

# ECO 8853 Industrial Organization I

## Problem Set #2

Fall 2022

### 1 1.3 Problem

The file `entryData.csv` contains information on 100 markets. It contains 7 columns -  $X_m$ ,  $\{Z_{fm}\}$ ,  $f \in F$  and entry decisions of the firms as dummy variables (in the same order as  $Z_{fm}$ ).

1. Berry, ECMA 1992 Suppose you know  $(\alpha, \beta, \delta), F$ . You aim to estimate  $(\mu, \sigma^2)$  based on market observables provided to you. Construct a maximum likelihood estimator and estimate  $(\mu, \sigma^2)$  using simulated likelihood under the correct assumption about the order of entry.
- A) Through this method, we get a  $(\mu, \sigma^2)$  estimate of (2.56, .592). It seems that our results are sensitive both to the draw of  $u$  as well as our initial guess. We have since fixed our draws which eliminates some of our more extreme results.
2. Ciliberto and Tamer, ECMA 2009 Suppose you know the true values of  $(\alpha, \beta, \delta), F$ , and  $\sigma^2$ . Your goal is to estimate the mean fixed cost of entry  $\mu$  using a moment inequality estimator that does not assume anything about the order of entry.

Write a function `calc_mi(mu; data)` that computes the moment inequality objective value. Taking guidance from the pseudocode provided (`ctPseudocode.jl`), construct and implement the moment inequalities estimator.

- A) Our estimate of the mean fixed cost given the assumptions is 2.36 (above the true value 2). The moment inequality bounds are (1.71, 3.11), which does contain the true parameter value 2.

While the paper used a non-parameteric frequency bin-estimator to calculate the empirical probabilities of each configuration in a market, we instead run a conditional multinomial logit<sup>1</sup> to estimate this from the data.

To estimate lower and upper bounds  $\hat{H}_1$  and  $\hat{H}_2$ , we simulate errors from a  $N(\mu, 1)$  distribution, and estimate payoff for each configuration. The paper defines an equilibrium if all firms in the market make non-negative profits. We use a stronger equilibrium condition, which also

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<sup>1</sup>we thank Federico and Joe for this idea

requires entry if positive profits *can* be made. For instance, if all 3 firms chose to not enter, they make 0 profits —this however is not necessarily an equilibrium since at least one firm is possibly not best responding by not entering!

3. Compare the two estimators. Comment.

A) Our two estimates are consistent with one another as both Berry's 2.56 and CT's 2.36 fall within the range of (1.71, 3.11). The Ciliberto-Tamer estimates tend to be more conservative due to lack of restriction on order entry, which allows for multiple equilibria in identity. This is in contrast to Berry (1992), who is able to use a restriction on the order of entry to rule out multiple equilibria and identify an additional parameter ( $\sigma$ ), while also giving a more precise estimate of  $\mu$ .