Autocovariance coefficients

PRACTICAL TIME SERIES ANALYSIS

THISTLETON AND SADIGOV

Objectives

- Recall the covariance coefficient for a bivariate data set
- Define autocovariance coefficients for a time series
- Estimate autocovariance coefficients of a time series at different lags

Covariance

- X, Y are two random variables.
- Measures the linear dependence between two random variables

$$Cov(X, Y) = E[(X - \mu_X)(Y - \mu_Y)]$$

Estimation of the covariance

- We have a paired dataset

$$(x_1, y_1), (x_2, y_2), \dots, (x_N, y_N)$$

- Estimation of covariance (cov() in R)

$$s_{xy} = \frac{\sum_{t=1}^{N}(x_t - \bar{x})(y_t - \bar{y})}{N-1}$$

Autocovariance coefficients

- Autocovariance coefficients at different lags $\gamma_k = Cov(X_t, X_{t+k})$
- c_k is an estimation of γ_k.
- We assume (weak) stationarity

Estimation

$$c_k = \frac{\sum_{t=1}^{N-k}(x_t - \bar{x})(x_{t+k} - \bar{x})}{N}$$

where

$$\bar{x} = \frac{\sum_{t=1}^{N} x_t}{N}$$

Routine in R

- acf() routine (next video lecture)
- acf(time_series, type='covariance')

Purely random process

- Time series with no special pattern
- We use rnorm() routine

What We’ve Learned

- Definition of autocovariance coefficients at different lags
- Estimate autocovariance coefficients of a time series using acf() routine