Lectures on Optimal Transport and economic applications
Università degli Studi di Milano
October 2023 and June 2024
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Optimal transport, also known as transportation theory or the theory of mass transportation, plays a crucial role in economics by providing a powerful framework to address various equilibrium allocation problems.
It is therefore a key ingredient of matching models, which arise in markets where individuals or entities must be paired efficiently and optimally, such as labor markets, marriage markets, or school choice programs. Whether it's matching job seekers with employers, students with schools, or organ donors with recipients, matching models play a pivotal role in the understanding and the design of these markets. This course will introduce the mathematical framework needed for an in-depth understanding of these models.

Recommended readings:

- Galichon, A. *Optimal Transport Methods in Economics*, Princeton, 2015.
- Chiappori, P.-A. *Matching with Transfers. The economics of love and marriage*. Princeton, 2014.

The language for the coding sessions will be Python.

Thursday Oct 26, 2023

- 230pm – Lecture: an overview introduction to optimal transport
    - Two centuries of ideas across economics and mathematics
    - Optimization and equilibrium
    - Kantorovich duality

- 430pm - Coding session 1: optimal transport in the discrete case
    - Computation using a black-box solver
    - Transportation simplex

Friday Oct 27, 2023

- 1030am - Practice exercises

    - Positive assortative matching and comonotonicity
    - The wage equation

- 230pm - Coding session 2: semi-discrete optimal transport
    - Semi-Discrete Optimal Transport
    - Voronoi Tesselations
    - Aurenhammer's method

- 430pm - Coding session 3: optimal transport and entropic regularization
    - Entropic regularization
    - Microfoundations using random utilities
    - IPFP/Sinkhorn’s algorithm

Thursday June 6, 2024

- 230pm – Lecture: separable models of matching
    - Duality
    - The logit case
    - Computation

- 430pm - Coding session 1: discrete choice methods
    - Generalized linear models
    - Logistic regression as a generalized linear model
    - Computation using scikit-learn

Friday June 7, 2024

- 1030am - Practice exercises

- 230pm - Coding session 2: matching estimation
    - Formulation as a generalized linear model
    - Estimation using scikit-learn

- 430pm - Coding session 3: gravity equation