PhD IO Fall 2022
Problem Set 2
Due Nov. 8, 2022
Appended files - entryData.csv, ctPseudocode.jl

1 Estimating Entry Costs

1.1 Model

The model has two periods. Firms decide whether to enter in the first period, and entrants realize profits in the second period.

1.1.1 First period

The number of potential entrants is $\mathcal{F}$. Fixed cost of entry of firm f into market m, ϕ_{fm}, is given by

$$\phi_{fm} = Z_{fm}\alpha + u_{fm}$$

where u_{fm} is distributed as $N(\mu, \sigma^2)$. Call Z_{fm} the firm-market characteristic. Firms observe *all* variables in the model. Firms enter the market sequentially; the firm with the least realized fixed cost enters the market first if it wants to. The firm with the second least realized fixed cost enters next if it wants to, and so forth. The payoff of staying out is normalized to zero.

1.1.2 Second period

Firms realize their profit (including fixed cost)

$$\pi_{fm} = X_m\beta - \delta \log N_m - \phi_{fm} \tag{1}$$

where N_m denotes the number of firms that enter the market m. The firm's profit when staying out is normalized to zero. Call X_m the market characteristic.

1.2 Parameters

For this problem, let true parameter values be:

- $\mathcal{F} = 3$

- $(\alpha, \beta, \delta) = (1, 1, 1)$
- $(\mu, \sigma^2) = (2, 1)$

And the distributions of observable characteristics are:

- $X_m \sim N(3, 1)$
- $Z_{fm} \sim N(0, 1)$

There are $M = 100$ markets.

1.3 Problem

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

1. **Berry, ECMA 1992** Suppose you know (α, β, δ) and $\mathcal{F}$. You aim to estimate (μ, σ^2) based on market observables provided to you. Construct a maximum likelihood estimator and estimate (μ, σ^2) using simulated likelihood under the correct assumption about the order of entry.

2. **Ciliberto and Tamer, ECMA 2009** Suppose you know the true values of (α, β, δ), $\mathcal{F}$, and σ^2. Your goal is to estimate the mean fixed cost of entry μ 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.

3. Compare the two estimators. Comment.