'math+econ+code' masterclass on optimal transport and economic applications: an introduction

Instructor: Alfred Galichon (ag133@nyu.edu)
TA: Jules Baudet (jules.baudet99@gmail.com)

January 18-22, 2021

Preliminary stuff

- Schedule: Mon 1/18 – Fri 1/22, 2021, 8am-12pm Eastern / 2pm-6pm Central European.
- Location: online, https://nyu.zoom.us/s/98208796151
- Course webpage: http://alfredgalichon.com/mec_optim
- Text (optional): Galichon (2016). *Optimal Transport Methods in Economics*, Princeton.

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Why this course?

- At the intersection between econ, math and data science
- The Rebirth of Optimization in Economics
- Giving you concepts:
  - in econ: equilibrium, matching, discrete choice, estimation, gravity equation...
  - in math: linear and nonlinear programming, duality, convexity...
  - in data science: networks, MDP, GLM, Lasso...
- Giving you tools: docker, python, git, jupyter, gurobi...
- Giving you a flavor of economic applications: labor, family economics, urban, trade...

Introducing ourselves

- Introducing me: A. Galichon, professor of economics and of mathematics at NYU (ag133@nyu.edu)
- Introducing the TA/guru/whiz: Jules Baudet, ENS graduate student (jules.baudet99@gmail.com)
- Introducing you: https://forms.gle/uC6U1h619ecdZFzV8

Remarks on this course

- Targeting graduate students from econ, math, data science and beyond.
- Teaching format: 10 "blocks"; each block = theory + code
  - code based on an empirical application related to the theory just seen
  - students are expected to write their own code, not just press ctl+Enter!
  - you are encouraged to work in groups: a forum will be set up to allow exchange among you
- Context-based learning: introduce tools on a needs basis, without any particular prerequisite other than the equivalent of a first year graduate sequence in econ, data science or in applied math.
- Programming: our demos will be done in Python and the support will be in this only, but you are welcome to use the language of your choice e.g. Matlab, C++, Julia... LP solver used will be Gurobi, so make sure your language of choice has an interface to it.
- Questions?

Outline

- Part I: Tools
  - Monday 6/17: linear programming
  - Tuesday 6/18: optimal transport toolbox 1 - duality
  - Wednesday 6/19: optimal transport toolbox 2 - convex analysis
- Part II: Models
  - Thursday 6/20: static and dynamic multinomial choice
  - Friday 6/21: statistical estimation of models of matching with transfers

Installing the ecosystem

- See Jules's presentation.

Assessment

- Students needing a grade for their home institution need to contact me before Friday Jan 22.
- Students taking the class for credit will have a choice between:
  - Either a take-home exam (24 hours) available e.g. from Saturday Jan 30 2pm Paris time, until Sunday Jan 31, 2pm Paris time (**to be confirmed with the group**),
  - Or a short paper (12 pages or more), to be discussed with the instructor. The paper will bear some connections, in a broad sense, with the topics of the course. Many papers are considered acceptable: original research paper, survey paper, report on numerical experiments, replication of existing empirical results... are all acceptable. The requirement is to be innovative on a theoretical, empirical, or computational level. This work should be submitted before June 30, 2021 (*** firm deadline ***).
- If you take the course for credit, you should indicate prior to Jan 22 which of these you are opting for.