Manipulating Time Series in R

This course will introduce learners to working with time series data in R. Learners will explore how to **store and format data in date and time objects** as well as how to manipulate time series datasets through subsetting, indexing, and extraction. Examples of time series data across a variety of fields in business and science should be discussed. The course will cover summarization, frequency, missing data, resampling, and comparison techniques as well as window functions for both rolling and expanding windows.

Objectives:

1. Store and format data in date/time objects
2. Manipulate TS datasets
   1. Subsetting, Indexing, Extraction
3. Introduce variety of datasets
   1. Example datasets from e.g., fma, AirPassengers, EuStockMarkets
   2. cranlogs::cran\_downloads
4. Summarization
5. Frequency
6. Missing Data and Resampling
7. Rolling/Expanding Windows

Course Outline:

## Chapter 1: Introduction to Time Series Data

* *Lesson 1.1: What is Time Series Data*
  + Learning Objective: Learner will be able to understand why TS-data is needed in real-world analyses, how TS-data differs from non-temporal data, as well as what can be gained by performing TS analysis
  + LO: Learners will be able to manipulate date-time data through functions e.g.: as.Date()
* *Lesson 1.2: How to Interpret Time Series Data*
  + LO: Learner will understand how to interpret a basic time series plot
  + – Learner will understand the difference between stationary and non-stationary data, and how the following differ between the two:
    - Mean,
    - Variance,
    - Covariance/Autocorrelation
* *Lesson 1.3: Components of Time Series Data*
  + – Learner will be able to understand the three primary components of TS-data: Trend, Seasonality, and Random components
  + – Learners will learn the difference between an “additive” and “multiplicative” model
  + – Learner will be able to interpret a “season plot”
* *Lesson 1.4: Creating a time series with* ***ts()***
  + LO: Learners will be able to read in data from a dataframe or tibble, and convert it into an object of class “ts” with the ts() function
  + – Learners will be able to understand what properties a *ts* object has, including:
    - Equi-spaced observations in time (i.e., equal, regular sampling intervals)
    - Attributes like frequency, start, and end.

## Chapter 2: Manipulating Time Series Data

* *Lesson 2.1: Subsetting, Indexing, and Extraction*
* *Lesson 2.2: Quantifying a Time Series*
  + LO: Learners will be able to perform the Dickey-Fuller test to determine if a time series is stationary or non-stationary
    - adf.test from the
  + LO: Learners will learn about the *print* and *plot* methods in R
    - forecast::autoplot
* *Lesson 2.3: Decomposing a Time Series*
  + LO: Learners will be able to decompose a time series with the `decompose` and `stl` functions, and be able to plot and interpret the results.
  + – Learners will be able to adjust for the seasonality in the data with forecast::seasadj()
* ***Lesson 2.4: Missing Values and Resampling***

## Chapter 3: Rolling Windows

* *Lesson 3.1: What are Windows?*
* *Lesson 3.2: Calculating a Rolling Window*
* *Lesson 3.3: Interpreting the Results*