01 - Course Overview

ml4econ, HUJI 2023

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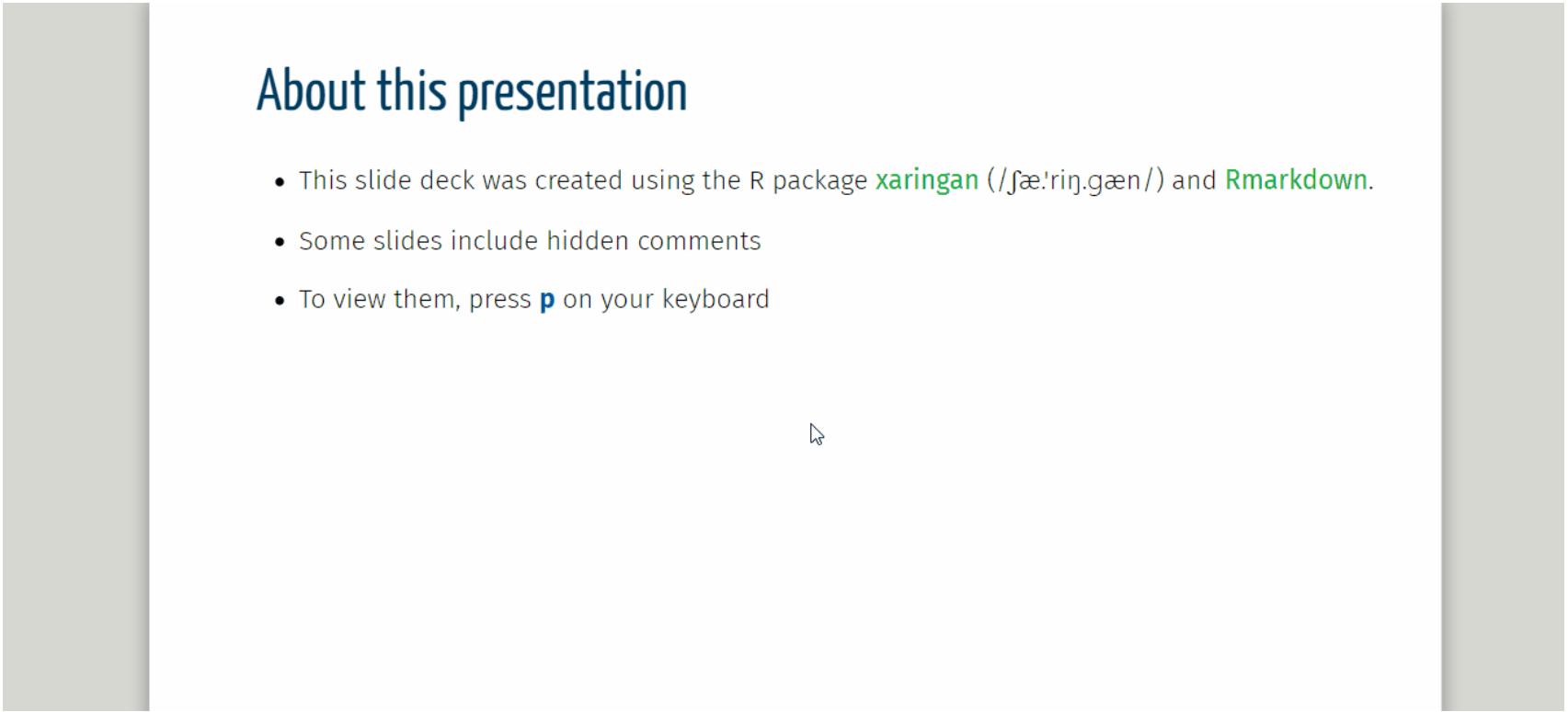
An aside: about the structure of these slides

- The course's slide decks are created using the xaringan (/ʃæ.'riŋ.gæn/) R package and Rmarkdown.
- Some slides include hidden comments. To view them, press **p** on your keyboard



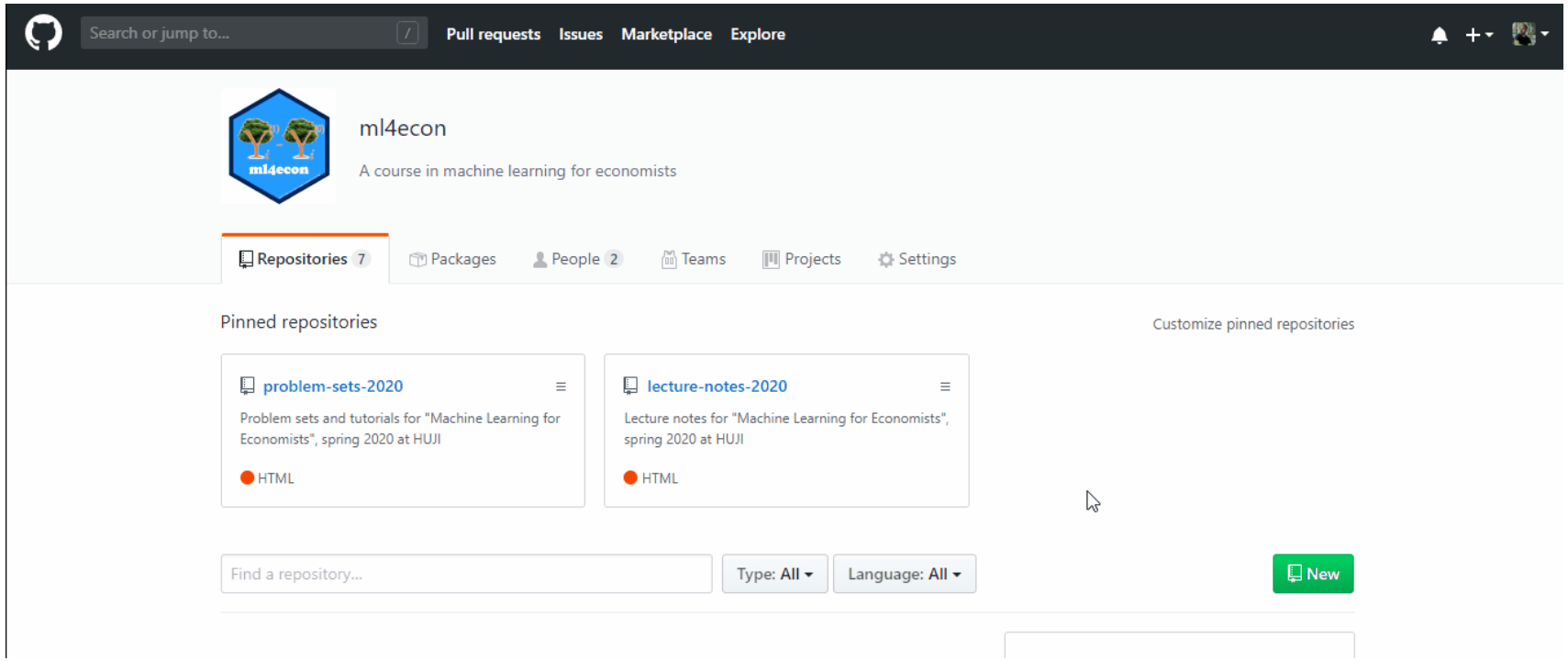
Outline

1. Logistics
2. About the Course
3. To Do List

Logistics

ml4econ GitHub repository

The class's GitHub repository: https://github.com/ml4econ



Posit Cloud workspace

Posit Cloud is a hosted version of RStudio in the cloud that will make it easy for R and Python novices to learn data science and machine learning using R and Python.

People

- **Itamar Caspi**
  - Head of Monetary Analysis Unit, Research Department, Bank of Israel.
  - email: caspi.itamar@gmail.com
  - homepage: itamarcaspi.rbind.io
- **Ariel Karlinsky**
  - Ariel Karlinsky is a PHD student in economics at Hebrew University who researches various economic fields and maintains the World Mortality Dataset.
  - email: karlinsky@gmail.com
- Meeting hours: after class/zoom, on demand.

Feedback

This is the fourth time we run this course ⇒ your continuous feedback is important!

Please feel free to contact us by

- email
- in person
- or open an issue in our discussion forum

About the Course

Prerequisites

- Advanced course in econometrics.
- Some early experience with R (or another programming language) are a plus.

This course is

About

How and when to apply ML methods in economics

- estimate treatment effects.
- prediction policy.
- work with new types of data (e.g., text).

To do that we will need to understand

- what is ML?
- how it relates to stuff you already know?
- how it differs?

Not about

- Cutting-edge ML techniques (e.g., generative AI)
- Computational aspects (e.g., gradient descent)
- Data wrangling (a.k.a. "feature engineering")
- Distributed file systems (e.g., Hadoop, Spark)

Tentative schedule

Week	Topic
1	Course Overview & ML Basics
2	Reproducibility and ML Workflow
3	Regression and Regularization
4	Classification
5	Non-parametrics
6	Unsupervised Learning
7	Text analysis
8	Causal Inference
9	Lasso and Average Treatment Effects
10	Trees and Heterogeneous Treatment Effects
11	Prediction Policy Problems
12	The Economics of AI

> **NOTE**: This schedule can (and probably will) go through changes!

Readings on ML for economists

> All materials and lecture notes will be available on the class website.

Please read the following excellent surveys:

- The impact of machine learning on economics Athey (2018)
  In *The Economics of Artificial Intelligence: An Agenda*.
  University of Chicago Press.

- Machine learning: an applied econometric approach Mullainathan and Spiess (2017)
  Journal of Economic Perspectives, 31(2), 87-106.

Readings on ML

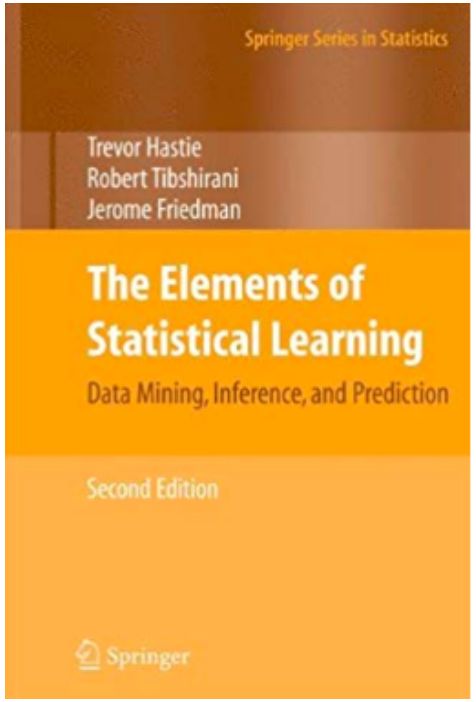
> All materials and lecture notes will be available on the course repo.

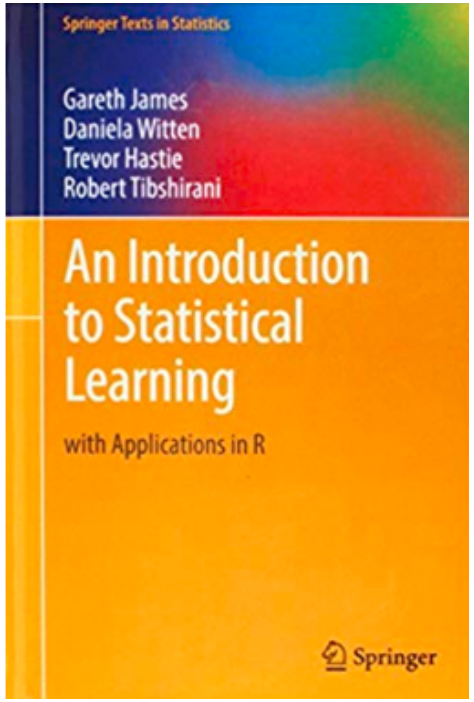
There are **no** required textbooks.

A couple of suggestions:

- An Introduction to Statistical Learning with Applications in R (ISLR), 2 ed.
  James, Hastie, Witten, and Tibshirani (2013)
  PDF available online

- The Elements of Statistical Learning (ELS)
  Hastie, Tibshirani, and Friedman (2009)
  PDF available online





Textbooks (optional)

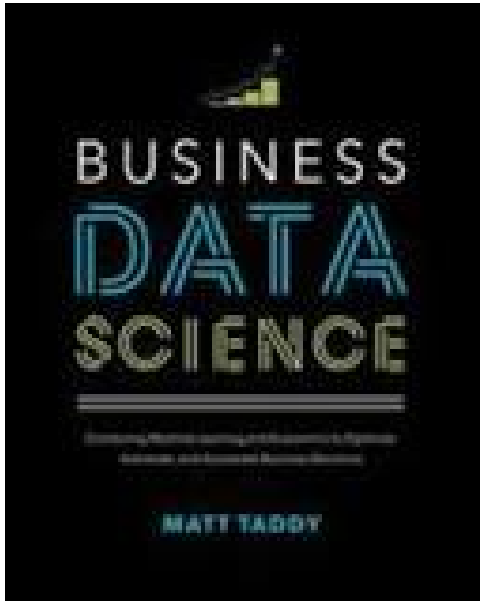
> All materials and lecture notes will be available on the course repo.

There are **no** required textbooks.

A couple of suggestions:

- Business Data Science by Matt Taddy
  No free version available

- Econometrics by Bruce Hansen, Ch. 29
  PDF available online



More resources

Can be found at our GitHub repo:

https://github.com/ml4econ/lecture-notes-2020/blob/master/resources.md

Programming

- Two of the most popular open-source programming languages for data science:
  - 
  -  Python
- This course: R.
- Why R? See presentation notes and the FAQ section of our class website.
- We do encourage you to try out Python. However, we will only be able to provide limited support for Python users.

Catching up with R

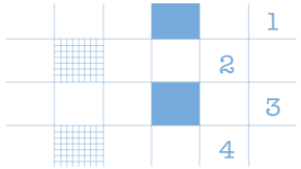
Posit Primers

Posit Primers

The Basics

Start here to learn the skills that you will rely on in every analysis (and every primer that follows): how to inspect, visualize, subset, and transform your data, as well as how to run code.

Work with Data

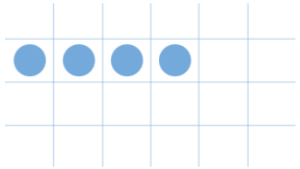


Learn the most important data handling skills in R: how to extract values from a table, subset tables, calculate summary statistics, and derive new variables.

Visualize Data

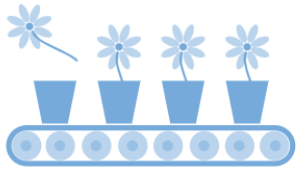
Learn how to use ggplot2 to make any type of plot with your data. Then learn the best ways to visualize patterns within values and relationships between variables.

Tidy Your Data



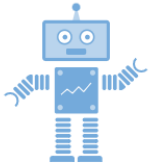
Unlock the tidyverse by learning how to make and use tidy data, the data format designed for R.

Iterate



Master a core programming paradigm with the purrr package: for each ___ do ___.

Write Functions



Functions are the key to programming in R. This primer will teach you how to write and use your own reusable functions.

Report Reproducibly

Learn to report, reproduce, and parameterize your work with the best authoring format for Data Science: R Markdown.

Build Interactive Web Apps

Say hello to Shiny, R's package for building interactive web apps. Learn to turn your analyses into elegant tools to share with others.

Large Language Models (LLMs)

We encourage you to use ChatGPT, BingAI, or any other LLM in this course, as it is an **essential skill to acquire**.

It is important you understand the (current) limitations of LLMs:

- Prompt engineering is necessary for quality outcomes.
- Always assume that it is wrong.
- Acknowledge its use in assignments and explain what prompts were used.

A couple of useful resources:

- Follow @emollick (Ethan Mollick)
- Read "Language Models and Cognitive Automation for Economic Research" by Korinek (2023).

Share your discoveries with us and your classmates!

Grading

Assignments:

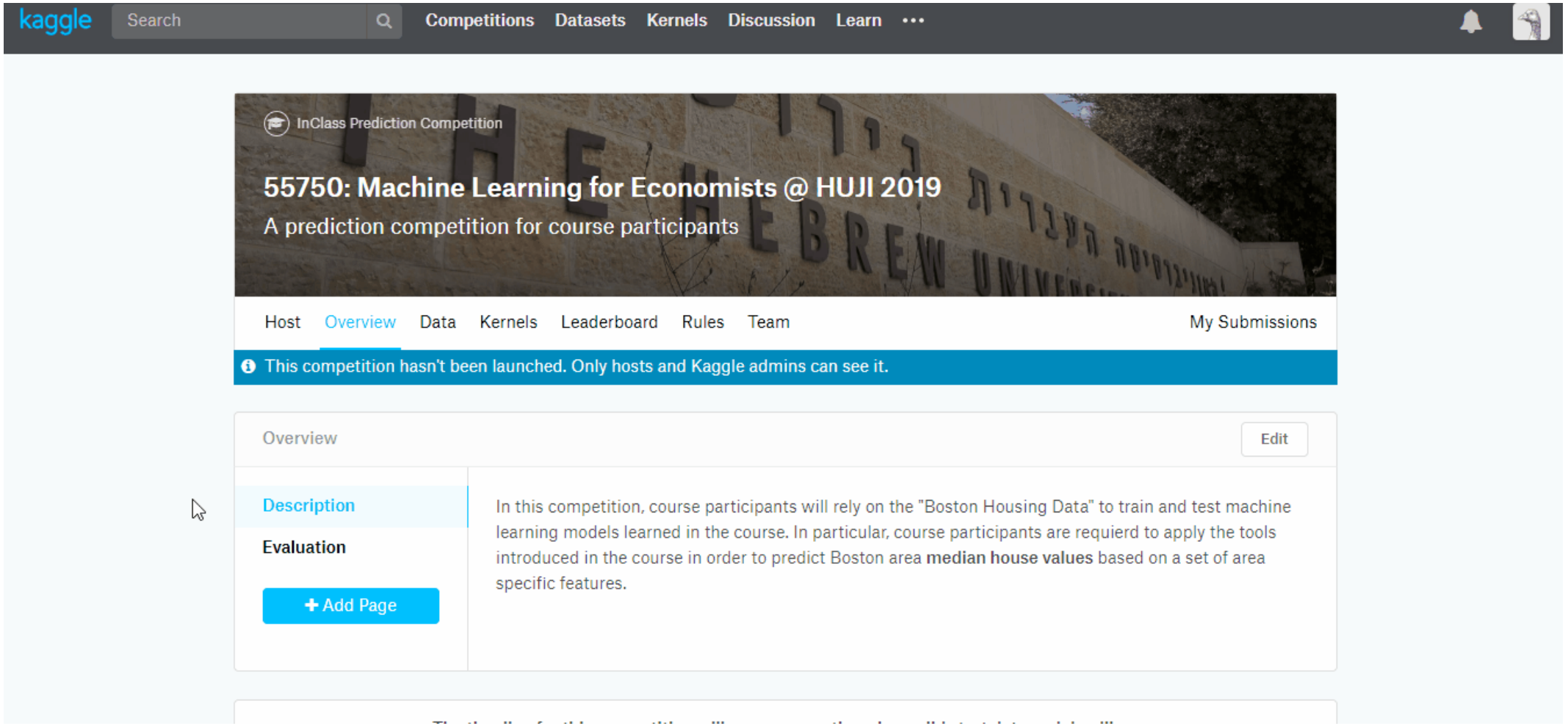
- Submit 4 out of a total of 6 Problem sets.

Projects:

- Kaggle prediction competition.
- Conduct a replication study based on one of the datasets included in the experimentdatar package, or a paper of your choice.

GRADING: Assingments **20%**, kaggle **40%**, project **40%**.

Kaggle


kaggle
Search
Competitions
Datasets
Kernels
Discussion
Learn
InClass Prediction Competition
55750: Machine Learning for Economists @ HUJI 2019
A prediction competition for course participants
Host
Overview
Data
Kernels
Leaderboard
Rules
Team
My Submissions
This competition hasn't been launched. Only hosts and Kaggle admins can see it.
Overview
Edit
Description
Evaluation
+ Add Page
In this competition, course participants will rely on the "Boston Housing Data" to train and test machine learning models learned in the course. In particular, course participants are requierd to apply the tools introduced in the course in order to predict Boston area median house values based on a set of area specific features.

experimentdatar

We will also make use of he `experimentdatar` data package that contains publicly available datasets that were used in Susan Athey and Guido Imbens' course "Machine Learning and Econometrics" (AEA continuing Education, 2018).

- You can install the **development** version from GitHub

```
# install.packages("devtools")
devtools::install_github("itamarcaspi/experimentdatar")
```

- **EXAMPLE:** Load the `experimentdatar` package and the `social` dataset:

```
library(experimentdatar)
data(social)
```

- Tips:
  1. Runnig `?social` privides variable definitions.
  2. Running `dataDetails("social")` will open a link to the paper associated with `social`.

To Do List

Homework*

- [x] Download and install Git.
- [x] Download and install R and RStudio.
- [x] Create an account on GitHub
- [x] Download and install GitHub Desktop.

[*] Feel free consult the Guides section in the course's old website.

```
slides %>% end()
```

Source code

References

[1] S. Athey. "The impact of machine learning on economics". In: *The Economics of Artificial Intelligence: An Agenda*. University of Chicago Press, 2018.

[2] T. Hastie, R. Tibshirani, and J. Friedman. *The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Second Edition*. Springer, 2009 .פבר. ISBN: 9780387848570.

[3] G. James, T. Hastie, D. Witten, et al. *An Introduction to Statistical Learning: With Applications in R*. Springer Texts in Statistics. Springer London, Limited, 2013. ISBN: 9781461471370.

[4] A. Korinek. "Language Models and Cognitive Automation for Economic Research". In: *NBER Working Paper* 30957 (2023 .פבר). DOI: 10.3386/w30957.

[5] S. Mullainathan and J. Spiess. "Machine learning: an applied econometric approach". In: *Journal of Economic Perspectives* 31.2 (2017), pp. 87-106.