

Home office and mobility tool ownership: SP design and modeling ideas

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15th workshop on discrete choice models



Sample selection, endogenous choice and path analysis - three perspectives on conditional probabilities in DCM

The home office SP

English ▾

Work arrangement choice

	A	B
Co-ordinated presence	Free choice of the days	Coordinated (Monday and/or Friday)
Core hours	None	Regular working hours
Help-desk and training	Yes	No
Adjustment hourly wage	No salary adjustment	+10%
Additional costs (e.g., heating, electricity)	50% participation	No contribution
Hardware budget	No contribution	50% of the necessary expenses
Work from anywhere	Not allowed	Allowed
Desk sharing	No	Yes
Your choice:	<input checked="" type="radio"/>	<input type="radio"/>

Home office frequency choice

	0 days	1 day	2 days	3 days	4 days	5+ days
under work arrangement A	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
under work arrangement B	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

→

1. conditional probability

Conditional on being in the sampled population

- Sample population = home office population
- Question of interest: Predicting for a new individual 1. has this individual home office access 2. if so, what is the preferred home office frequency?

=> **Heckman-selection type model**

$$E[y^O | \mathbf{x}^O = \mathbf{x}_i^O, \mathbf{x}^S = \mathbf{x}_i^S, \underbrace{y^S = 1}_{\substack{\text{1. conditional probability}}}] = \beta^{O'} \mathbf{x}_i^O + \underbrace{E[\varepsilon^O | \varepsilon^S \geq -\beta^{S'} \mathbf{x}_i^S]}_{\substack{\text{biased results if } \rho \neq 0, \varrho \neq 0}}$$

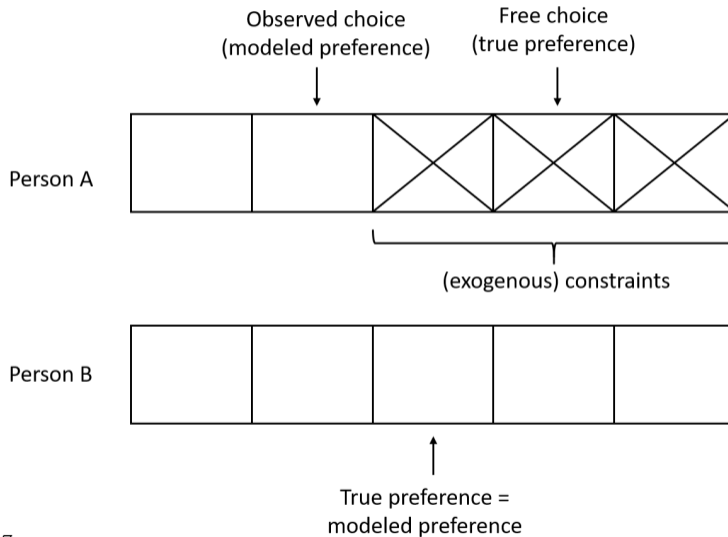
$$\begin{pmatrix} \varepsilon^S \\ \varepsilon^O \end{pmatrix} \sim N \left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \varrho \\ \varrho & \sigma^2 \end{pmatrix} \right)$$

- Usually assumed that errors follow bivariate normal distribution.

=> ε^O is logistically distributed!

2. conditional probability

Conditional on considering the alternative



Manski's theoretical framework

$$P_n(i) = \sum_{C_m \subseteq C} P_n(i | \underbrace{C_m}_{\text{2. conditional probability}}) P_n(C_m)$$

- The sum runs on every possible subset C_m of the universal choice set C
 - Usually a high combinatorial problem
- => Home Office choice set $|C| = 6$: $\{0\}, \{0, 1\}, \dots, \{0, \dots, 5\}$
- Or is it realistic to have $C_m = \{1, 5\}$?
- Latent home office feasibility (among others) determines $P_n(C_m)$

Alternative perspective: Latent class model with $S = 5$ classes, each class s having a deterministic choice set C_s (and no class-specific parameters). $P_n(C_m)$ is the class-allocation model.

3. conditional probability

The mobility tool ownership SP

Experiment 1

Please choose your preferred **bundle** of mobility tools based on the **home office situation** presented below.

For your information:

- The home office situation applies to all your subsequent choices on this page.
- Do not deselect a mobility tool simply because you do not like any of the three proposed alternatives.

Home office situation

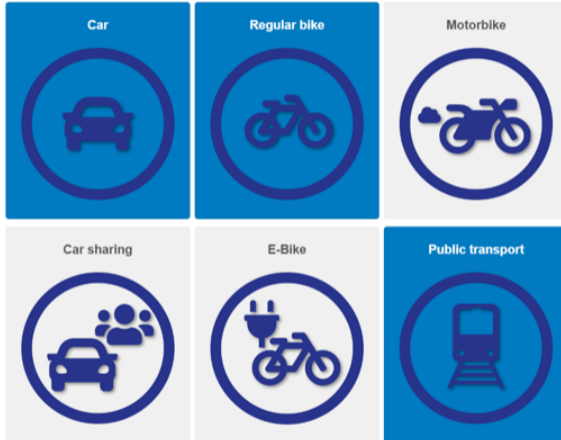
Number of days you work from home

2 days

Work from anywhere

allowed

Mobility tool ownership choice



Choice of preferred alternative

Only if car and/or car sharing and/or public transport has been selected



	A	B	C
Car type	Luxury or sports car	Small car	Medium to large car
Fuel type	Electric	Diesel	Diesel
Fixed cost (annual)	22443 CHF/a	3803 CHF/a	5855 CHF/a
Per km cost	1.23 CHF/km	0.82 CHF/km	1.25 CHF/km
Your choice:	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>



	A	B	C
Subscription type	Regional season ticket	Regional season ticket	HT
Class	2	1	
Fixed cost (annual)	547 CHF/a	931 CHF/a	240 CHF/a
Cost for additional zone	28 CHF/Zone	88 CHF/Zone	
Your choice:	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

Conditional on having made a previous choice

Category => alternative

- **Heckman perspective:**

- Multivariate probit as selection model
- Car SP is only observed if car category has been selected

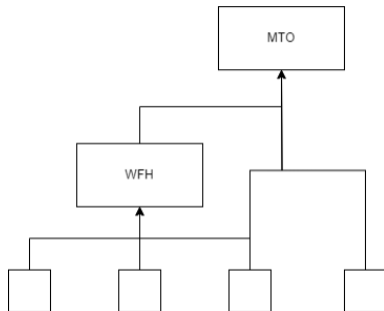
- **Manski perspective:**

$$P_n(\mathbf{y}) = \sum_{C_m \subseteq C} P_n(\mathbf{y}|C_m)P_n(C_m)$$

- We make a simultaneous choice of mobility tools \mathbf{y} but the available choice set is probabilistic
- $P_n(\mathbf{y}|C_m)$ should account for substitution patterns: E.g., e-bike and regional season card

=> Very related!

WFH => MTO



- $P(mto|\mathbf{x} = \mathbf{x}_i, wfh = wfh_i)$
 - Path analysis: endogenous predictors
 - If errors $\varepsilon_{wfh}, \varepsilon_{mto}$ are correlated then the log likelihood contains joint probability
- => What if errors do not follow the same distribution? Mixture distribution

Conclusion

- Structural choice modeling
- Multiple endogenous variables (sample selection, choice set formation, previous choice) with a "path" between them (condition)
- Does the choice activate a subsequent choice? => Heckman-type selection
- Does the choice influence the subsequent choice? => Path analysis (SEM)
- Error distributions (same, different)? Errors correlated? => Joint (mixture) distributions

Questions?



Swiss New Normal

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