Assignment 3

Hema Yoganarasimhan

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

1 Overview

This assignment follows up on your previous two assignments. Assume the same optimal stopping problem (and model specifications) as in Assignment 1.

The goal of this assignment is to estimate the replacement costs and maintainence costs for a given dataset using the Two-step CCP method.

2 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). Note that this is the same format as the data you generated in Assignment 1, except it doesn’t have the column for the choice-specific value function.
- Discount factor $\beta$

3 Outputs

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

- Parameters $\{\theta_1, \theta_2\}$ and the standard errors for each of them.

4 Outline of the Code

There are two parts to this code – the first step and the second step. The details of how the code should look like are given below.

- In the first step you will nonparametrically estimate the CCPs for the observed states and the state-transition probabilities. If the size of the state-space is $Z$, then the number of CCPs to be estimated is $Z$ (for two decisions) and the dimension of the state-transition matrix is $Z \times Z$, where you need to estimate $Z \times (Z - 1)$ parameters. Note that for certain parameter values,
you will have a sparsely populated state space. This can affect the quality of your first-step estimates.

• In the second step, you will calculate the expected future value-functions, plug them into the choice probabilities. Because the Rust bus engine replacement demonstrates ‘finite-dependence’, use this property to simplify your value function calculation. Since mileage resets to zero after every replacement decision, if you represent the next period’s value function in terms of the replacement decision, you only need to forward simulate one period ahead. See Arcidiacono & Ellickson (2011) for details.

Once you have numerical estimates of the expected future value functions, plug them into the choice probabilities, write out the log-likelihood and estimate it. You can use a ready-made ML estimator, like asclogit from Stata, to do this.

• Because your value function estimates are not data, your standard errors are likely to be biased downwards. So bootstrap the standard errors using 250 simulations.

5 Some suggestions

• Compare the estimation time that the Nested Fixed Point algorithm takes with the time the two-step method takes (without bootstrap). Report the time differences.

• Compare the efficiency of the bootstrapped standard errors for the two-step method, non-bootstrapped standard errors for the two-step method, and the efficiency of the Nested Fixed Point algorithm (without bootstrap).

• Ensure that your code can accept the data in .txt format.

6 Evaluation

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 and the bootstrapped standard errors.