

Problem Set 3

ECON 6343: Econometrics III

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Due: September 16, 9:00 AM

Directions: Answer all questions. Each student must turn in their own copy, but you may work in groups. Clearly label all answers. Show all of your code. Turn in jl-file(s), output files and writeup via GitHub. Your writeup may simply consist of comments in jl-file(s). If applicable, put the names of all group members at the top of your writeup or jl-file.

You will need to load the following packages:

Optim

HTTP

GLM

LinearAlgebra

Random

Statistics

DataFrames

CSV

FreqTables

On Github there is a file called `PS2_starter.jl` that has the code blocks below already created.

1. Estimate a multinomial logit (with alternative-specific covariates Z) on the following data set:

```
using DataFrames
using CSV
using HTTP
url = "https://raw.githubusercontent.com/OU-PhD-Econometrics/fall-2021/
master/ProblemSets/PS3-gev/nls88w.csv"
```

```
df = CSV.read(HTTP.get(url).body)
X = [df.age df.white df.collgrad]
Z = hcat(df.elnwage1, df.elnwage2, df.elnwage3, df.elnwage4,
         df.elnwage5, df.elnwage6, df.elnwage7, df.elnwage8)
y = df.occupation
```

The choice set represents possible occupations and is structured as follows.

- 1 Professional/Technical
- 2 Managers/Administrators
- 3 Sales
- 4 Clerical/Unskilled
- 5 Craftsmen
- 6 Operatives
- 7 Transport
- 8 Other

Hints:

- Index the parameter vector so that the coefficient on Z is the last element and the coefficients on X are the first set of elements.
- You will need to difference the Z 's in your likelihood function.
- Normalize $\beta_J = 0$
- The formula for the choice probabilities will thus be

$$P_{ij} = \begin{cases} \frac{\exp(X_i\beta_j + \gamma(Z_{ij} - Z_{iJ}))}{1 + \sum_{k=1}^{J-1} \exp(X_i\beta_k + \gamma(Z_{ik} - Z_{iJ}))}, & j = 1, \dots, J-1 \\ \frac{1}{1 + \sum_{k=1}^{J-1} \exp(X_i\beta_k + \gamma(Z_{ik} - Z_{iJ}))}, & j = J \end{cases}$$

2. Interpret the estimated coefficient $\hat{\gamma}$.
3. Estimate a nested logit with the following nesting structure:
 - White collar occupations (indexed by WC)
 - 1 Professional/Technical
 - 2 Managers/Administrators
 - 3 Sales
 - Blue collar occupations (indexed by BC)
 - 4 Clerical/Unskilled
 - 5 Craftsmen

- 6 Operatives
- 7 Transport
- Other occupations (indexed by Other)
- 8 Other

Specify the parameters such that there are only nest-level (rather than alternative-level) co-efficients. That is, estimate a model with the following parameters:

- β_{WC}
- β_{BC}
- λ_{WC}
- λ_{BC}
- γ
- β_{Other} is normalized to 0
- The formula for the choice probabilities will thus be

$$P_{ij} = \begin{cases} \frac{\exp\left(\frac{X_i\beta_{WC} + \gamma(Z_{ij} - Z_{iJ})}{\lambda_{WC}}\right) \left[\sum_{\ell \in WC} \exp\left(\frac{X_i\beta_{WC} + \gamma(Z_{i\ell} - Z_{iJ})}{\lambda_{WC}}\right)\right]^{\lambda_{WC}-1}}{1 + \left[\sum_{k \in WC} \exp\left(\frac{X_i\beta_{WC} + \gamma(Z_{ik} - Z_{iJ})}{\lambda_{WC}}\right)\right]^{\lambda_{WC}} + \left[\sum_{m \in BC} \exp\left(\frac{X_i\beta_{BC} + \gamma(Z_{im} - Z_{iJ})}{\lambda_{BC}}\right)\right]^{\lambda_{BC}}}, & j \in WC \\ \frac{\exp\left(\frac{X_i\beta_{BC} + \gamma(Z_{ij} - Z_{iJ})}{\lambda_{BC}}\right) \left[\sum_{\ell \in BC} \exp\left(\frac{X_i\beta_{BC} + \gamma(Z_{i\ell} - Z_{iJ})}{\lambda_{BC}}\right)\right]^{\lambda_{BC}-1}}{1 + \left[\sum_{k \in WC} \exp\left(\frac{X_i\beta_{WC} + \gamma(Z_{ik} - Z_{iJ})}{\lambda_{WC}}\right)\right]^{\lambda_{WC}} + \left[\sum_{m \in BC} \exp\left(\frac{X_i\beta_{BC} + \gamma(Z_{im} - Z_{iJ})}{\lambda_{BC}}\right)\right]^{\lambda_{BC}}}, & j \in BC \\ \frac{1}{1 + \left[\sum_{k \in WC} \exp\left(\frac{X_i\beta_{WC} + \gamma(Z_{ik} - Z_{iJ})}{\lambda_{WC}}\right)\right]^{\lambda_{WC}} + \left[\sum_{m \in BC} \exp\left(\frac{X_i\beta_{BC} + \gamma(Z_{im} - Z_{iJ})}{\lambda_{BC}}\right)\right]^{\lambda_{BC}}}, & j = J \end{cases}$$

4. Wrap all of your code above into a function and then call that function at the very bottom of your script. Make sure you add `println()` statements after obtaining each set of estimates so that you can read them.