

# Implementing Causal Machine Learning in

Thursday: Own empirical study



August / September / **October** 2024



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# The workshop series

Astana Workshop September 30 to October 4, 2024

- 10-11:15, 11:45-13:00, 14:00-15:30, 16:00-17:30)
- Monday
  - Morning: Identification with experiments & selection on observables
  - Afternoon: Discussion of potential programmes to be evaluated
- Tuesday: Causal Machine Learning (theory) (ends at 16:00)
- Wednesday
  - Empirical examples: Active labour market programmes in Flanders
  - The mcf package – how to use it & how to interpret the results
- **Today: Doing an empirical study in groups with the data introduced in online workshop 4**
- Friday: Discussion of programmes to be evaluated continued (core team only)





1 | Introduction

2 | Task & organisation

3 | Conceptual work: Outcomes ( $Y$ ) & treatment ( $D$ ), confounders ( $X$ ), heterogeneity ( $Z$ )

4 | Data download, data cleaning & definition of population of interest

5 | Effect estimation: Implementation & interpretation of the results

6 | Optimal policy: Implementation & interpretation of the results

7 | Summary & general discussion





# Organisation

## Teams

- Form teams of 3-4 people
- Ideally, there is a similar skill composition in each team

## Access to computing resources

- Most of the smaller data sets can be run on a notebook
  - May be slow, memory could become a problem
- It may be advantages to secure access to some server (or remote engine) if possible
  - If this is not possible, it is advisable
    - to choose one of the smaller data sets
    - to analyse only 2 programmes
    - not to be too ambitious w.r.t. to the allocation method used (e.g., policy tree should not be too deep)



## Task | General set-up

Country **XXX** (which cannot be named for privacy (data) protection reasons) runs expensive training programmes as well as employment programmes to promote employment opportunities of their unemployed. Nevertheless, the programmes are small compared to the relevant regional labour markets. Their goal is to increase earnings and employment by raising the skill level, particularly of the low skilled.

A governmental agency approaches you & your team to perform an evaluation study of the effectiveness of those **Training or Employment** programmes for the unemployment. You are asked to look at the different subprogrammes as well. The government is interested in the effects of programme participation on individual employment and earnings of participating unemployed (for different regions).

Training programme T1: Typical duration of 3-6 months; full time training in classrooms; the intention is to adjust already available vocational skills to current technology.

Training programme T2: Typical duration of about 20 months; major realignments of skills intended; may even result in new vocational degree, if old degree is in sector that might go out of business.

Employment programme E1: Typical duration of six months. No training components. Goal is to give the participants some work experience in public and private firms.

Employment programme E2: Typical duration of 1-2 years. About 10-20% training.

Each team may select *at least 2* programmes of interest

- Always include non-participation



## Task | Institutional information









From your discussions with the case workers, you know that clients are allocated randomly to case workers and that case workers decide about the allocation to programmes.

Caseworkers base their decisions primarily on the skill level of the unemployed, employment history, local demand for labour as well as other employment related factors. From past experiences it appears likely that case workers are more likely to allocate programmes to those ‘who’ need it most (it seems that the individual caseworkers use their own judgement about labour market success without a programme as a guide). Usually, participants learn in the month before the programme about their future participation.



## Data from different regions (& country as a whole)

Chose data

	Study description.pdf	17.08.2024 13:51	Adobe Acr...	156 KB
	West.csv	17.08.2024 13:01	Microsoft ...	19'027 KB
	Central.csv	17.08.2024 13:01	Microsoft ...	10'892 KB
	East.csv	17.08.2024 13:01	Microsoft ...	12'543 KB
	North.csv	17.08.2024 13:01	Microsoft ...	13'142 KB
	South.csv	17.08.2024 13:01	Microsoft ...	9'823 KB
	Southwest.csv	17.08.2024 13:01	Microsoft ...	19'622 KB
	All_regions.csv	17.08.2024 13:01	Microsoft ...	84'323 KB

The file ***Study description.pdf*** contains the description of the data

- All data files have the same variables





**Joint discussion when all teams have  
completed their tasks**





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Define  $Y$  &  $D$ ,  $Z$ ,  $D$  (*without data*)

Conceptionally define a treatment variable that you want to use ( $D$ )

Conceptionally define outcome variable(s) that you want to use ( $Y$ )

Conceptionally define the heterogeneities you are interested in ( $Z$ )

Discuss identification

- Based on this discussion, define the confounders ( $X$ )





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# Data

Download *your* data

Clean the data

- Reduce to cover only variables related to  $Y, D, Z, X$
- Check for missing & implausible values
  - In the current version, missing values (e.g., NaN) may lead to problems for *mcf* estimation
- Clean data in an appropriate way

Reduce data to the subpopulation of interest

- Remove observations relating to treatments that are not of interest





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# Effects estimation

Common support?

Implication of the results

- ATE
- GATE
- IATE analysis: Any additional heterogeneity

Did the programmes (not) work?

- Long run vs. short run
- On average?
- Who was positively and/or negatively affected by the programmes?





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***Please share your most relevant results***





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# Optimal allocation

## Obtain an optimal allocation

- Select an allocation method of your choice
  - Consider the pro's & con's of the different methods
- Evaluate the quality of your allocation rule compared to ...
  - the actual allocation
  - a random allocation
- Use a sample splitting approach for ...
  - training the policy score
  - obtaining the allocation rule
  - evaluating the allocation rule





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## Discussion

Any topics that have not yet been discussed in sufficient depth







## ***Tomorrow***

**Use what we have learned in the last 4 days to define a workplan  
for the real programme evaluation**

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