Assignment 5

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Course Number: MKTG 584 A
Course Name: Dynamic Structural Models

1 Overview

In this Assignment, you will expand your estimation of the bus-engine problem to allow for persistent bus-specific unobservables. Here, you will implement the Arcidiacono & Jones algorithm, which involves an EM loop over the Rust nested fixed point.

2 Assumptions

- Assume the deterministic mileage transition process and utility specification given from Assignment 4.
- In your code, you don't need to infer the state transition. Just assume it to be known.
- Assume there are two unobserved types of buses.

3 Inputs

Your code should take the following inputs:

- Data in following format (in columns) – BusNo., Timeperiod, DecisionNo. (0 if the line refers to continuation, 1 if it refers to replacement), Mileage, Chosen (0 if this line was chosen, 1 otherwise).
- Discount factor β

4 Outputs

For a given dataset and discount factor, the code should generate the following outputs:

- Parameters $\{\theta_1, \theta_2, \theta_3, \pi\}$ and the standard errors for each of them.
- Think about how you would get the standard errors π, and implement the algorithm so you can get these standard errors too.

5 Some suggestions

- Note that you cannot use Stata's asclogit command to run the outer-loop of ML because your ML is specified at the bus-level, not at the bus-timeperiod level. So if you are using Stata for ML estimation, you will need to write an .ado code. At this stage, do not try to write the derivative/Hessian for the ML. Instead used numerical derivatives.
- Give the estimates from the last iteration of the EM as the starting values for the ML in the current iteration. That will speed up your algorithm significantly.
- EM algorithms tend to crawl towards the end. So be aware that it might take some time to converge.
- As with the previous assignments, I will evaluate the correctness of your code by giving you a .txt dataset in the format described above and a discount factor. Your code should produce the correct parameters for the data. So please check to see if your code is working well.
- When bootstrapping the standard errors, start the EM algorithm at the estimated values of θs from the first run for each simulation in the bootstrap. That will ensure that individual simulations in the bootstrap do not take too long to run.

6 Evaluation

Please submit the following:

1. Your code
2. A pdf document with the following results

    (a) Run your model on the dataset that is provided with this assignment and present the following – a) the parameter estimates and standard errors without bootstrap (run on the full data), and b) the bootstrapped parameter estimates and standard errors with at least 250 replications.

    (b) The probability distribution of parameters from the bootstrap process.

    (c) Without bootstrap, specify the time it takes to run and the number of iterations for the EM algorithm to converge, along with the convergence criterion.

    (d) Run a simple Nested Fixed Point algorithm (as you did in Assignment 2) and report the bias in parameters from ignoring persistent unobservable. It is sufficient to compare the non-bootstrapped parameter estimates from Assignment 2 and Assignment 5 (since the estimates are consistent, though inefficient).

    (e) Report the differences in runtime (for non-bootstrapped estimation) for the Nested Fixed Point and Nested Fixed Point with EM.