Forecasting

Aggregation

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Introduction to choice models

ÉCOLE POLYTECHNIQUE
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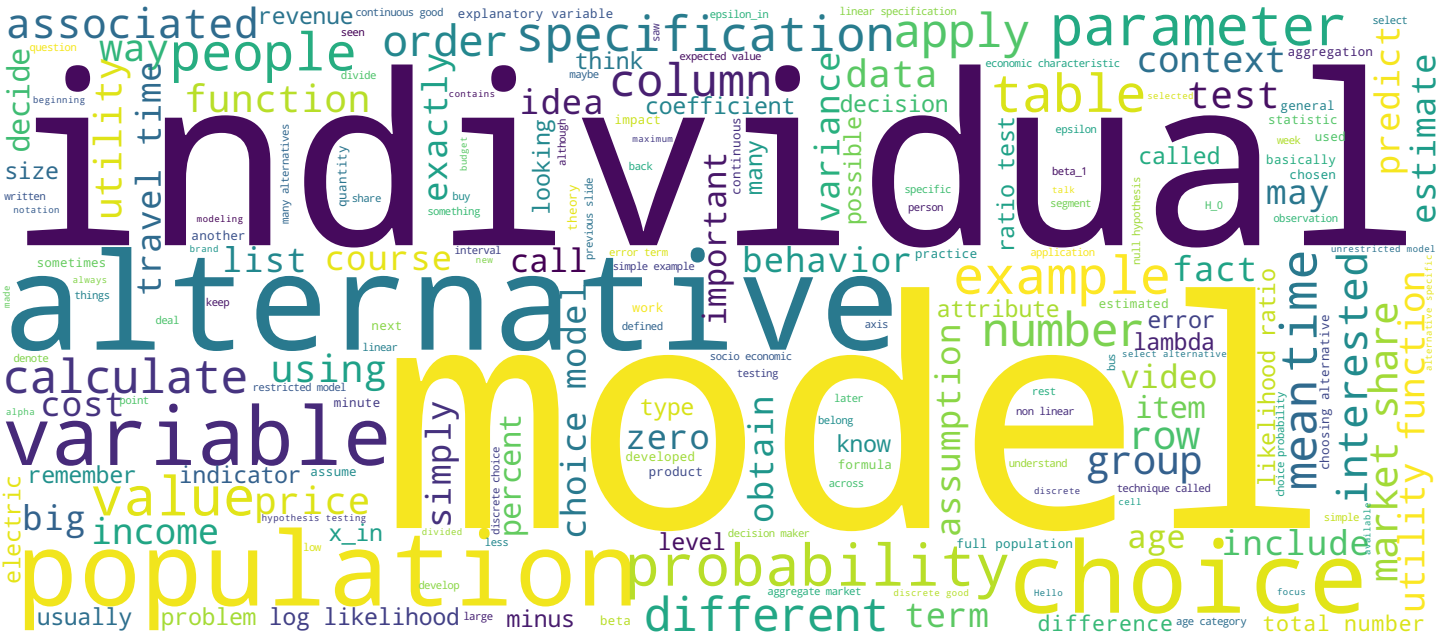

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Aggregation

Hello. So we've spent a lot of time to develop a behavioral model that predicts the choice of individuals. But why? Why are we doing this? So, in this week, we will focus on how to use this model in order to do actual predictions. And the first thing we'll do is to look at aggregation because, although we have developed models for individuals, globally we are interested in indicators that apply to the full population. And this will be the beginning of the week.

Notes

Summary

0m 04s

Motivation

- Prediction about a single individual is of little use in practice.
- Need for indicators about aggregate demand.
- Typical application: aggregate market shares.

Indeed, in practice, predicting a single individual is of little use. What we need to do is to calculate aggregate indicators that apply to the full population. And one of the typical indicators that we are interested in is the market shares, the aggregate market shares of each alternative in the population.

Notes

Summary

0m 36s

Aggregation

- Disaggregate model:

$$P_n(i|x_n;\theta)$$

- Obtain x_n for each individual n in the population.
- Question: why is $\mathcal{C}_n$ omitted?

So in terms of notations, we have developed our model which is a model predicting the probability that alternative i is chosen given the list of explanatory variables, and also some parameters that we have already estimated from data. So in order to apply this model, what we need to do is to obtain for each individual in the population the value of x_n so the list of explanatory variables, and then plug them in the model. So that we can, for each individual in the population, calculate the probability of choosing alternative i. By the way, as you may notice, the specification that I've written here does not include the choice set. If you remember, the choice set C_n may vary from one individual to the next. So why did I omit C_n? Well, you need to think about it on your side and we'll talk about it later on.

Notes

Summary

0m 58s

Aggregate market shares

Number of individuals choosing alternative i

$$N_T(i) = \sum_{n=1}^{N_T} P_n(i|x_n;\theta).$$

Share of the population choosing alternative i

$$W(i) = \frac{1}{N_T}\sum_{n=1}^{N_T} P(i|x_n;\theta) = \mathsf{E}\left[P(i|x_n;\theta)\right].$$

The indicator I'm interested in is the aggregate market shares. Basically I would like to calculate the number of individuals who choose alternative i in the population. The expected value of this number is simply given by the sum over all people in the population of the probability of choosing alternative i. In general, we are more interested in the share, not in the number. To calculate the share, we just need to divide the total number of individuals by the size of the population. So the market share of alternative i is simply the expected value of the choice probability over the population.

Notes

Summary

1m 51s

Aggregation

Population	Alternatives				Total
	1	2	⋯	J	
1	$P(1\|x_1;\theta)$	$P(2\|x_1;\theta)$	⋯	$P(J\|x_1;\theta)$	1
2	$P(1\|x_2;\theta)$	$P(2\|x_2;\theta)$	⋯	$P(J\|x_2;\theta)$	1
⋮	⋮	⋮	⋮	⋮	⋮
N	$P(1\|x_N;\theta)$	$P(2\|x_N;\theta)$	⋯	$P(J\|x_N;\theta)$	1
Total	$N(1)$	$N(2)$	⋯	$N(J)$	N

Well, in order to understand better how this works you can actually think about it as a table. Each row of this table is associated with one individual in the population. And there are N of them. So we have N rows in this table. And each column is associated with the alternatives in the choice set. And we have J such columns. For each cell of this table, we have a choice model, which predicts the probability that the corresponding individual chooses the corresponding alternative. For example, this cell calculates the probability that individual two, chooses alternative 1. And we can do this for each row and column. Now if you look at the sum of each row, well by definition, this sum is1. Because it's a probability distribution across the alternatives. So it sums up to 1. If you look at the column totals, this is exactly the formula that we developed in the previous slides. So, for example, if you look at column one the sum of all these probabilities gives you the expected total number of people who select alternative 1 in the population. And now, if you take the complete total here. Well you simply get the number of people in the population.

Notes

Summary

2m 37s

Aggregation

Population	Alternatives				Total
	1	2	$\cdots$	J	
1	$P(1\|x_1;\theta)$	$P(2\|x_1;\theta)$	$\cdots$	$P(J\|x_1;\theta)$	1
2	$P(1\|x_2;\theta)$	$P(2\|x_2;\theta)$	$\cdots$	$P(J\|x_2;\theta)$	1
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
N	$P(1\|x_N;\theta)$	$P(2\|x_N;\theta)$	$\cdots$	$P(J\|x_N;\theta)$	1
Total	$N(1)$	$N(2)$	$\cdots$	$N(J)$	N

So aggregation is about looking at this table and calculating totals over the rows. The main issue is that usually this table is really big. It has a lot of rows, because most of the time the population of interest is very big. And sometimes, it may have a lot of columns as well, when you are considering a case where there are many alternatives. And so these are the two things we will have to deal with. How do we do when the table is too big that we cannot enumerate rows and columns.

Notes

Summary

4m 06s

Large table

When the table has too many rows...

apply sample enumeration.

When the table has too many columns...

apply micro simulation.

When the table has too many rows, meaning that when the population of internet is too large, we apply a technique called "sample enumeration". When the table has too many columns, it means that when we have too many alternatives, we apply a technique called micro simulation. And we will look into these two techniques in the rest of this week.

Notes

Summary

4m 38s