

# Machine Learning in Econometrics

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The goal of this course is to give an introduction to Machine Learning in Econometrics. In the first part, methods from Machine Learning are presented. In the second part, applications of those methods in Econometrics are discussed. Moreover, the statistical software package R is used for illustration of the methods.

## Lectures

### 1. Introduction

- Definitions
- Basic Concepts
- Challenges in High-Dimensions

### Part I. How to make predictions?

#### 1. Linear Regression and Extensions

- Recap: Linear Regression
- Regression Splines
- Smoothing Splines

#### 2. Ridge Regression

#### 3. Lasso Regression

- Basic Principle
- Some Results
- Extensions

#### 4. Of Trees and Forests

- Regression Trees
- Bagging
- Random Forests

#### 5. Neural Nets / Deep Learning

#### 6. Boosting

- Basic Idea
- $L_2$ Boosting for Regression

#### 7. Support Vector Machines

#### 8. Model Selection: How to choose between different models?

### Part II. Estimation and Inference of Structural Parameters and Treatment Effects

#### 1. Partialling-out

#### 2. Inference on Selected Target Variables in Regressions in High-Dimensions

#### 3. IV Estimation in High-Dimensions

#### 4. The Orthogonality Principle

## Problem Sets

- PS1 Introduction to R /RStudio and some important R Packages
- Ps2 Linear Regression and Extensions
- Ps3 Ridge and Lasso Regression

## Literature

Hastie, Trevor, Robert Tibshirani, and Jerome Friedman. 2001. *The Elements of Statistical Learning*. Springer Series in Statistics. New York, NY, USA: Springer New York Inc.

James, Gareth, Daniela Witten, Trevor Hastie, and Robert Tibshirani. 2014. *An Introduction to Statistical Learning: With Applications in R*. Springer Publishing Company, Incorporated.

Shalev-Shwartz, Shai, and Shai Ben-David. 2014. *Understanding Machine Learning: From Theory to Algorithms*. New York, NY, USA: Cambridge University Press. <http://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf>.

Victor Chernozhukov, Martin Spindler, Chris Hansen. 2016. *hdm: High-Dimensional Metrics (Vignette)*.