STAT 443: Time Series and Forecasting

Lab 1
Introducing Time Series in R

Objectives of the lab:

- Learn to read time series data into `R`.
- Create a time series object using package `ts`.
- Perform basic manipulations on time series.
- Plot a time series and identify its main features.
- Plot a sample autocorrelation function and interpret its behaviour.
- Creating a reproducible report using `R Markdown`.

Getting started

- Open *RStudio*
- Create a new `R` script: File → New File → R Script
- Set working directory: Session → Set Working Directory → ...
- Install (via Tools → Install Packages) and load necessary package(s)

  ```
  library(tseries)
  ```

- To use the "Help" facility in R, enter `help(function)` or just `?function`, which will produce the help page for the R command/object `function`.

Through the following exercises, you will learn how to read in data into `R`, define a time series object and plot time series data.

1. (**Reading in data**) Datasets can be read into `R` by one of several methods, the most common being `read.table()` and `read.csv()`

   - The dataset "LakeLevels.csv" contains the daily depths (in meters) of a lake from 2007 to 2011 inclusive. Read the data into `R` using `read.csv()`. Use the command `<-` to assign your dataset to a named object, `dat` say.

     To look at the data, you can use commands `head()` and `tail()`.
     Try `head(dat,10)` to view the first 10 rows of the data.

   - Objects in `R` are each of a prescribed "class", this determining characteristics of the object and how functions will act on the object. Your object is a so–called "dataframe", which is similar to a matrix except it allows for different columns to be of different class and uses a different vocabulary for its manipulation.

     The command `names()` can be used on a data frame to obtain a list of the vectors contained in the data frame. The call `object$name` extracts the vector `name` from the data frame `object`.

   - Create a plot of variable "LakeLevel". How does this plot differ from one you would like for these data?

2. **(Creating a time series object)** Time series objects in `R` are of either `ts` or `zoo` class. We will initially learn how to work with the `ts` object.

   - To determine whether the dataframe you have created is of class `ts`, the command `is.ts()` can be used.
   - Objects can be coerced into being time series objects using `ts` command. Read the help page on the command `ts`.
   - Create a time series object `x` containing the lake level data, correctly specifying arguments `start` and either `end` or `frequency`.

3. **(Plotting time series)** Using command `plot()`, make a plot of your time series object, giving your plot a suitable title and labels for the axes using the `main`, `xlab,` and `ylab` arguments. How does your new plot differ from your first plot?

4. **(Features of data)** Comment on the main features of this time series and provide physical justification(s) for what you observe.

You can now prepare a lab report using `R Markdown` by either creating a new R Markdown file (File → New File → R Markdown) or using the provided R Markdown template. Knit your file to PDF and upload as your lab submission via Gradescope.

Useful R commands for time series analysis

- `read.csv()`
- `ts()`
- `window()`
- `start()`
- `end()`
- `time()`
- `diff()`
- `lag()`
- `lag.plot()`
- `head()`
- `tail()`
- `class()`
- `str()`