Market Analysis with Econometrics and Machine Learning

Overview

Uni Ulm

Prof. Dr. Sebastian Kranz

SoSe 2020

Important Notes

- **The course was previously called "Empirical Industrial Organization and Consumer Choice"**. If you have heard that course, you CANNOT take this course again.
- Due to the Corona virus outbreak the course will (at least initially) only be taught digitally.
  - Weakly assignments and detailed material (slides, videos, problem sets) time table will all be put on Moodle.
- You will work through most content of the courses by solving yourself interactive R problem sets that you regularly have to upload to Moodle.

What the course is about

- Methods to model and estimate
  - demand functions and the behavior of consumers
  - the strategic behavior and interactions of firms

Example 1: Designing Railway Routes

- A typical stated preference data set
  - In 1987 the Hague Consulting Group for the national Dutch Railways invited 237 consumers to a choice experiment
  - Each respondent made a sequence of hypothetical choices among two possibilities for traveling by train that differed in some or all of the following attributes: fare, journey time, number of rail changes, and comfort level.
  - The goal was to improve route planning by better knowing consumers trade-off between travel time, interchanges and price

Example 1: The value of travel time

- By estimating an econometric model*, one finds the following average willingness to pay

One hour less travel	**25.54**
One less change of rails	4.84

*The results are based on the assumption that consumers act according to a conditional logit model

- The course teaches you how to generate, visualize and interpret such estimates
- Most importantly, you will learn about the small print:
  - Understand models and the econometric methods that are used to generate such estimates
  - Learn how your estimates can be complete rubbish when you don't carefully think about the model that generated the data

Example 2: What if Volkswagen bought Opel...

- How would prices of cars change if Volkswagen bought Opel?

https://moodle.uni-ulm.de/mod/resource/view.php?id=192595

- Note the website only shows correctly if you have the Flash player plugin activated.

Example 2: Analysing the effects of mergers

- Competition authorities commonly have to assess how a merger affects market outcomes
- One way for such an assessment is a structural econometric model that describes consumers' preferences and firm's strategies.
- The visualization illustrates predictions off such a model that has been estimated with historical sales data for different European markets.
- You will replicate such a study in one problem set and learn details of the methods

Some applications of the methods covered in class

- Marketing and business strategy, for determining optimal prices and product features and predicting competitors reactions
- Competition policy, e.g. predicting the effects of a merger on market outcomes and total welfare
- Planning of public projects, e.g. predicting the demand of new public transportation route
- Environmental policy, determining the effects of subsidies or taxes on consumer behavior
- International trade, predicting the effects of changes in tariffs and exchange rates on imports and exports in specific markets

Some methods will we cover in this class

- Key ideas behind estimation methods and statistical tests
- Difference between estimating causal effects (a main concern of econometrics) and pure prediction (main focus of machine learning)
- OLS, IV, GMM, Maximum Likelihood estimation
- Machine Learning Methods (decision trees, random forst, cross-validation)
- Discrete choice models

R

- We will extensively use the statistical programming language R to conduct
  - simulation
  - estimation
  - machine learning
  - data transformation and aggregation
  - visualization of data and results
- You will learn a lot of skills and tricks that are generally useful beyond this class and beyond your time as student
- You don’t need previous knowledge in R but you should be willing to learn it and solve exercises on your computer

R and RStudio

- We will use R together with RStudio in this class
  - R is a very popular statistical programming language
  - RStudio is a convenient IDE that facilitates working with R
  - R and RStudio are open source programs and are freely available

Interactive R Problem Sets

- During the course, you will be asked to solve and hand in, several interactive R problem sets.
  - They are based on the package RTutor (written by me)
  - You can immediately check your solution, get automatic feedback and can ask for hints.
  - The goal is to provide a fun and effective way to learn R and the concepts of this course
- The problem sets count a total of 10% of your final grade
  - This shall be some extrinsic motivation to solve the problem sets.

Further Ressources to Learn R

- If you are a complete beginner to R, you may want to take a look at some further ressources to learn R. There is a huge amount of free teaching material online.
- Here are some examples that cover similar material than our first RTutor problem set:
  - https://www.datacamp.com/courses/free-introduction-to-r
  - tryr.codeschool.com
  - http://swirlstats.com/students.html
  - https://www.teamleada.com/courses/r-bootcamp

Final Exam

How exactly examinations will take place depends on the development of the Corona outbreak.

Here are the modalities from last year:

- The final exam will determine 90% of your grade
- If the class is sufficiently large, there will be a written exam
  - Questions will be in English but you can answer in English or German
- If the class is not too large, there may be an oral exam (mündliche Prüfung)
  - You can freely decide whether you want to take the exam in English or German

Questions:

On the moodle page of the course is a Question and Answer forum. Please try to post your question there if there is a chance that it is also of interest to other students (which is the case for almost all questions.)

In other cases send an email:

- Lecturer: Sebastian Kranz (sebastian.kranz@uni-ulm.de)
- Teaching Assistant: Clara Ulmer (clara.ulmer@uni-ulm.de)

We possible then schedule a time to discuss the question via Phone or Skype.

Optional Background Readings

- Peter Kennedy: “A Guide to Econometrics”
  - Gives a good introduction what econometrics is about
- An open online textbook using R for an undergraduate econometric class by Florian Oswald, Jean-Marc Robin and Vincent Viers: https://scpoecon.github.io/ScPoEconometrics/
- Train, Kenneth E.. 2009. “Discrete Choice Methods with Simulation.” Cambridge University Press, ed. 2.
  - free download on Kenneth Train’s website\ http://elsa.berkeley.edu/books/choice2.html
- Matt Taddy: "Business Data Science"
  - A nice modern overview of econometric and machine learning techinques for business relevant decisions. Book uses R.

- You learn a lot, but also have to invest considerably time and effort.
- If you are not sure, just try out the course and see if you like it.