

Methods for Structural Microeconometrics

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Welcome to this course! Find details on the syllabus here, and check out the menu to find other materials.

[Here is a link](#) to the git repo for this course, which by cloning is probably the simplest way for you to get access to the data, code, and assignments. I will continue to add materials throughout the course. You may prefer to selectively download these materials.

1 Topics

1.1 Identification, Credible Inference, and Marschak's Maxim

2024 is the last year I will make this topic a part of the course.

We formally define identification and discuss (via examples) what people really mean when they talk about identification and **credible inference**. We use the **Generalized Roy Model** to compare identification via functional form to nonparametric identification.

We introduce **Marschak's Maxim** as a guide for doing empirical model-based research.

1.1.1 Reading

The two survey articles by Keane (2010) ([link](#)) and Angrist and Pischke (2010) ([link](#)) - although aging - provide two important perspectives on the issues of credible inference in economics. Low and Meghir (2017) **provide** a nice review of the advantages of the structural approach.

The original paper by Marschak (1953) may be of interest. Heckman and Vytlacil (2007) provide a **nice discussion** of Marschak's Maxim in the context of policy evaluation. They introduce (Heckman and Vytlacil 2005; Carneiro, Heckman, and Vytlacil 2011) the *Marginal Treatment Effect* as a tool for thinking about quasi-experimental estimators and policy evaluation.

1.2 Dynamic Discrete Choice

We introduce the dynamic discrete choice model and briefly discuss identification when all persistent state variables are observed. We review some of the basics of discrete choice such as the generalized extreme value distribution, which produces tractable choice probabilities with relatively flexible cross-price elasticities.

1.2.1 Reading

The main example that we work with throughout the course can be found in Mullins (2022) ([pdf](#)).

Rust (1987) is the canonical example demonstrating estimation of dynamic discrete choice models with maximum likelihood and a nested solution method.

We show that if one can directly estimate choice probabilities, several tractable approaches produce estimates of structural parameters without repeatedly solving the model. These include Hotz and Miller (1993), Aguirregabiria and Mira (2002), Aguirregabiria and Mira (2007), Pesendorfer and Schmidt-Dengler (2008), and Arcidiacono and Miller (2011). We will review these methods and why they are not appropriate to use in Mullins (2022).

1.3 Estimation of Dynamic Models with Unobserved Heterogeneity

Using Mullins (2022) as an example, we talk about the inferential pitfalls that can occur when models fail to account for **unobserved heterogeneity**. We briefly discuss how this can depend on estimation approaches and sources of identification.

We review methods for estimation of dynamic models, including the **Expectation-Maximization** algorithm (EM) (see, e.g. Arcidiacono and Miller (2011)) and the **clustering**

approach of Bonhomme and Manresa (2015). We review practical considerations for these approaches and introduce the **Forward-Back algorithm** for implementing **EM** in hidden Markov Models with **time-varying unobserved state variables**. We introduce a sparse matrix implementation of this algorithm.

1.4 Identification of Dynamic Models with Unobserved Heterogeneity

We discuss how either **panel data** or **instrumental variables** can facilitate identification of models with unobserved heterogeneity, and briefly review identification results for finite mixtures in panel data settings due to Kasahara and Shimotsu (2009) and Bonhomme, Jochmans, and Robin (2016). Berry and Compiani (2023) analyze identification and estimation of dynamic models with persistent heterogeneity using instrumental variables.

2 Assessment

There will be 7 problem sets. Your best 5 of these 7 problem sets will be worth 20%. Hence, you can skip two if you want.

Here is the proposed timeline of due dates. Submissions **must** be made through Canvas as a notebook (e.g. jupyter or quarto) formatted to html with printed output.

Assignment	Due Date
Assignment 1	March 22
Assignment 2	March 29
Assignment 3	April 5
Assignment 4	April 12
Assignment 5	April 19 April 26
Assignment 6	April 26 May 3
Assignment 7	May 3 May 10

3 Office Hours

I will provide a link on Canvas to sign up for my weekly office hours.

Reading List

- Aguirregabiria, Victor, and Pedro Mira. 2002. "Swapping the Nested Fixed Point Algorithm: A Class of Estimators for Discrete Markov Decision Models." *Econometrica* 70 (4): 1519–43.
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- Arcidiacono, Peter, and Robert A Miller. 2011. "Conditional Choice Probability Estimation of Dynamic Discrete Choice Models with Unobserved Heterogeneity." *Econometrica* 79 (6): 1823–67.
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- Carneiro, P., J. J. Heckman, and E. J. Vytlačil. 2011. "Estimating Marginal Returns to Education." *American Economic Review* 101 (October): 2754–81. <http://www.nber.org/papers/w16474>.
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- Keane, Michael P. 2010. "A Structural Perspective on the Experimentalist School." *Journal of Economic Perspectives* 24 (2).
- Low, Hamish, and Costas Meghir. 2017. "The Use of Structural Models in Econometrics." *Journal of Economic Perspectives* 31 (2).
- Marschak, Jacob. 1953. "Economic Measurements for Policy and Prediction." In *Studies in Econometric Method*, edited by W. Hood and C. Koopmans. John Wiley & Sons.
- Mullins, Joseph. 2022. "Designing Cash Transfers in the Presence of Children's Human Capital Formation." *Working Paper*.
- Pesendorfer, Martin, and Philipp Schmidt-Dengler. 2008. "Asymptotic Least Squares Estimators for Dynamic Games." *The Review of Economic Studies* 75 (3): 901–28.

Rust, John. 1987. “Optimal Replacement of GMC Bus Engines: An Empirical Model of Harold Zurcher.” *Econometrica: Journal of the Econometric Society*, 999–1033.