

# Time Series Forecasting: Machine Learning and Deep Learning with R and Python - Course Syllabus -

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## Lecture 1: Time Series Manipulations, Transformations & Visualizations

### Manipulations:

- summarizing by time
- padding by time
- filtering by time
- mutating by time
- joining by time

### Transformations:

- variance reduction
- range reduction
- smoothing
- rolling averages
- missing values imputation
- anomaly detection and cleaning
- lags and differencing
- Fourier transforms
- confined intervals

### Visualizations:

- time series
- autocorrelations
- cross-correlations
- smoothing
- seasonality
- time series decomposition
- anomaly detection
- time series regressions

## Lecture 2: Time Series Features Engineering

### Feature Engineering:

- time-based features
- trend-based features
- seasonal features
- interaction features
- rolling average features

- lag features
- Fourier features
- event data features
- external features

**Tidymodel:**

- recipes
- workflows

## **Lecture 3: Tidymodel & Modeltime**

**Tidymodel:**

- package framework

**Modeltime:**

- package framework
- algorithm specifications
- workflows
- calibration
- evaluation
- refitting
- forecasting

## **Lecture 4: Time Series Models**

**Forecasting Methods:**

- Naive / Seasonal Naive
- Window Functions
- S-ARIMA-X
- Exponential Smoothing
- TBATS
- STL (Decomposition models)
- Facebook's Prophet

## **Lecture 5: Machine Learning Models**

**Forecasting Methods:**

- Linear Regression
- Elastic Net
- MARS
- SVM
- KNN
- Random Forest
- Boosting
- Cubist
- Neural Network

## **Lecture 6: Boosting Time Series Models**

**Forecasting Methods:**

- ARIMA Boost
- Prophet Boost

## Lecture 7: Deep Learning Models

### Forecasting Methods:

- GluonTS Deep AR
- GluonTS NBEATS
- GluonTS GP Forecaster
- GluonTS Deep State
- Torch Deep AR

## Lecture 8: Automatic Machine Learning

### Forecasting Methods:

- H2O

## Lecture 9: Hyperparameter Tuning

### Methods:

- Sequential
- Non-Sequential

### Cross Validation:

- Time Series Cross Validation
- V-Fold Cross Validation
- Grid Searches

## Lecture 10: Ensemble Learning

### Forecasting Methods:

- Simple Averaging Ensemble
- Weight Averaging Ensemble
- Stacking and Metalearning
- Multi-level Ensemble

## Lecture 11: Recursive Machine Learning Forecasting

### ML Recursivity:

- single time series recursive modelling
- panel data recursive modelling