

# Advanced Quantitative Methods

## Lab 5: Panel data

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1. A famous example dataset is the Grunfeld data:

**inv** gross investment  
**value** market value of firm  
**capital** value of stock of equipment / plant  
for 10 firms ( $N = 10$ ) over 20 years ( $T = 20$ ).

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```
library(plm)
data("Grunfeld", package = "plm")
head(Grunfeld)
```

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- (a) Using `plm()`, estimate the pooled, unit fixed, time fixed, random unit effects models.
- (b) Test the fixed and random effects specifications.
- (c) Calculate panel-corrected standard errors (using the `pcse` package).
- (d) Graphically inspect the regression results.

### Additional code examples

A pooled effects model can also be estimated with, for example:

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```
lm(inv ~ value + capital, data = Grunfeld)
```

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and a fixed effect model:

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```
lm(inv ~ value + capital + factor(firm), data = Grunfeld)
```

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and a random effect model:

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```
library(lme4)
lmer(inv ~ value + capital + (1|firm), data = Grunfeld)
```

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