EPFL
ENAC TRANSP-OR
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Mathematical Modeling of Behavior
Fall 2018

Analysis of mode choice behavior in low density areas of Switzerland

Project Description

1 Aim and content

The goal of this assignment is to develop a discrete choice model for analyzing the *mode* choice behavior of people living in low density areas of Switzerland. The objective of your project is to specify and estimate the "best" model that you can, by testing **different model specifications**, and use it to:

1. **Forecast the changes in demand** in response to:
   (a) an increase in car cost by 10% (imitating an increase in fuel taxes), and
   (b) a decrease in public transport cost by 10% (imitating a provision of subsidies).
2. **Determine the price modification** that would incur an increase of 5% of the revenue of public transport from the ticket sales.

The description of the case study and the explanation of the data is provided in the file `OptimaDescription.pdf` (under "Mode choice in Switzerland" in `http://transp-or.epfl.ch/discretechoice/data.html`). The dataset can be found in the `optimaDataset_XX.dat`[1] file (under the "Graded assignment" section in the Laboratories tab of the website).

2 Grade

10 points will be distributed among the tasks described in Section 3 and the technical report that is outlined in Section 4.

- **8 points** for the modeling tasks, and
- **2 points** for the technical report.

3 Tasks

In order to achieve the goal of the assignment you shall perform the following tasks.

1. **Model specifications [3 points]**
   (a) Start with a simple model specification and **exclude** the observations for which the choice variable (*Choice*) is equal to -1 (representing missing values). This specification should include:

[1] Where XX is your group number.

i. alternative specific constants, and
ii. the cost and the travel time of the alternatives associated with generic parameters.

This should be your **base** model. Then, gradually develop the following models (i.e., Model 1 is constructed from the base model, Model 2 from Model 1, etc.):

(b) **Model 1:** Include alternative specific parameters.

(c) **Model 2:** Include more attributes of the alternatives that you expect to have an influence on the choice.

(d) **Model 3:** Include interactions of socioeconomic variables with the ASC and the attributes.

(e) **Model 4:** Include at least one appropriate non-linear specification for one of the variables.

(f) In each extension of the **base** specification (i.e., for each of the above-mentioned models) you shall: **[2 points]**
i. Identify the underlying assumptions and the hypothesis that you are testing.
ii. Compute the average value-of-time for car and public transport and discuss if the obtained values are reasonable or not, and why.
iii. Compare the current specification with the previous specification using statistical tests.
iv. Comment on the estimation output (e.g. if the signs of the parameters correspond to the expectations).
v. Provide a general interpretation of the obtained results.

(g) **Best model** Select your best model specification and use it for the remaining tasks. Make sure to justify your choice according to the evaluation criteria outlined in the last step of the previous task. **[1 point]**

2. **Forecast the changes in demand [3 points]**

(a) Develop and test the two scenarios described in Section 1 (an increase in car cost by 10% and a decrease in public transport cost by 10%). **[1 point]**

(b) Use the mode shares of the original scenario and compare them with the ones that you have obtained from the two policies. Which is the best policy if the goal is to decrease the share of car? **[1 point]**

(c) Compute the cost elasticity for the whole population. Then, try to identify subgroups with higher or lower cost elasticities in order to analyze the forecast. Note that as many people do not pay (owning travel cards, seasonal tickets, etc.) the aggregate cost elasticity is lower than expected. **[1 point]**

3. **Determine the price [2 points]**

(a) Test different variations of the cost of public transportation with respect to its current price. **[1 point]**

(b) Determine the price that would result in the desired increase of revenue (an increase of 5%, as described in Section 1). **[1 point]**

4 Check list of the technical report

Make sure that you have addressed all items of the checklist below in your project report. The quality of the report will account for the last **2 points** of your grade.

1. Short introduction with **[0.25 points]**
   (a) the context,
   (b) a brief data description,
   (c) the objective, and
   (d) the principal results and conclusions.
2. Model specifications and estimation results including: **[0.75 points]**
   (a) a specification table summarizing the model specifications that you have tested (base model and models 1-4) *must be provided as an Appendix* (for more details on specification tables, take a look at Table 4.1 on page 157 of the textbook),
   (b) a table presenting the estimation results of the models and the value-of-time estimates, and
   (c) your choice of the best model, motivated by the discussion about the comparison of the model specifications that you have tested.
3. Forecasting results including: **[0.75 points]**
   (a) a presentation and analysis of the forecasting results,
   (b) an answer to the question "*Which is the best policy*?" and why, and
   (c) an answer to the question "*What is the price variation that would incur a* 5% *increase of the revenues*?" and if it is according to the expectations.
4. Conclusion with **[0.25 points]**
   (a) a short summary of the project, and
   (b) the main conclusions.

5 Technical information

- For this assignment, you will work jointly with your group.
- You will find the necessary material for the assignment on the course website, under the **Graded assignment** section of the Laboratories tab.
- All the necessary concepts to answer the problems on hand are covered during the lectures and/ or laboratory sessions.
- The results of your analysis should be documented in a report.
- Each group must submit **one** report.

- The report must be in English and **maximum 4 one-sided pages** long. The Appendix does not count in this 4 pages, it should be included at the end of the document and it should contain the table summarizing the tested model specifications (as indicated before). Please notice that a **0.25 points** penalty apply for each page exceeding the allowed 4 pages.
- **All members of the group should contribute equally in both the modeling and the writing tasks!**
- Please include the following files in a single `.zip` file named `Group_XX.zip`[2]:
  - your report as a **.pdf** file,
  - your model as a **.py** file,
  - your results as a **.html** file,

  and upload the `Group_XX.zip` file in the submission link provided in the **Project submission** section that you will find in `http://transp-or.epfl.ch/courses/dca2018/labs.php` by **December 18, 2018 at noon**.

Bon travail !

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[2]Where XX is your group number.