Iterative Estimation Algorithms

Tyler Ransom
Duke University

July 4, 2012

Outline

- Introduce various commonly used estimation algorithms in empirical micro

Multistage Estimation Algorithms

- In advanced econometrics, complex algorithms abound
- These algorithms pare down the dimensionality of a problem so that computation is much easier
- Typically, these algorithms rely on certain theoretical assumptions, so they may not be generalizable to all types of problems

Multistage Estimation Algorithms

- Another property of these algorithms is that they typically induce estimation error between the multiple steps of estimation
- Hence, inference on the final parameter estimates may require bootstrapping in order to recover (an approximation to) the true variance matrix of the parameter estimates
- At the very least, some sort of correction to the standard errors is required

Examples of Multistage Estimation Algorithms

- Expectation Maximization (EM) algorithm
- Berry, Levinsohn and Pakes (BLP) method for demand estimation
- Bajari, Benkard and Levin (BBL) method for solving dynamic games
- Iterative algorithm for multi-dimensional fixed effects
- We'll go through each of these in more detail

EM Algorithm

- A famous algorithm for estimating models with missing data
- Can be applied to finite mixture unobserved heterogeneity models
- "E" step: given parameters θ, estimate the probability that each person is of finite mixture type R
- "M" step: given type probabilities, estimate the parameters θ
- Iterate until parameters θ converge
- You will see this again if you take Peter Arcidiacono's dynamic discrete choice class (which I highly recommend)

BLP method

- This is a famous method in IO for estimating demand for products, where the demand (market share) is a function of product characteristics interacted with consumer characteristics
- The estimation method is quite complicated.
- Involves a contraction mapping over consumer mean utilities
- This contraction mapping is nested within a GMM algorithm
- This is called a "Contraction Mapping Fixed Point" algorithm
- Allows researcher to recover random coefficients for the consumers

BBL method

- Estimation algorithm for dynamic games where players are assumed to play Markov Perfect Equilibria
- Step 1: estimate the policy functions and law of motion for state variables
- Step 2: given the Step 1 estimates, estimate the structural parameters given the FOCs that are consistent with MPE
- Iterate until structural parameters converge

Suppose we have an outcome equation

$$y_{ijt} = X_{ijt}\beta + \theta_i + \theta_j + \theta_i\theta_j + \varepsilon_{ijt}$$

where θ_i and θ_j are fixed effects for two different agents e.g. worker and firm, student and teacher, individual and village

Multidimensional Fixed Effects

- Arcidiacono et al. (2011) outlines a simple estimation routine that will allow the researcher to recover the fixed effects without having to use LSDV
- Step 1: Given values for θ_i, estimate θ_j and β by OLS
- Step 2: Given the estimates for θ_j and β, estimate θ_i by OLS
- Iterate until all parameters converge