video:**ARMA Models (And a Little Theory)
6. **Reading:**ARMA Properties and Examples
7. **Video:**ARMA Properties and Examples
8. **Reading:**All slides together for this lesson
9. **Video:**ARIMA Processes
10. **Notebook:**ARIMA(2,1,1) Simulation
11. **Video:**Q-Statistic
12. **Video:**Daily births in California in 1959
13. **Reading:**Daily birth dataset
14. **Notebook:**Daily birth - R code
15. **Reading:**Daily female birth (R file)

Show less

**Graded:**AIC and model building

**Graded:**ARMA Processes

**Graded:**ARIMA and Q-statistic

**Graded:**'BJsales' dataset

**WEEK 6**

Week 6: Seasonality, SARIMA, Forecasting

In the last week of our course, another model is introduced: SARIMA. We fit SARIMA models to various datasets and start forecasting.

10 videos, 6 readings

1. [**Video:**Week 6 Welcome Video](https://www.coursera.org/learn/practical-time-series-analysis/lecture/witjD/week-6-welcome-video)
2. **Reading:**All slides together for the next two lessons
3. **Video:**SARIMA processes
4. **Video:**ACF of SARIMA models
5. **Reading:**SARIMA simulation (code block)
6. **Video:**SARIMA fitting: Johnson & Johnson
7. **Reading:**SARIMA code for J&J (code block)
8. **Video:**SARIMA fitting: Milk production
9. **Notebook:**SARIMA code for Milk production
10. **Video:**SARIMA fitting: Sales at a souvenir shop
11. **Notebook:**SARIMA code for Sales at a souvenir shop
12. **Reading:**Forecasting using Simple Exponential Smoothing
13. **Video:**Forecasting Using Simple Exponential Smoothing
14. **Reading:**Forecasting Using Holt Winters for Trend (Double Exponential)
15. **Video:**Double Exponential Smoothing
16. **Reading:**Forecasting Using Holt Winters for Trend and Seasonality (Triple Exponential)
17. **Video:**Triple Exponential Smoothing Concept Development
18. **Video:**Triple Exponential Smoothing Implementation

Show less

**Graded:**SARIMA processes

**Graded:**'USAccDeaths' dataset

**Graded:**Forecasting

How It Works

GENERAL

**How do I pass the course?**

To earn your Course Certificate, you’ll need to earn a passing grade on each of the required assignments—these can be quizzes, peer-graded assignments, or programming assignments. Videos, readings, and practice exercises are there to help you prepare for the graded assignments.

**What do start dates and end dates mean?**

Most courses have sessions that run multiple times a year — each with a specific start and end date. Once you enroll, you’ll have access to all videos, readings, quizzes, and programming assignments (if applicable). Peer-graded assignments can only be submitted and reviewed once your session has begun. If you choose to explore the course without purchasing, you may not be able to access certain assignments. If you don’t finish all graded assignments before the end of the session, you can enroll in the next session. Your progress will be saved and you’ll be able to pick up where you left off when the next session begins.

**What are due dates? Is there a penalty for submitting my work after a due date?**

Within each session there are suggested due dates to help you manage your schedule and keep coursework from piling up. Quizzes and programming assignments can be submitted late without consequence. However, it is possible that you won't receive a grade if you submit your peer-graded assignment too late because classmates usually review assignment within three days of the assignment deadline.

**Can I re-attempt an assignment?**

Yes. If you want to improve your grade, you can always try again. If you’re re-attempting a peer-graded assignment, re-submit your work as soon as you can to make sure there’s enough time for your classmates to review your work. In some cases you may need to wait before re-submitting a programming assignment or quiz. We encourage you to review course material during this delay.

[Show less](https://www.coursera.org/learn/practical-time-series-analysis/home/info)

[View the course in catalog](https://www.coursera.org/learn/practical-time-series-analysis)

Related Courses

[[](https://www.coursera.org/learn/pca-machine-learning)](https://www.coursera.org/learn/pca-machine-learning)

[Mathematics for Machine Learning: PCA](https://www.coursera.org/learn/pca-machine-learning)

[Imperial College London](https://www.coursera.org/learn/pca-machine-learning)

[[](https://www.coursera.org/learn/multivariate-calculus-machine-learning)](https://www.coursera.org/learn/multivariate-calculus-machine-learning)

[Mathematics for Machine Learning: Multivariate Calculus](https://www.coursera.org/learn/multivariate-calculus-machine-learning)

[Imperial College London](https://www.coursera.org/learn/multivariate-calculus-machine-learning)

[[](https://www.coursera.org/learn/linear-algebra-machine-learning)](https://www.coursera.org/learn/linear-algebra-machine-learning)

[Mathematics for Machine Learning: Linear Algebra](https://www.coursera.org/learn/linear-algebra-machine-learning)

[Imperial College London](https://www.coursera.org/learn/linear-algebra-machine-learning)

[[](https://www.coursera.org/learn/mcmc-bayesian-statistics)](https://www.coursera.org/learn/mcmc-bayesian-statistics)

[Bayesian Statistics: Techniques and Models](https://www.coursera.org/learn/mcmc-bayesian-statistics)

[University of California, Santa Cruz](https://www.coursera.org/learn/mcmc-bayesian-statistics)

[[](https://www.coursera.org/learn/bayesian-methods-in-machine-learning)](https://www.coursera.org/learn/bayesian-methods-in-machine-learning)

[Bayesian Methods for Machine Learning](https://www.coursera.org/learn/bayesian-methods-in-machine-learning)

[National Research University Higher School of Economics](https://www.coursera.org/learn/bayesian-methods-in-machine-learning)