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**Selected Aspects of Stochastic Processes**

**Time series stationarity diagnosis. Identification of the SARIMA model**

Create on your network disk a new folder and give it the name: *Lab\_04*. This is the folder for the fourth project of this lab. All the exercises, experiments and scripts made during the laboratory classes are to be saved in the *Lab\_04* project.

Prepare the report from your experiments, in which all tasks are presented, the results are enclosed and discussed. The report contains sections following the structure of this instruction, all properly formatted. Do not forget about graphical illustrations.

In each section of the experimental part, place the whole R script you developed for the section.

Each graph should be described with appropriate elements, using colours to enhance the graph.

Remark

Two time series, obtained by students as part of their homework from the previous laboratories, are the subject of the experiments described below:

* TS\_M time series with monthly seasonality,
* TS\_Q time series with quarterly seasonality.
1. **Examination of time series for stationarity**

For two selected time series TS\_M and TS\_Q discuss possible reasons of their non-stationary; indicate arguments justifying the diagnosis by doing the ADF tests and considering for example:

* occurrence of an increase or decrease in the amplitude of seasonal fluctuations,
* inhomogeneous variability of data in successive values of the series,
* trend,
* high impact of outliers.
1. **Time series transformation for stationarity**

On the basis of the results of the previous diagnosis, propose and process an appropriate transformation which will lead to the stationarity of both considered time series.

1. **Identification of SARIMA models**

Inspect the ACF and PACF functions for the two considered time series and conduct the identification of the general SARIMA model type as follows, taking into account seasonality *s* if necessary:

* AR model type: SARIMA(p, d, 0)(P, D, 0)s
* MA model type: SARIMA(0, d, q)(0, D, Q)s
* ARIMA model type: SARIMA(p, d, q)(p, D, Q)s

In each case, justify your decision with a graphical illustration. If Box-Cox-transformed data is being researched, be sure to report it.

Remember that the model of the last type should not be too complicated. Therefore, consider smaller model, which is the model with smaller number of parameters than the sum of the AR and MA parameters.