

A short introduction

Two sessions of Alfred Galichon's "math+econ+code" masterclasses took place in 2021, one in January on optimization and optimal transport in economics, the second one in June on equilibrium and economic applications of matching models. About 50 students and researchers from diverse and distinguished universities including Harvard, NYU, Chicago, Rice, MIT (USA), Tilburg (Netherlands), Lahore University of Management Sciences (Pakistan), Zhejiang University of Finance and Economics (China), LSE (UK), Toulouse School of Economics, and Sciences Po (France) were selected to go through an intensive curriculum at the frontier of economics and data science.

In both cases, the masterclasses were initially scheduled to take place in person but had to be moved online due to the sanitary situation. The teaching assistants, Jules Baudet and Gabriele Buontempo, did their best to maintain a community spirit among the participants, and the format of the classes had to be adapted to the challenge: Scientific Workplace replaced the whiteboard to go through math derivations, and the participants had a chance to interact and collaborate among them using the Discord app though a dedicated channel. And as usual, Jupyter notebooks were used as a virtual lab for coding exercises, and participants learned to work with Docker in order to streamline software installation and version management: a course image was available with all the required software and packages, which participants simply had to pull and run. Course participants in the January class were also introduced to the magic of Gurobi, one of the best commercial linear optimization software on the market, through a special course license generously made available by the editor.

The first 'math+econ+code' masterclass of 2021 took place between January 18-22 and revolved around optimal transport and its economic applications. Topics such as the resource allocation, dynamic programming, network problems, the optimal assignment model, stable matchings, equilibrium wages, demand for automobiles, and international trade flows, were covered. After the intensive 5-day class, a series of monthly special lectures were offered. During those sessions, participants were introduced to advanced computational topics and to

cloud computing, using google colab and aws; dynamic discrete choice models; kidney exchanges; zero-sum games, and congested transportation models.

The June 2021 version of the 'math+econ+code' masterclass on equilibrium transport and matching models in economics took place between June 21-25th in an online format. The focus there is more on departures from the standard model with efficient transfers. Topics such as matching with taxes, without money, waiting lines, were covered. The famous algorithm of Gale and Shapley was revisited from a conceptual and computational angle. A general framework to deal on equilibrium on networks was introduced. The self-contained intensive lecture series took place over five intensive days and will be followed by a series of "advanced lectures" in the upcoming months.

Gabriele Buontempo and Akshaya Devasia



More information on https://www.math-econ-code.org/

Student Testimonials

"The open-source material gives us time to prepare for the course in advance. The professor and TA are patient and friendly to answer questions. I love the algorithm part with the coding demo. It is a good introduction to the matching problem for me. The code part and the key idea of the algorithm will help me when I need to solve an equilibrium problem by numerical methods."

"The models are powerful and can be applied in my future research when they fit the need."

Xinyu Dai – Masters student in Research, Economics, Sciences Po

"After reading part of Alfred Galichon's book, I felt that I have gained a secret weapon. I believe the biggest advantage of this MEC masterclass is that it's highly research-oriented.

Professor Galichon teaches us how to implement the theoretical models in Python in detail. This masterclass reminds me of the old-time craftsmanship: The apprentices learn to make workmanship by observing and following the steps of the master. Following this class is also like being a RA with an extremely patient supervisor.

I did benefit a lot from MEC masterclasses, especially from the 2021-January session, as a behavioural economist. The methods of optimal transport have introduced me to new optimization methods to handle the problems that I used to solve by convex optimization. After the 2021 January session, I used quite a lot of time to reformulate several problems from behavioural economics, contract theory and Bayesian persuasion through the Monge-Kantorovich framework. Through the process of reformulation, I gained some ideas that became my new research projects.

For example, in behavioral economics, according to Vincent Crawford, behavioral economists approach seemingly irrational behavior with basically two approaches: bounded rationality method and optimization-based method. I follow the second approach most of the time i.e., I try to find explanations for seemingly irrational behavior with rationality with various cognitive constraints. Therefore, I am interested in collecting various optimization techniques to help my research and OT is like a secret weapon for me. The existence and uniqueness of the solution of Monge-Kantorovich problem make the OT method extremely useful and flexible. I am currently working on two projects relating OT method. The first is about rational inattention. During the 2021-January session, I got the idea that the hot topic rational inattention in behavioral economics can be formulated as an optimal network flow problem solved by OT technique and the new formulation would be simpler and has more implications than the current formulation; the second is to reformulate Bayesian persuasion problem in the framework of Monge-Kantorovich."

"I genuinely would like to thank the MEC masterclass for not only teaching me a new technique but also giving me a new perspective to understand my own field."

Haihan Yu - Assistant Professor of Economics, Zhejiang University of Finance and Economics Hangzhou, China

"I enjoyed the intensive format of the course and how engaging it was despite spending long hours on a computer. The course was very hands-on and I appreciate the professor's method of taking us through the entire code which made it possible to follow despite complexities and this format was especially important as it was online. The course material broadened my understanding of optimization problems and equipped me with new tools to approach them."

Antoine Jacquet- Fourth-year PhD student in Economics at the Toulouse School of Economics.

"The step-by-step learning format on python helped make the language quite comprehensible even to beginners. The lectures were nicely delivered with very accessible introductions to new topics. I got some new ideas from the course and have been able to reframe some of the topics I am working on currently. The course has also provided me with new ideas on how to approach problems in the field and the tools available to answer the research questions my co-authors and I have. The self-contained nature of the course is great. I have begun to use networks and open-maps and incorporate market design and socio-economic networks to incorporate in my teaching."

"It will be great if the next physical versions are streamed online."

Rubén Martínez Cárdenas - Senior Lecturer in Economics, Department of Economics and Marketing, Faculty of Business and Law, De Montfort University

