# How to Use these Techniques Using STATA

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# Which Techniques?

- Cross tabulation
- Simple and multiple linear regression
- Difference-in-difference regression
- Propensity score matching regression

# Research Question

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Do firm linkages with universities positively affect R&D of manufacturing firms in Uruguay?

# Measuring Variables of Interest

- Firm linkages with universities
  - Ask the firms whether they are running co-operation projects with universities or not:

    D = 1 if they have co-operations
    = 0 if they don't have

- R&D
  - Ask the firms how much they spent on R&D

    Y = expenditure in 1000 UY peso

# Controlling other Factors Influencing R&D

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- Size:
  Larger firms may be more likely to do R&D since they have more funds, more specialised personnel etc.
- Sector:
  R&D and R&D costs to differ between sectors
- Foreign ownership:
  Foreign owned firms may not do R&D because the mother company abroad does
- Part of conglomerate:
  Firms part of a conglomerate may not do R&D because the mother company does

# Controlling other Factors Influencing R&D (2)

- Exporting activities:
  Firms may have the need to do R&D to compete on international markets
- Links to public research institutions:
  Firms may have more (or less) R&D if the co-operate with non-university public research
- Links to NSI institutions:
  The same again

# Linear Regression

- Effect of treatment on the outcome given the treatment does not correlate with observed and unobserved control variables
- Here: Effect of university linkages on R&D expenditure when these linkages do not correlate with e.g. size or sector or whatever you might think of could effect R&D expenditure, too.
- Problem 1:
  Effect is biased in the multiple regression
- Problem 2:
  Neglecting critical variables does not help. Effect is biased in the simple regression, too. Everything left out or forgotten is in the error term

# Difference-in-Difference Regression

- Is the change in outcome due to changes in the control or due to the treatment
- Here: Change in R&D expenditure due to changes in size, exporting behaviour etc. or due to installing a university link
- Solution:
  Regress change in R&D expenditure on change in other variables and on treatment.

# Difference in Differences

# Propensity Score

- Conditional probability of receiving a treatment given pre-treatment characteristics

- Here:
  Probability that a firm with given characteristics – like size, sector, ownership, etc. – is having a link with a university

# What could a propensity score look like?

- Treated firms (D=1), e.g. firms with university linkages:
  0.45, 0.48, 0.52, …, 0.77, 0.85, 0.98
- Non-Treated firms (D=0), e.g. firms without university linkages:
  0.28, 0.34, 0.46, …, 0.65, 0.71, 0.78
- Common Support: 0.45 – 0.78
- Reason: Difficult to find a comparable partner in the other group.

# What Does Balancing Mean?

- Given the propensity score
  - given the way we have used the control variables to estimate the probability of being treated –
  there is no correlation between treatment and control variables

- All the information on getting treatment is just in the propensity score

- All the information on the outcome of being treated is in the coefficient of the propensity score

# Testing Balancing

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## What the software does:

- Sort observations by propensity score.
- Split the observations in blocks by propensity score.
- Test whether propensity score has the same mean for treated and untreated within a block.
- If not: Split the block and do it again.
- Stop the procedure when equality is not rejected.

## What you have to do:

- If equality is always rejected re-estimate the propensity score additionally using squares and cross-products of variables.
- Pray!

# Testing Balancing Reloaded

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## What the software does:

- Given the blocks found above
- For each control variable, test whether it has the same mean for treated and untreated within a block.
- If not: You might run into problems.

## What you have to do:

- Have you ever said “I love you” to your dataset?

# Nearest Neighbour Matching

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## What is the nearest neighbour?

- For each treated firm (one with university link) find a non-treated firm for which the propensity score is as equal as possible.

## What to do with the neighbour?

- Look at the difference of the outcome (difference of R&D expenditure) of the treated firm to its neighbour
- Calculate the average difference of the outcome of the treated and its non-treated counterpart

## Average Treatment Effect on the Treated

# Radius Matching

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## Why not nearest neighbour?

- Even the nearest neighbour could be quite far away.

## Radius

- Define what you think is a reasonable neighbourhood, i.e. the radius
- Look at the difference of the outcome of the treated firm to each single firm in the radius
- Calculate the average difference of the outcome of the treated and its non-treated counterparts

## Average Treatment Effect on the Treated

# Kernel Matching

Is there a way to make it more complicated in order to impress referees of scientific journals?

Kernel (not Colonel)

- Use a weighted average of all controls
- Use weights somehow – so complicated that few people do understand - inverse to the distance (difference in propensity score)
- Look at the difference of the outcome of the treated firm to the weighted average
- Calculate the average difference of the outcome of the treated and its non-treated counterparts

Average Treatment Effect on the Treated

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# You might feel heavily treated now?!

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