

Time series [10 Points]

1. Download a price time series using an API. The length of the time series T , with $T = 300$.
The resolution could be any, from tick data to months.
2. Plot the price time series

Moving averages [20 Points]

3. Define mathematically the moving average of the price time series with an arbitrary time-window τ
4. Compute three moving averages of the price time series, with time-windows $\tau = 10, 20, 30$
5. Plot the moving averages against the price time series
6. Compute the linear and log-return of the price time series
7. Plot the linear return against the log-return time series

Time Series Analysis [20 Points]

8. Define the auto-correlation function (for a stationary time-series)
9. Compute the auto-correlation function (ACF) of the price time series
10. Plot the price ACF
11. Compute the partial auto-correlation function (PACF) of the price time series
12. Plot the price PACF
13. Compute the auto-correlation function (ACF) of the return time series

14. Plot the return ACF
15. Compute the partial auto-correlation function (PACF) of the return time series
16. Plot the return PACF

ARMA models [30 Points]

17. Define mathematically an ARMA(p,q) model
18. Define a training and test set and fit an ARMA model to the price time series
19. Display the parameters of the model and its Mean Squared Error (MSE) in the training set and in the test set
20. Plot the price time series vs the ARMA forecast in the test set
21. Fit an ARMA model to the return time series
22. Display the parameters of the model and its Mean Squared Error (MSE) in the training set and in the test set
23. Plot the return time series vs the ARMA forecast in the test set

Gaussianity and Stationarity test [20 Points]

24. Introduce mathematically a Gaussianity test
25. Perform a Gaussianity test of the return time series
26. Introduce mathematically a stationarity test
27. Perform a stationarity test of the return time series

Written report Write a report clearly providing an answer to each of the numbered instructions.

A single written report in pdf (maximum 10 pages) structured into

- Time Series,

- Moving averages,
- ARMA models,
- Gaussianity and Stationarity test,

will need to be submitted to Moodle before the deadline of 20/02/2023.

Coding and Editing Students are allowed to use any programming language and any editing software for the report. The code will need to be uploaded as well (you can choose your preferred format).

Marking The marking will be based on the following criteria:

- Clarity of presentation;
- Validity of results;
- Consistency of language and mathematical notation;