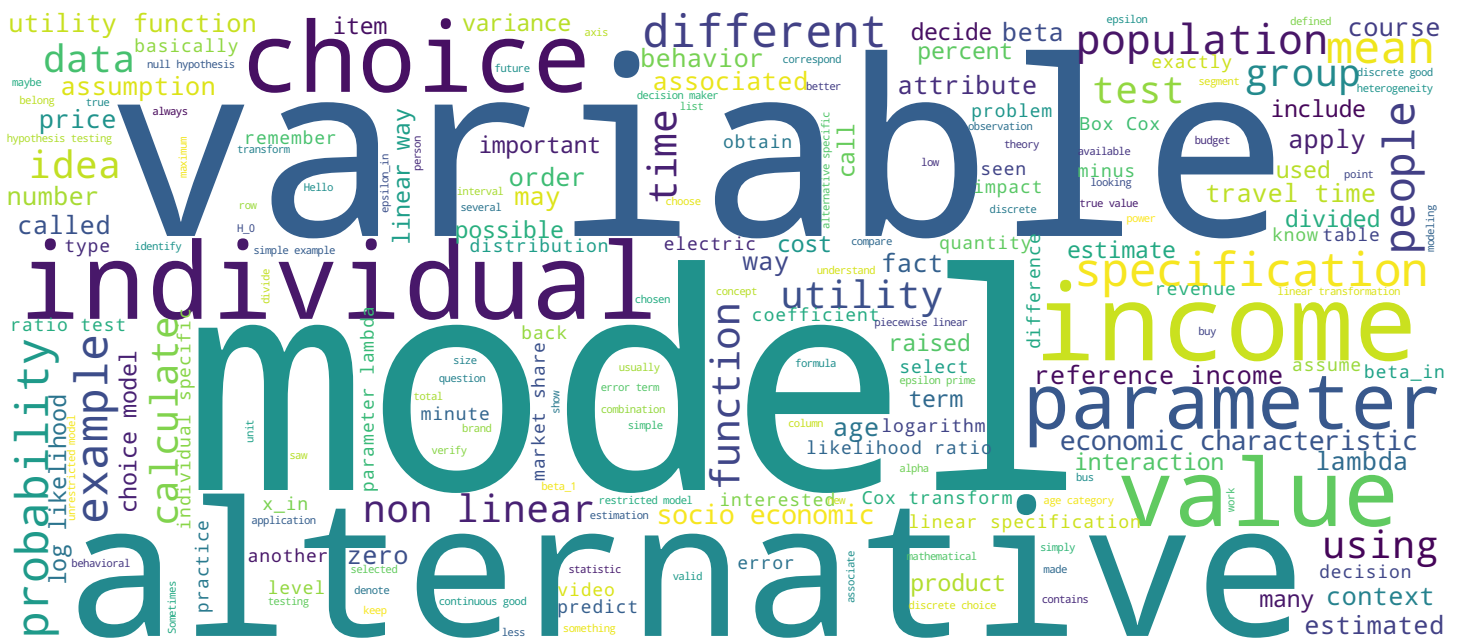


Choice with multiple alternatives

Specification of the deterministic part

Michel Bierlaire

Introduction to choice models



EPFL

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Nonlinear specifications: heterogeneity



OK. We have seen three ways to transform the variables using a non linear transformation: the logarithm, the piecewise linear specification and the Box-Cox transform. Now, we would like to go back to this idea of heterogeneity and to model the fact that the socio-economic characteristics interact with the attributes of the alternatives. And we will show that it is possible to do it in a non linear way as well. I mean, we did it already using a linear transformation, let's do it now in a non linear way.

Notes

Summary



0m 04s

Nonlinear interactions

Interaction

$$V_{in} = \beta_{in} z_{in} + \dots$$

Linear interaction

$$\beta_{in} = \beta \text{ income}_n$$

Nonlinear interaction

$$\beta_{in} = \beta \text{ income}_n^\lambda, \text{ where } \lambda = \frac{\partial \beta_{in}}{\partial \text{income}_n} \frac{\text{income}_n}{\beta_{in}}$$

So, if you remember, the idea of the interaction is that we would like the β_{in} to be individual specific. And the way we presented it before it to say, let's make β_{in} a function of one of the socio-economic characteristics. For example, we defined β_{in} equals β , a parameter to be estimated, times the income of individual n . So that people with different income will have a different parameter. But we can do it now in a non linear way, using the same idea that was used for the Box-Cox transform. We can say: let's include an additional parameter λ , and let's define now β_{in} to be equal to β , times income but raised to the power λ . And λ can be interpreted as the marginal modification of β , as a function of income. Actually, the mathematical definition of λ is the derivative of β with respect to income, which is normalized: multiplied by income, and divided by β . You can verify that this is valid. So, this extension to the interaction is a non linear extension, involving a new parameter λ , which should be estimated from data.

Notes

Summary



0m 36s

Nonlinear interactions

Remarks

- ▶ λ must be estimated
- ▶ Utility is not linear-in-parameters anymore
- ▶ Use a reference value for the socio-economic characteristic:

$$\beta_{in} = \beta \left(\frac{\text{income}_n}{\text{refIncome}} \right)^\lambda$$

- ▶ Reference value is arbitrary
- ▶ Several (continuous) characteristics can be combined:

$$\beta_{in} = \beta \left(\frac{\text{income}_n}{\text{refIncome}} \right)^{\lambda_1} \left(\frac{\text{age}_n}{\text{refAge}} \right)^{\lambda_2}$$

Some remarks associated with this specification. As I said, lambda must be estimated from data. And the utility, in this case, is not linear-in-parameters anymore. Sometimes, because you raise a value of income to a power, this generates numerical issues. Usually, it is a good idea to divide income by a reference income, like the mean income in the population, or the max income in the population. It does not matter. Select a reference value, and divide the actual value of income by this reference income. In this case, when the income of the individual n is the reference income, well the beta coefficient for this individual is actually the value of beta which is here. Now, you can be creative and combine various socio-economic characteristics into this specification. But they must be continuous. Typically, the two classical continuous socio-economic characteristics are income and age, so you can define your individual specific coefficient to be the product of a parameter beta, a term which is related to income, again divided by the reference income and raised to the lambda_1, and a third term, which is the age, divided by the reference age, and raised to a power lambda_2. And in this case, we have three parameters to estimate: beta, lambda_1 and lambda_2.

Notes

Summary



1m 53s