Title

Subtitle

Authors

2025-07-02

University of Copenhagen

First section

First slide

Wow, this is a slide.

Second slide

The music experience has been cancelled.

This quote is from the Severance TV-show

Touying equation with pause:

$$f(x) =$$

Touying equation is very simple.

Animations

Touying equation with pause:

$$f(x) = x^2 + 2x + 1 =$$

Touying equation is very simple.

Animations

Touying equation with pause:

$$f(x) = x^2 + 2x + 1 = (x+1)^2$$

Touying equation is very simple.

At subslide 1, we can

use for reserving space,

use for not reserving space,

call `#only` multiple times ⊓ for choosing one of the alternatives.

Complex Animations

At subslide 2, we can

use `#uncover` function for reserving space,

use `#only` function for not reserving space,

use `#alternatives` function ✓ for choosing one of the alternatives.

Complex Animations

At subslide 3, we can

use `#uncover` function for reserving space,

use `#only` function for not reserving space,

use `#alternatives` function ✓ for choosing one of the alternatives.

If you have “animations” in your presentation, you can set “handout” to “true” in the config and only include the last subslide.

```
#import "@preview/ucph-nielsine-touying" as uc
#import "@preview/touying:0.6.1" as ty
show: uc.ucph-metropolis-theme.with(
  // ...
  ,
ty.config-common(handout: true)
)
```

Slide with columns

First column.

Second column. Schelling (1971)[1]

[1] a footnote

The OLS estimator

For a multiple linear regression model, the equation can be written in matrix form as:

$$\boldsymbol{y} = \boldsymbol{X}\boldsymbol{\beta} + \boldsymbol{\varepsilon}$$

where:

- $\boldsymbol{y}$ is an $n \times 1$ vector of observed dependent variables.
- $\boldsymbol{X}$ is an $k \times (k+1)$ matrix of independent variables (including a column of ones for the intercept).
- $\boldsymbol{\beta}$ is a vector of unknown coefficients.
- $\boldsymbol{\varepsilon}$ is an $n \times 1$ vector of error terms.

Derivation of the OLS estimator

Implying we have a vector of residuals given by:

$$\boldsymbol{\varepsilon} = \boldsymbol{y} - \boldsymbol{X}\boldsymbol{\beta}$$

Our objective is to minimize the sum of squared residuals:

$$\begin{aligned}
\min_{\beta} \boldsymbol{\varepsilon}^T\boldsymbol{\varepsilon} &= (\boldsymbol{y} - \boldsymbol{X}\boldsymbol{\beta})^T(\boldsymbol{y} - \boldsymbol{X}\boldsymbol{\beta}) \leftrightarrow \\
&= \underbrace{\boldsymbol{y}^T\boldsymbol{y}}_{\perp \boldsymbol{\beta}} - \boldsymbol{y}^T\boldsymbol{X}\boldsymbol{\beta} - \boldsymbol{\beta}^T\boldsymbol{X}^T\boldsymbol{y} + \boldsymbol{\beta}^T\boldsymbol{X}^T\boldsymbol{X}\boldsymbol{\beta} \leftrightarrow \\
&= -2\boldsymbol{\beta}^T\boldsymbol{X}^T\boldsymbol{y} + \boldsymbol{\beta}^T\boldsymbol{X}^T\boldsymbol{X}\boldsymbol{\beta}
\end{aligned}$$

Note: By multiple a vector with itself transposed with just a scalar, or in this case $\boldsymbol{\varepsilon}^T\boldsymbol{\varepsilon}$ which is the sum of squared error terms.

Derivation of the OLS estimator

$$\frac{\partial}{\partial \beta}(-2\beta^T \boldsymbol{X}^T \boldsymbol{y} + \beta^T \boldsymbol{X}^T \boldsymbol{X}\beta) = 0 \leftrightarrow$$

$$2\boldsymbol{X}^T \boldsymbol{X}\beta = 2\boldsymbol{X}^T \boldsymbol{y} \leftrightarrow$$

$$\boldsymbol{X}^T \boldsymbol{X}\beta = \boldsymbol{X}^T \boldsymbol{y} \leftrightarrow$$

Multiply both sides with $(\boldsymbol{X}^T \boldsymbol{X})^{-1}$:

$$\underbrace{(\boldsymbol{X}^T \boldsymbol{X})^{-1} \boldsymbol{X}^T \boldsymbol{X})}_{=\boldsymbol{I}}\beta = (\boldsymbol{X}^T \boldsymbol{X})^{-1} \boldsymbol{X}^T \boldsymbol{y} \leftrightarrow$$

$$\hat{\beta} = (\boldsymbol{X}^T \boldsymbol{X})^{-1} \boldsymbol{X}^T \boldsymbol{y}$$

Derivation of the OLS estimator

The OLS estimator

$$\hat{\beta} = \left(\boldsymbol{X}^T \boldsymbol{X}\right)^{-1} \boldsymbol{X}^T \boldsymbol{y}$$

- This is very important.
- Remember this.

Colors

Let me show you the colors

Dark red #901a1e	Dark blue #122947	Dark petroleum #0a5963	Dark green #39641c	Dark grey #3d3d3d
Red #c73028	Blue #425570	Petroleum #197f8e	Green #4b8325	Grey #666666
Light red #db3b0a	Light blue #bac7d9	Light petroleum #b7d7de	Light green #becaa8	Light grey #e1dfdf

Wake up!

Wake up with a gradient!

References

Schelling, T.C. (1971) "Dynamic models of segregation," *Journal of mathematical sociology*, 1(2), pp. 143–186.

Appendix

Appendix

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Page layout


Header
Margin⟶
Content
Footer