

This research project consists of **two** assignments. The first one covers chapters 1 and 2, while the second assignment covers chapter 3. The research project should be handed in **no later than June 12**.

## Assignment 1

The file `QualidadeAR03.xlsx` contains time series of hourly-ground-levels of  $O_3$  values, in micrograms per cubic meter ( $\mu g/m^3$ ), collected at the following stations of the qualar network

- Antas-Espinho
- Entrecampos
- Estarreja
- Laranjeiro-Almada
- Mem-Martins
- Paio-Pires
- Restelo
- Sobreiras-Porto
- VNTelha-Maia

from 01/01/2020 to 31/12/2020. Further details on the qualar network can be found in this link <https://qualar.apambiente.pt/>.

1. Fit a **SARIMA-type** model to each of the nine time series. Discuss your model fitting in a step-by-step fashion, presenting your
  - (a) initial examination of the data;
  - (b) transformations (if necessary);
  - (c) initial identification of the dependence orders;
  - (d) parameter estimation;
  - (e) residual diagnostics and model choice.
2. After deciding on appropriate models, forecast the data into the future up to 5 time periods ahead and calculate 95% prediction intervals for each of the 5 forecasts.

## Assignment 2

The files

- EDP RENOVAVEISprice.xlsx
- GALP ENERGIA-NOMprice.xlsx
- MOTA ENGILprice.xlsx
- NOSSGPSprice.xlsx
- NOVABASESGPSprice.xlsx

contain daily share related-prices from five companies (EDP, GALP, MOTA ENGIL and NOVABAS-ESGPS) listed on Euronext Lisbon (<https://live.euronext.com/pt/markets/lisbon>), namely the date, open, high, low, close, number of shares, number of trades, turnover and vwap.

1. For the five time series calculate its corresponding log-returns associated to the daily closing values;
2. Fit the best **GARCH-type** model to the time series of log-returns. Discuss your model fitting in a step-by-step fashion, presenting your
  - (a) initial examination of the data;
  - (b) initial identification of the dependence orders;
  - (c) parameter estimation;
  - (d) residual diagnostics and model choice.

### Grading Criteria for Research Report

- Title accurately reflects content (1.0 point)
- Abstract provides concise summary that highlights most salient points (2.5 points)
- Paper is effectively organized into sections (2.0 points)
- Topic area is covered in sufficient depth (3.0 points)
- The report is statistically/mathematically consistent (4.0 points)
- Tables and Figures are consistent in format (3.0 points)
- Spelling, grammar, presentation (3.0 points)
- List of references (1.5 points)