

# Cost-effectiveness & Machine Learning

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Netherlands Institute of  
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# Introduction

- Econometrics / Health Economics / Data Science
- Harvard University / MIT
- Trimbos institute – Centre of Economic Evaluation & Machine Learning
- Machine learning in clinical practice
- Process Improvement Methodology
- Data Science lead at Arkin



# Summary

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1. It is very hard to determine cost-effectiveness outside of an experimental context
2. Clinical (observational / non-experimental) data have a number of advantages over experimental data, **iff** they are used to answer the right type of question
3. Machine Learning provides the tools for leveraging the strengths of clinical (observational) data and a way to determine how to improve cost-effectiveness in clinical practice

# Agenda

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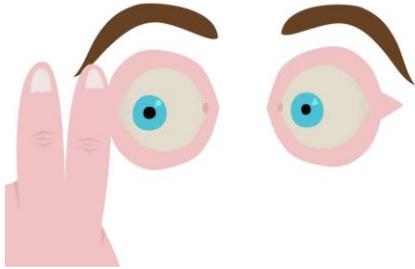
1. cost-effectiveness
2. machine learning
3. effect versus prediction
4. machine learning in mental health
5. improving cost-effectiveness using machine learning
6. current projects
7. workshop: generating ideas on improving clinical practice
8. wrap-up

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# Cost-effectiveness

# Cost-effectiveness

Concerned with determining: additional health effect and additional costs of an intervention



e.g.: how much more effective and how much more costly is EMDR vs CAU for people with PTSD?

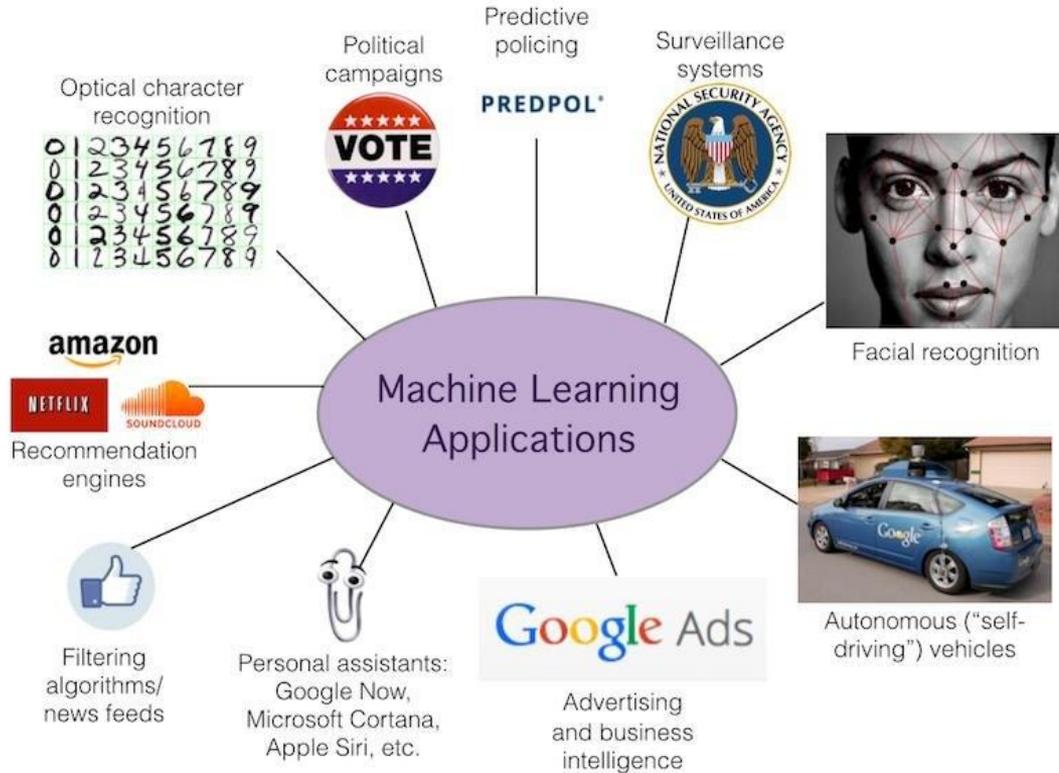
Additional health effects and additional cost => cost per effect

*Cost per effect* below some threshold => relatively cheap / good bargain / cost-effective

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# Machine Learning

# Machine Learning



Al Musawi, A (2018). *Introduction to Machine Learning*

# The essence of machine learning



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# Effect versus Prediction

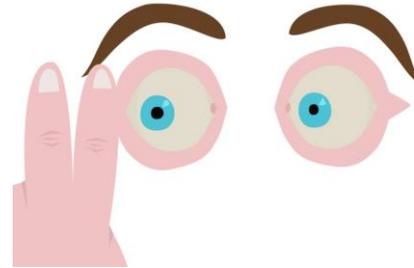
# Prediction versus Effect

Prediction



Knowing how the world will **present** itself such that we can have an adequate **response** to it

Effect



Knowing how best to **change** the course of the world

# Predictions versus Effect

Asking the right questions to the right data:

- 1) There is no better way to solve an 'effect problem' than using randomization (using a randomized design)
- 2) There is no better way to solve a 'prediction problem' than using machine learning (on observational data)

If observational data is what you have, then:

- ⇒ Don't ask 'effect questions'
- ⇒ Ask 'prediction questions'

Misconceptions:

- ⇒ Machine learning replaces the need for traditional research
- ⇒ Machine learning is useless because we can never distinguish correlation from causation

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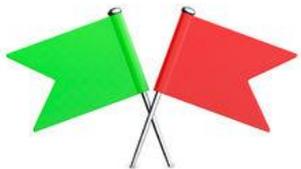
# Machine Learning in mental health

# Clinically relevant predictions?

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- ⇒ Who has a high probability of dropping out?
  - ⇒ Who has a low probability of treatment success?
  - ⇒ Who has a high probability of attempting suicide?
  - ⇒ Who has a high probability of recurrence?
  - ⇒ Who has a high probability of hospitalization?
  - ⇒ Who has a high probability of developing first psychosis?
- 
- ⇒ And what to do about it?

# Prediction and effect: a happy marriage



+



Machine Learning

Effectiveness research

Can we see trouble coming?

And what can we do about it?

# And what to do about it?



+



Machine Learning

Effectiveness research

What to do about it?

- Often you don't know (and need to find out by trial and error)
- But sometimes you actually do

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# Improving cost-effectiveness using machine learning

# Machine learning as the missing link



*Available evidence:*

## THE NEW ZEALAND MEDICAL JOURNAL

Vol 120 No 1251 ISSN 1175 8716



### **Effective strategies for suicide prevention in New Zealand: a review of the evidence**

*Guideline defined stepped-care:*

Review Article - Neuropsychiatry (2016) Volume 6, Issue 3

### **Acute pharmacological treatment strategies for bipolar depression**

**Zeid Mohammed<sup>1</sup>, Heinz Grunze<sup>2\*</sup>**

<sup>1</sup>Tees, Esk and Wear Valleys NHS Foundation Trust, Lanchester Road Hospital, Lanchester Road, County Durham, DH1 5RD, United Kingdom

<sup>2</sup>Paracelsus Medical University, Strubergasse 21, 5020 Salzburg, Austria

*Common sense:*



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## Current work

# Masterclasses Machine Learning

Applying Machine Learning while respecting its limits and possibilities should come from a proper understanding of Machine Learning



We train professionals in healthcare in applying Machine Learning in clinical practice

# Masterclasses Machine Learning

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It is not obvious how to apply Machine Learning properly when coming from an effectiveness-research frame of mind

e.g.

- Focus on  $y$  rather than  $\beta$
- Well thought out designs vs 'trial and error'
- Unbiasedness vs accepting some degree of bias
- Necessity to thoroughly and structurally explore and prepare data

# Research I

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Availability of observational data is the one prerequisite for the potential to publish articles

Collaborating on publications with:

- NIVEL
- Altrecht
- Pro Persona
- Indigo
- GGZ Rivierduinen
- Dimence
- GGZ NHN
- GGD Amsterdam

# Research II

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- 1) Federated Learning / Distributed Learning:  
the benefits of sharing data, without actually sharing data
- 2) Intuitive, high interpretable, visualization of prediction algorithm
- 3) How to communicate findings to patient and/or healthcare professional
- 4) Prediction in the context of trials

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# workshop: generating ideas on improving clinical practice

# Workshop

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- 1) Team up with people concerned with the same patient population
- 2) Create a list of clinically relevant prediction problems
- 3) Classify items on your list as predictions resulting in clear actionable insights or not
- 4) Present your findings

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wrap up

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Questions?

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