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**Selected Aspects of Stochastic Processes**

**Time series plots. Autocorrelation and Partial autocorrelation functions**

Create on your network disk a new folder and give it the name: *Lab\_02*. This is the folder for the second project of this lab. All the exercises, experiments and scripts made during the laboratory classes are to be saved in the *Lab\_02* project.

Prepare the report from your experiments, in which all tasks are presented and the results are enclosed. The report has the following sections, all formatted adequately:

* Beginning: authors, affiliation, date, the report title.
* Section devoted to a white noise experiment.
* Section devoted to a random walk experiment.
* Section devoted to a selected time series experiment.

In each section of the experimental part, place the R script used.

Each time series plot is to be explained by appropriate charts elements, like for example: axis descriptions, titles, subtitles, type of a plot, point characters, colours etc.

1. **White noise**

Generate realizations of Gaussian white noise with lengths *n* that differ by an order of magnitude (do not forget to save the seed value for the pseudo-random number generator). The mean and standard deviation parameters are different for different student teams. However, they are the same for experiments conducted by one team.

Create graphs for the generated data: standard trajectory of a time series, correlation and partial autocorrelation functions.

Interpret and justify conclusions about the significance of autocorrelation. Observe how the intervals of the critical regions (confidence intervals, significance intervals) change for series of different lengths. What follows from the observed change in the width of these intervals as the length of the series increases?

Remark. Perform an experiment for increasing values of the parameter n. Choose time series examples that best illustrate your experiment.

1. **Random walk**

Using white Gaussian noise with the zero mean, generate a random walk process with a positive at least two-digit mean value. Create the following plots for the random walk:

* trajectory,
* autocorrelation and partial autocorrelation functions
* time series with delayed versions of itself (scatter plot). It helps to visualize "autodependence" even when autocorrelations disappear. Use the *lag.plot* function.
1. **Selected time series**

Transfer the time series data from the project *Lab\_01* to the project *Lab\_02*. If not named, give the series a mnemonic name.

Illustrate the variability of the series using the learned functions for different forms of the time series plot: *plot*, *seasonplot*, *monthplot*, *boxplot*, *xyplot* (for self-defined panels), *lag.plot*, *Acf*, *Pacf* .

On the basis of the created plots discuss the characteristics of your time series.

Homework

For the next laboratory lesson, find (prepare) two time series with monthly and quarterly seasonality.