The project work is done in groups of 1-2 students and is evaluated on the basis of your written report. You may use whatever software you like (e.g., STATA, Matlab, R, ...), use available functions for time series analysis, or write your own functions. Whatever you choose, you are required to state precisely what you are using and what the specific function does; it is not enough to only provide the name of a function and its output.

The project can be done individually or in group of 2. If done individually, the score will be multiplied by 150%.

I: Descriptive Statistics (4pts)

In the first part, you are required to collect a dataset of your choice. It could be stock prices, housing prices, temperature, etc. State the source of your dataset.

Denote y the variable of interest in your dataset, i.e. stock prices, housing prices, etc.

(a - 1 point) Provide the main statistics of the dataset, i.e. the mean, variance, number of observation, minimum value, maximum value.

(b - 1 point) Plot y against time. What can you say about this process?

(c - 1 point) Plot y_t against its previous value, i.e. y_{t-1}. What can you say of this graph?

(d - 1 point) Could you plot y_t againt y_{t-1} and y_{t-2}?

II: First order autoregressive process (4pts)

Assume y_t follows the $AR(1)$ process:

$$(1 - \alpha L)Y_t = \mu + \epsilon_t \tag{1}$$

(a - 1 point) Estimate the parameters α and μ. Is Y_t a stable system?

(b - 1 point) Is Y_t covariance stationary? If so, compute the mean and the autocovariance. Is Y_t ergodic?

(c - 1 point) As ϵ_t are not observable, how could you predict the values of ϵ_t? Plot ϵ against time. How do you estimate the mean and the variance of ϵ_t?

(d - 1 point) Forecast the values of Y_{t+5} based on the observations of $Y_t, Y_{t-1}, \dots$. Call these forecasts $\hat{Y}_{t+5}$. Plot Y_{t+5} and $\hat{Y}_{t+5}$ on the same graph against time. Discuss the power of your forecast.

III: Second order autoregressive process (4pts)

Assume y_t follows the $AR(2)$ process:

$$(1 - \alpha_1 L - \alpha_2 L^2)Y_t = \mu + \epsilon_t \tag{2}$$

(a - 1 point) Estimate the parameters α_1, α_2 and μ. Is Y_t a stable system?

(b - 1 point) Is Y_t covariance stationary? If so, compute the mean and the autocovariance. Is Y_t ergodic?

(c - 1 point) As ϵ_t are not observable, how could you predict the values of ϵ_t? Plot ϵ against time. How do you estimate the mean and the variance of ϵ_t?

(d - 1 point) Forecast the values of Y_{t+5} based on the observations of $Y_t, Y_{t-1}, ...$ Call these forecasts $\hat{Y}_{t+5}$. Plot Y_{t+5} and $\hat{Y}_{t+5}$ on the same graph against time. Discuss the power of your forecast.

IV: Third order autoregressive process (4pts)

Assume y_t follows the $AR(3)$ process:

$$(1 - \alpha_1 L - \alpha_2 L^2 - \alpha_3 L^3)Y_t = \mu + \epsilon_t \tag{3}$$

(a - 1 point) Estimate the parameters α_1, α_2, α_3 and μ. Is Y_t a stable system?

(b - 1 point) Is Y_t covariance stationary? If so, compute the mean and the autocovariance. Is Y_t ergodic?

(c - 1 point) As ϵ_t are not observable, how could you predict the values of ϵ_t? Plot ϵ against time. How do you estimate the mean and the variance of ϵ_t?

(d - 1 point) Forecast the values of Y_{t+5} based on the observations of $Y_t, Y_{t-1}, ...$ Call these forecasts $\hat{Y}_{t+5}$. Plot Y_{t+5} and $\hat{Y}_{t+5}$ on the same graph against time. Discuss the power of your forecast.