Lab 5: Autoregressive (AR) models

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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 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 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 AR forecasting

Find the AR model that predicts Robusta coffee time series. Download data using pandas'read_html function For calculations, use data for the two decades of this century. First, use the original time series to forecast twelve months into the future. After differencing, repeat the analysis. Compare the accuracy of the forecast for the undifferenced and differenced data. Note that the differencing is invertible.