Economics 8281: Topics in Econometrics
Estimation of Dynamic Models

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University of Minnesota, Fall Semester 2000, Mini II

Assignment

The purpose of this assignment is to empirically implement a dynamic estimation algorithm using one of the two applicable techniques that we discussed. Accordingly, there are two steps. First, you will design simulated data for the Rust model. Second, you will use these data to estimate the model.

Step 1: Simulate data

You should use the following simple variant of the Rust model. Every period, Harold Zurcher must decide whether or not to replace the bus engine. Zurcher is a rational dynamic agent with discount rate $\beta = 0.925$.

The time t mileage of an engine, x_t, can take on one of 6 values: 0, 1, 2, 3, 4, and 5. If the engine is not replaced, then with some probability it accrues mileage between times t and t+1: Specifically,

$$x_{t+1} = \begin{cases} x_t, \text{ with prob. } 1-\lambda \\ \min\{5, x_t+1\}, \text{ with prob. } \lambda \end{cases}.$$

The mean cost of running a bus with mileage x_t is $C(x_t) = \theta x_t$. The cost of replacing the bus engine is RC. (Note that a cost constant term would not be identified.) Zurcher's per-period utility is:

$$U(x_t) = \begin{cases} -C(x_t) + \varepsilon_{0t}, \text{ if } r_t = 0 \\ -C(0) - RC + \varepsilon_{1t}, \text{ if } r_t = 1 \end{cases},$$

where r_t is the replacement decision, and the unobservables, ε_{jt} are Type I extreme value and known to Zurcher before he makes his decision.

You will need to choose values for the true parameter vector (λ, θ, RC). Then, you will need to solve the dynamic programming problem given these true parameter values. Lastly, you will need to simulate unobservables and store the values of (x_t, r_t). Since there are no serially correlated unobservables, it is valid to simulate a long time series; use 1000 observations for your simulated data set.

Step 2: Estimate model

You can estimate the model using either Hotz and Miller's method or Ackerberg's method. To do this, you will use your simulated data on (x_t, r_t). You will then need to perform a non-linear search in the parameter space (λ, θ, RC). For each parameter vector, you need to solve for the optimal policy functions and use these to construct moment conditions as discussed in class. You will then find the parameter vector that minimizes the moment conditions, and report the mean and standard errors for your estimated parameter vector.