EPFL
ENAC TRANSP-OR
Prof. M. Bierlaire

Mathematical Modeling of Behaviour
Fall 2020

LAB SESSION 5

The topic of this exercise session is the *Multinomial Logit* model. You will estimate different model specifications for the *Airline Itinerary Choice* (Boeing) case study.

First, download the files from the folder *Case study Lab 5*. It contains:

1. the `MNL_airline_generic.ipynb` jupyter notebook file with an example model specification,
   - which is a MNL model among three flight itineraries, and
   - this is your base model and you will use it as a template to perform more modeling exercises;
   - note, the file `MNL_airline_generic.py` is also included if you would prefer to use a python text editor instead of Jupyter notebooks - it has the same content as the `ipynb` file (these instructions assume you will use the `ipynb` notebook);
2. the description and interpretation of the base model, as well as some extensions of it that we propose (`MNL_Airline_2020.pdf`).

Now, make a copy of the `MNL_airline_generic.ipynb` notebook, and open it in Jupyter. Use it as a template to perform the following tasks:

Practise

Follow the description in the `MNL_Airline.pdf` file and for each model described there:

1. Try to understand the proposed specification.
2. Try to code the proposed specification. You should create the following files:
   (a) `MNL_airline_specific.ipynb`
   (b) `MNL_airline_socioecon.ipynb`
   (c) `MNL_airline_socioecon_mi.ipynb`
   (d) `MNL_airline_piecewise.ipynb`
   (e) `MNL_airline_powerseries.ipynb`
   (f) `MNL_airline_boxcox.ipynb`
3. Estimate the model specifications. You should obtain the following files:
   (a) `MNL_airline_specific.html`
   (b) `MNL_airline_socioecon.html`

(c) `MNL_airline_socioecon_mi.html`

(d) `MNL_airline_piecewise.html`

(e) `MNL_airline_powerseries.html`

(f) `MNL_airline_boxcox.html`

4. In order to verify that your code is correct, compare the results that you obtain with the ones that we provide in the description.

5. For the specific and socioeconomic specifications, perform a likelihood ratio test against the base model
(`MNL_airline_generic.ipynb`)

6. For each non-linear specification, perform a likelihood ratio test against the base model (`MNL_airline_specific.ipynb`)

7. Can you use a likelihood ratio test to decide between models with different non-linearities?

Create and analyze
Chose one of the above models as a base and develop new model specifications using your own hypotheses. We suggest the following:

1. Include characteristics of the decision makers.

2. Include interactions of attributes of the alternatives with the characteristics of the individuals.

Then,

1. Explain what each of your proposed specifications captures: what are the underlying hypotheses that you want to test through each specification?

2. Estimate the models you developed and interpret the obtained results: comment on the signs of the parameters. Are the results according to your expectations?

---

jp/th/rk/no/mpp/mw