Lab 5: ARIMA models 1

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1 Correlations in AR models

An autoregressive model of order p is defined as

$$y_t = c + \phi_1 y_{t-1} + \phi_2 y_{t-2} + ... + \phi_p y_{t-p} + \epsilon_t, \tag{1}$$

where ϵ is normally distributed white noise with mean zero and variance one.

Perform the following tasks:

- Write a function that calculates the values of AR(p) model. The function must have a parameter *burnin* that determines how many initial values are discarded.
- Calculate $n = 5000$ values of the AR(1) model $y_t = 18 - 0.6y_{t-1} + \epsilon_t$.
- Calculate the autocorrelation (ACF) and partial autocorrelation (PACF) function for this time series.
- Repeat the calculations for $\phi_1 = -0.7, -0.8, -0.9$.
- Are the generated time series stationary? What happens when $|\phi_1| > 1$.
- Calculate $n = 5000$ values of the AR(2) model $y_t = 8 + 1.3y_{t-1} - 0.7y_{t-2} + \epsilon_t$. Compare the structure of PACFs for AR(1) and AR(2) models.

2 Correlations in MA models

A moving average model of order q is defined as

$$y_t = c + \epsilon_t + \theta_1 \epsilon_{t-1} + \theta_2 \epsilon_{t-2} + ... + \theta_q \epsilon_{t-q}, \tag{2}$$

where ϵ is normally distributed white noise with mean zero and variance one.

Perform the following tasks:

- Write a function that calculates the values of MA(q) model. The function must have a parameter *burnin* that determines how many initial values are discarded.
- Calculate $n = 5000$ values of MA(1) model $y_t = 20 + \epsilon_t + 0.8\epsilon_{t-1}$.
- Calculate the autocorrelation (ACF) and partial autocorrelation (PACF) function for this time series.
- Repeat the calculations for the MA(2) model $y_t = \epsilon_t - \epsilon_{t-1} + 0.8\epsilon_{t-2}$.
- Compare the structure of ACF/PACFs for AR and MA models. Use the AR results from problem 1.