Choice with multiple alternatives – 5.3 An example: mode choice in Switzerland

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Descriptionof the data.

This example deals with the estimation of a mode choice behavior model for inhabitants in Switzerland using revealed preference data. The survey was conducted between 2009 and 2010 for CarPostal, the public transport branch of the Swiss Postal Service. The main purpose of this survey is to collect data for analyzing the travel behavior of people in low-density areas, where CarPostal typically serves. A following study proposes new public transport alternatives according to the respondents' willingness to pay for these potential services in order to increase the market share of public transport.

Data collection

The survey covers French and German speaking areas of Switzerland. Questionnaires were sent to people living in rural area by mail. The respondents were asked to register all the trips performed during a specified day. The collected information consists of origin, destination, cost, travel time, chosen mode and activity at the destination. Moreover, we collected socio-economic information about the respondents and their households.

1124 completed surveys were collected. For each respondent, cyclic sequences of trips (starting and ending at the same location) are detected and their main transport mode is identified. The resulting data base includes 1906 sequences of trips linked with psychometric indicators and socio-economic attributes of the respondents. It should be noticed that each observation is a sequence of trips that starts and ends at home. A respondent may have several sequences of trips in a day.

Variables and descriptive statistics

The variables are described in Tables 1, 2, 3, 4 and 5. The attitudinal statements are written in Tables 6 and 7. A summary of descriptive statistics for the main variables is given in Table 8.

Given the presence of missing data (coded as -1) an additional table summarizing the three main affected variables (TripPurpose, ReportedDuration, age) after removing the missing cases is presented (see Table 9).

We refer the reader to Atasoy et al. (2013) for an analysis based on this data set.

References

Atasoy, B., Glerum, A. and Bierlaire, M. (2013). Attitudes towards mode choice in switzerland, *disP - The Planning Review* **49**(2): 101–117.

Table 1: Description of variables

Name	**Description**
ID	Identifier of the respondent who described the trips in the loop.
NbTransf	The total number of transfers performed for all trips of the loop, using public transport (ranging from 1-9).
TimePT	The duration of the loop performed in public transport (in minutes).
WalkingTimePT	The total walking time in a loop performed in public transports (in minutes).
WaitingTimePT	The total waiting time in a loop performed in public transports (in minutes).
TimeCar	The total duration of a loop made using the car (in minutes).
CostPT	Cost for public transports (full cost to perform the loop).
MarginalCostPT	The total cost of a loop performed in public transports, taking into account the ownership of a seasonal ticket by the respondent. If the respondent has a "GA" (full Swiss season ticket), a seasonal ticket for the line or the area, this variable takes value zero. If the respondent has a half-fare travel card, this variable corresponds to half the cost of the trip by public transport..
CostCarCHF	The total gas cost of a loop performed with the car in CHF.
CostCar	The total gas cost of a loop performed with the car in euros.
TripPurpose	The main purpose of the loop: 1 =Work-related trips; 2 =Work- and leisure-related trips; 3 =Leisure related trips. -1 represents missing values
TypeCommune	The commune type, based on the Swiss Federal Statistical Office 1 =Centers; 2 =Suburban communes; 3 =High-income communes; 4 =Peri-urban communes; 5 =Touristic communes; 6 =Industrial and tertiary communes; 7 =Rural and commuting communes; 8 =Agricultural and mixed communes; 9 =Agricultural communes
UrbRur	Binary variable, where: 1 =Rural; 2 =Urban.
ClassifCodeLine	Classification of the type of bus lines of the commune: 1 =Center; 2 =Centripetal; 3 =Peripheral; 4 =Rabattement.

Table 2: Description of variables

Name	**Description**
frequency	Categorical variable for the frequency: 1 =Low frequency, $<$ 12 pairs of trips per day; 2 =Low-middle frequency, 13 - 20 pairs of trips per day; 3 =Middle-high frequency, 21-30 pairs of trips per day; 4 =High frequency, $>$ 30 pairs of trips per day.
NbTrajects	Number of trips in the loop
Region OR Coderegion-CAR	Region where the commune of the respondent is situated. These regions are denoted by CarPostal as follows: 1 =Vaud; 2 =Valais; 3 =Delemont; 4 =Bern; 5 =Basel, Aargau, Olten; 6 =Zurich; 7 =Eastern Switzerland; 8 =Graubunden.
distance_km	Total distance performed for the loop.
Choice	Choice variable: 0 = public transports (train, bus, tram, etc.); 1 = private modes (car, motorbike, etc.); 2 = soft modes (bike, walk, etc.).
InVehicleTime	Time spent in (on-board) the transport modes only (discarding walking time and waiting time), -1 if missing value.
ReportedDuration	Time spent for the whole loop, as reported by the respondent. -1 represents missing values
LangCode	Language of the commune where the survey was conducted: 1 =French; 2 =German.
age	Age of the respondent (in years) -1 represents missing values.
DestAct	The main activity at destination: 1 is work, 2 is professional trip, 3 is studying, 4 is shopping, 5 is activity at home, 6 is eating/drinking, 7 is personal business, 8 is driving someone, 9 is cultural activity or sport, 10 is going out (with friends, restaurant, cinema, theater), 11 is other and -1 is missing value.
FreqTripHouseh	Frequency of trips related to the household (drive someone, like kids, or shopping), 1 is never, 2 is several times a day, 3 is several times a week, 4 is occasionally, -1 is for missing data and -2 if respondent didn't answer to any opinion questions.

Table 3: Description of variables

Name	**Description**
ModeToSchool	Most often mode used by the respondent to go to school as a kid (> 10), 1 is car (passenger), 2 is train, 3 is public transport, 4 is walking, 5 is biking, 6 is motorbike, 7 is other, 8 is multiple modes, -1 is for missing data and -2 if respondent didn't answer to any opinion questions.
ResidChild	Main place of residence as a kid (< 18), 1 is city center (large town), 2 is city center (small town), 3 is suburbs, 4 is suburban town, 5 is country side (village), 6 is countryside (isolated), -1 is for missing data and -2 if respondent didn't answer to any opinion questions.
FreqCarPar	Frequency of the usage of car by the respondent's parents (or adults in charge) during childhood (< 18), 1 is never, 2 is occasionally, 3 is regularly, 4 is exclusively, -1 is for missing data and -2 if respondent didn't answer to any opinion questions.
FreqTrainPar	Frequency of the usage of train by the respondent's parents (or adults in charge) during childhood (< 18), 1 is never, 2 is occasionally, 3 is regularly, 4 is exclusively, -1 is for missing data and -2 if respondent didn't answer to any opinion questions.
FreqOthPar	Frequency of the usage of tram, bus and other public transport (not train) by the respondent's parents (or adults in charge) during childhood (< 18), 1 is never, 2 is occasionally, 3 is regularly, 4 is exclusively , -1 is for missing data and -2 if respondent didn't answer to any opinion questions.
NbHousehold	Number of persons in the household. -1 for missing value.
NbChild	Number of kids (< 15) in the household. -1 for missing value.
NbCar	Number of cars in the household.-1 for missing value.
NbMoto	Number of motorbikes in the household. -1 for missing value.
NbBicy	Number of bikes in the household. -1 for missing value.
NbBicyChild	Number of bikes for kids in the household. -1 for missing value.

Table 4: Description of variables

Name	**Description**
NbComp	Number of computers in the household. -1 for missing value.
NbTV	Number of TVs in the household. -1 for missing value.
Internet	Internet connection, 1 is yes, 2 is no. -1 for missing value.
NewsPaperSubs	Newspaper subscription, 1 is yes, 2 is no. -1 for missing value.
NbCellPhones	Number of cell phones in the household (total). -1 for missing value.
NbSmartPhone	Number of smartphones in the household (total). -1 for missing value.
HouseType	House type, 1 is individual house (or terraced house), 2 is apartment (and other types of multi-family residential), 3 is independent room (subletting). -1 for missing value.
OwnHouse	Do you own the place where you are living? 1 is yes, 2 is no. -1 for missing value.
NbRoomsHouse	Number of rooms is your house. -1 for missing value.
YearsInHouse	Number of years spent in the current house. -1 for missing value.
Income	Net monthly income of the household in CHF. 1 is less than 2500, 2 is from 2501 to 4000, 3 is from 4001 to 6000, 4 is from 6001 to 8000, 5 is from 8001 to 10'000 and 6 is more than 10'001. -1 for missing value.
Gender	Gender of the respondent, 1 is man, 2 is woman. -1 for missing value.
BirthYear	Year of birth of the respondent. -1 for missing value.
Mothertongue	Mothertongue. 1 for German or Swiss German, 2 for French, 3 for other, -1 for missing value.
FamilSitu	Familiar situation: 1 is single, 2 is in a couple without children, 3 is in a couple with children, 4 is single with your own children, 5 is in a co-location, 6 is with your parents and 7 is for other situations. -1 for missing values.
OccupStat	What is you occupational status? 1 is for full-time paid professional activity, 2 for partial-time paid professional activity, 3 for searching a job, 4 for occasional employment, 5 for no paid job, 6 for homemaker, 7 for invalidity leave, 8 for student and 9 for retired. -1 for missing values.
SocioProfCat	To which of the following socio-professional categories do you belong? 1 is for top managers, 2 for intellectual professions, 3 for freelancers, 4 for intermediate professions, 5 for artisans and salespersons, 6 for employees, 7 for workers and 8 for others. -1 for missing values.

Table 5: Description of variables

Name	**Description**
Education	Highest education achieved. As mentioned by Wikipedia in English: "The education system in Switzerland is very diverse, because the constitution of Switzerland delegates the authority for the school system mainly to the cantons. The Swiss constitution sets the foundations, namely that primary school is obligatory for every child and is free in public schools and that the confederation can run or support universities." (source: Wikipedia, accessed April 16, 2013). It is thus difficult to translate the survey that was originally in French and German. The possible answers in the survey are: 1. Unfinished compulsory education: education is compulsory in Switzerland but pupils may finish it at the legal age without succeeding the final exam. 2. Compulsory education with diploma 3. Vocational education: a three or four-year period of training both in a company and following theoretical courses. Ends with a diploma called "Certificat fédéral de capacité" (i.e., "professional baccalaureate"). 4. A 3-year generalist school giving access to teaching school, nursing schools, social work school, universities of applied sciences or vocational education (sometime in less than the normal number of years). It does not give access to universities in Switzerland 5. High school: ends with the general baccalaureate exam. The general baccalaureate gives access automatically to universities. 6. Universities of applied sciences, teaching schools, nursing schools, social work schools: ends with a Bachelor and sometimes a Master, mostly focus on vocational training 7. Universities and institutes of technology: ends with an academic Bachelor and in most cases an academic Master 8. PhD thesis
HalfFareST	Is equal to 1 if the respondent has a half-fare travel card and to 2 if not.
LineRelST	Is equal to 1 if the respondent has a line-related season ticket and 2 if not.
GenAbST	Is equal to 1 if the respondent has a GA (full Swiss season ticket) and 2 if not.
AreaRelST	Is equal to 1 if the respondent has an area-related season ticket and 2 if not.
OtherST	Is equal to 1 if the respondent has a season ticket that was is not in the list and 2 if not.
CarAvail	Represents the availability of a car for the respondent: 1 is always, 2 is sometime, 3 is never. -1 for missing value.

Table 6: Attitude questions. Coding: 1= strongly disagree, 2=disagree, 3=neutral, 4= agree, 5= strongly agree, 6=not applicable, -1= missing value, -2= all answers to attitude questions missing

Name	**Description**
Envir01	Fuel price should be increased to reduce congestion and air pollution.
Envir02	More public transportation is needed, even if taxes are set to pay the additional costs.
Envir03	Ecology disadvantages minorities and small businesses.
Envir04	People and employment are more important than the environment.
Envir05	I am concerned about global warming.
Envir06	Actions and decision making are needed to limit greenhouse gas emissions.
Mobil01	My trip is a useful transition between home and work.
Mobil02	The trip I must do interferes with other things I would like to do.
Mobil03	I use the time of my trip in a productive way.
Mobil04	Being stuck in traffic bores me.
Mobil05	I reconsider frequently my mode choice.
Mobil06	I use my current mean of transport mode because I have no alternative.
Mobil07	In general, for my activities, I always have a usual mean of transport.
Mobil08	I do not feel comfortable when I travel close to people I do not know.
Mobil09	Taking the bus helps making the city more comfortable and welcoming.
Mobil10	It is difficult to take the public transport when I travel with my children.
Mobil11	It is difficult to take the public transport when I carry bags or luggage.
Mobil12	It is very important to have a beautiful car.
Mobil13	With my car I can go wherever and whenever.
Mobil14	When I take the car I know I will be on time.
Mobil15	I do not like looking for a parking place.
Mobil16	I do not like changing the mean of transport when I am traveling.
Mobil17	If I use public transportation I have to cancel certain activities I would have done if I had taken the car.
Mobil18	CarPostal bus schedules are sometimes difficult to understand.
Mobil19	I know very well which bus/train I have to take to go where I want to.
Mobil20	I know by heart the schedules of the public transports I regularly use

Table 7: Attitude questions. Coding: 1= strongly disagree, 2=disagree, 3=neutral, 4= agree, 5= strongly agree, 6=not applicable, -1= missing value, -2= all answers to attitude questions missing.

Name	**Description**
Mobil21	I can rely on my family to drive me if needed
Mobil22	When I am in a town I don't know I feel strongly disoriented
Mobil23	I use the internet to check the schedules and the departure times of buses and trains.
Mobil24	I have always used public transports all my life
Mobil25	When I was young my parents took me to all my activities
Mobil26	I know some drivers of the public transports that I use
Mobil27	I think it is important to have the option to talk to the drivers of public transports.
ResidCh01	I like living in a neighborhood where a lot of things happen.
ResidCh02	The accessibility and mobility conditions are important for the choice of housing.
ResidCh03	Most of my friends live in the same region I live in.
ResidCh04	I would like to have access to more services or activities.
ResidCh05	I would like to live in the city center of a big city.
ResidCh06	I would like to live in a town situated in the outskirts of a city.
ResidCh07	I would like to live in the countryside.
LifSty01	I always choose the best products regardless of price.
LifSty02	I always try to find the cheapest alternative.
LifSty03	I can ask for services in my neighborhood without problems.
LifSty04	I would like to spend more time with my family and friends.
LifSty05	Sometimes I would like to take a day off .
LifSty06	I can recognize the social status of other travelers by looking at their cars.
LifSty07	The pleasure of having something beautiful consists in showing it.
LifSty08	For me the car is only a practical way to move.
LifSty09	I would like to spend more time working.
LifSty10	I do not like to be in the same place for too long.
LifSty11	I always plan my activities well in advance
LifSty12	I like to experiment new or different situations
LifSty13	I am not afraid of unknown people
LifSty14	My schedule is rather regular.

Table 8: Descriptive statistics of the main variables (no data excluded)

	nbr. cases	nbr. null	min	max	median	mean	std.dev
age	1906	0	-1	88	47	46.48	18.57
Choice	1906	536	0	2	1	0.78	0.54
TypeCommune	1906	0	1	9	6	5.39	1.99
UrbRur	1906	0	1	2	2	1.51	0.5
ClassifCodeLine	1906	0	1	4	4	3.17	0.97
LangCode	1906	0	1	2	2	1.74	0.44
CoderegionCAR	1906	0	1	8	5	4.58	2.08
CostCarCHF	1906	5	0	67.65	2.98	5.76	8.34
distance_km	1906	1	0	519	18.75	40.38	62.6
TimeCar	1906	28	0	494	26	40.68	47.61
TimePT	1906	7	0	745	85	107.88	86.52
frequency	1906	0	1	4	3	2.84	1.09
ID	1906	0	10350017	96040538	44690042	45878800	23846908
InVehicleTime	1906	66	-128	631	40.5	55.13	57.78
MarginalCostPT	1906	270	0	230	5.6	11.11	16.13
NbTrajects	1906	0	1	9	2	2.04	1.05
NbTransf	1906	644	0	14	2	2.01	2.17
Region	1906	0	1	8	5	4.58	2.08
ReportedDuration	1906	3	-1	855	35	57.73	72.47
TripPurpose	1906	0	-1	3	2	1.94	1.18
WaitingTimePT	1906	693	0	392	5	13.13	22.07
WalkingTimePT	1906	17	0	213	33	39.63	28

Table 9: Descriptive statistics of the main variables affected by missing data (observations with -1 excluded)

	nbr. cases	nbr.null	min	max	median	mean	std.dev
age	1791	0	16	88	48	49.53	14.59
ReportedDuration	1835	3	0	855	37	60	72.92
TripPurpose	1783	0	1	3	3	2.14	0.92