

Problem Set 1

The model used in the simulation has the following structure:

$$x_{i1} = 1, x_{i2} : x_{i11} \sim \mathcal{N}(0, 1)$$

$$y_i = \mathbf{x}_i' \boldsymbol{\beta} + \varepsilon$$

with $\boldsymbol{\beta} = (1 \quad 0.5 \quad 0 \quad 0 \quad 0)$ and $\varepsilon \sim \mathcal{N}(0, \sigma^2 = 1)$ and $n = 100$.

Simulation

- Define the deterministic- and simulate all random quantities in an R Script.
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Estimating model parameters

Calculate - $\hat{\boldsymbol{\beta}}$ - $\hat{\mathbf{y}}$ and - $\hat{\varepsilon}$ and the standard errors of the coefficient estimates.

Please try to program these entities yourself instead of using pre-specified functions in **R**.

Automization

Write a simulation function that takes three arguments:

- n : number of observations
- σ : standard deviation of the error term
- $\boldsymbol{\beta}$

The function should return two objects: **X** and **y**.

Write an estimation function that takes two arguments:

- **X**
- **y**

The function should return $\hat{\boldsymbol{\beta}}$ and the associated standard errors.

Simulation study

In a suitably designed simulation study show the behavior of the OLS estimator of the standard errors of the coefficients by varying

- n
- σ^2 .

Plot the results in two different plots to demonstrate the properties of the OLS estimator.