Assignment 6

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

1 Overview

This assignment follows Assignment 5 in also allowing for bus-specific persistent unobservables. Here, you will implement the Arcidiacono & Miller algorithm, which involves an EM loop over the two-step CCP method (that you used in Assignment 3).

2 Assumptions

- Assume the deterministic mileage transition process and utility specification 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.
- Because this is a two-step method, you need to use bootstrap to obtain the standard errors for all the parameters.

5 Some suggestions

- Follow the same suggestions regarding optimizers and speeding the algorithm from Assignment 5.
- Use the same dataset provided with Assignment 5 for estimating the parameters for your report as well.

6 Evaluation

In your submission, include the following:

1. Your code with detailed comments. I will evaluate the correctness of your code using the same dataset as that provided for Assignment 5. Your code should produce the correct parameters for the data.
2. A pdf document with the following results:
   (a) Run your model on the dataset (provided with Assignment 5) 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) Compare the estimates, standard errors, and run-times from Assignment 5 and this one. What are the main differences? For simplicity, use the non-bootstrapped estimates
   (e) Run a simple two-step estimator (as you did in Assignment 3) and report the bias in parameters from ignoring persistent unobservables. It is sufficient to compare the non-bootstrapped parameter estimates from Assignment 3 and Assignment 6 (since the estimates are consistent, though inefficient).
   (f) Report the differences in runtime (for non-bootstrapped estimation) for the two-step method and two-step method with EM.