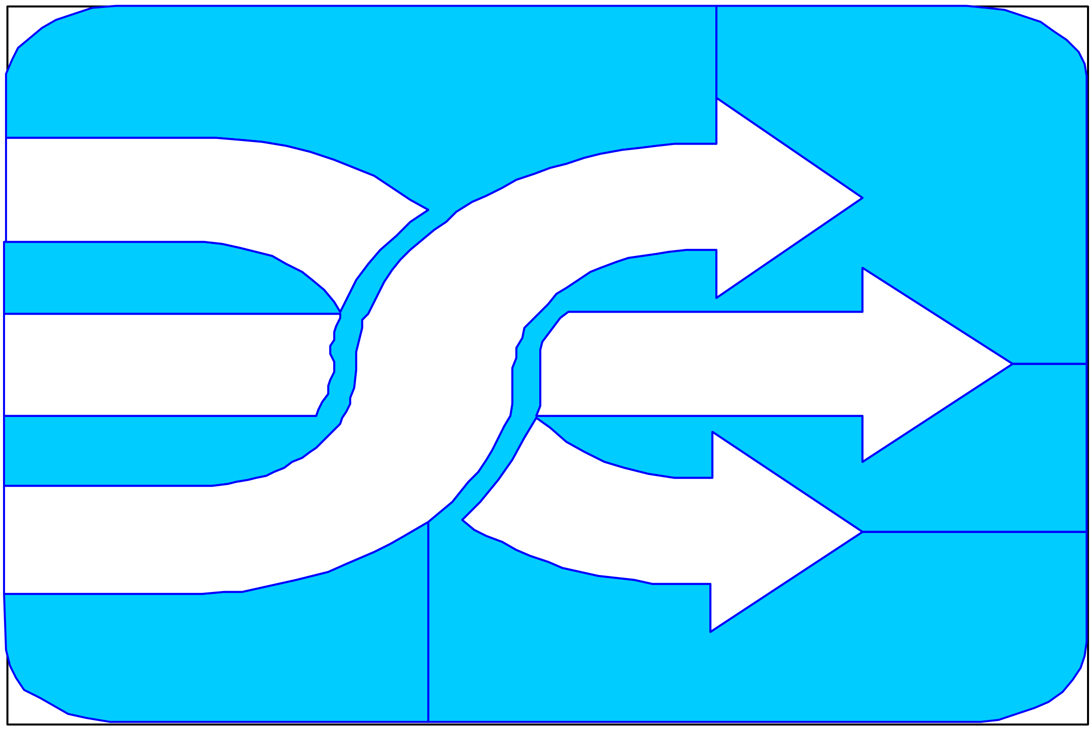

Activity analysis and transportation planning: actual improvement or further complication?

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Abstract

In recent times, the connection between activities - mainly work, education, shopping, recreation - and travel has been advocated with growing insistence in the analysis of urban travel demand. It is also believed that formulating the relationships between them will invigorate the travel demand models, improving by that their forecasting capacity. This trend is transferring to the professional practice what has been mainly a research perspective.

Implementation by the planning agency has long been hampered by increased data requirements and lack of adequate standard software. As to this latter difficulty, the situation is changing, as a handful of suppliers have been able to impose their presence on this rapidly growing market. One in particular, PTV system GmbH with the product VISEM, has met with considerable success in Germany and Switzerland.

The present study intends to submit to a test two of the principal assumptions of the methodology proposed by this software. A first problem concerns the destination chosen by a traveler. It is maintained that the alternatives considered in this choice differ according to whether the move represents a single displacement or is integrated into an activity chain. A second hypothesis relates to the modal choice. Also in this case, a reference is made to activity analysis when stating that the set of means at disposal for carrying out a trip is conditioned by the choice made at a preceding move. It is maintained by the developers of application that the validity of these two hypotheses would increase the level of precision of the projections. However, at the same time the complexity of the calculations is greatly magnified.

Data from the microcensus on mobility for Switzerland of 1994 have been used in order to carry out a verification, and several loglinear/logit estimations have been considered. The first evidence produced by this analysis does not dispel all doubts about the validity of the improvements postulated by this program. Although the reliability of some hypotheses may not be questioned , it remains to be proven that, at a planning level, the intricacy of the calculation is a prerequisite to generate better forecasts.

Keywords

Travel demand – Activity analysis – Software

1. Introduction

Activity analysis has been gaining increasing acceptance among scholars in the transportation field. Advances are indisputable in the comprehension of the problems related to trip chaining, multi-day travel patterns, and interpersonal interaction, to cite only those where results have been more considerable[1]. However, the translations of these substantial results into directions and methods applicable to planning and policy problems are by far less numerous than those proposed by standard disaggregate choice analysis centered on the multinomial logit model[2].

Although if only few in number, planning instruments have, however, been proposed: one of them is VISEM[3], a software developed by PTV VISION, Karlsruhe, Germany. This package has gained wide acceptance in Europe, especially in the German speaking area, Switzerland included. The user adressed is the planning agency more than the academical scholar.

VISEM represents a module of software in a multi-purpose set of applications. It is aimed at the development of projections in the area of travel demand, along the traditional components of the analysis: trip generation, trip distribution, and mode choice. The standard result of the whole process is a matrix of flows, to be subsequently used in network modelling.

What seems particularly intriguing here is that the solution envisaged and the methodology proposed is quite complicated and requiring a lot of data. Its starting point is a series of activity chains from which a number of chains of trips is derived, which give rise in their turn to the evaluation of the different components of demand. The reference to activity analysis is evident but the incorporation of its results is carried out in a rather mechanical way and these same results seem to be used more for devising classificatory schemes than for exploiting them for an adaptation to the models. Neither is an increased precision in the results automatically warrented, considering the intricated calculations proposed.

[1] For an overview, see among others: Kitamura, 1988; Jones et al., 1990; Axhausen and Gärlig, 1992; Ettema and Timmermans, 1997. Also: Axhausen and Herz, 1989, cited in Haupt et al., 1996 (see note 3).

[2] The reasons for the conditions prevailing in this area of research are disussed in Kitamura, op.cit.

[3] For a synthetical and clear presentation of the methodology, see Haupt et al., 1996

In view of the widespread use of this kind of software, it seemed interesting to subject to a critical examination the principal contentions on which it is based. Two alternatives are open.

- An empirical validation of the main hypotheses on the basis of an adequate model. In this case one has to devise an appropriate specification, consenting to carry out a number of pertinent tests.
- An alternative would be to carry out a planning exercise and to successively critically assess the results obtained.

An analysis proceeding along the first alternative will be carried out, as a planning experiment would imply an effort disproportioned to the results prospected in the present study. Only a summary examination will be carried out, making use of secondary statistical sources. On the subject of transportation, the Swiss Federal Statistical Office (SFSO) carries out periodical inquiries among the population focussing on the peculiarities of their mobility behaviour. These supply one with sufficient information to carry out preliminary surveys of the most different kinds. In this instance, it offers also the opportunity to resort to the same statistical bases a planner without particular financial endowments would necessarily be confronted with.

In section 2 I present how the tests can be devised according to the methodology which will be used. In the following section the results of the different adjustments will be commented upon. Section 4 summarizes the main results obtained.

2. The problem: is the evaluation of the individual stops in the chain necessary?

The philosophy of VISEM may be synthetized in a few statements. Its basic principle is directly connected to activity analysis. It states that the movements of a traveller imply a series of decisions, which in this case – and here is the peculiarity of the method – are formulated in a hierarchical order. So, each of them is conditioned by those preceding it.

As a consequence, if a transfer consenting the performance of an activity, say, work, is preceded by an other activity, say, shopping, the former's prediction should be carried out in two steps instead of one. First, one takes into account all distinctive features of the first stop and, successively, one evaluates going out from this first destination the opportunities existing in order to best reach the journey's end. Certainly, the characterization of the rationale underlying this methodology is expressed here in rather crude terms, as some finishing touch is brought in to this construct. But its implementation goes clearly along these lines.

What seems objectionable here is not the principle per se as its implementation. Apart from the question whether the relationship is hierarchical, what is implied here is that the decisions are not considered simultaneously, only their order is determined. In clear: when one makes a detour the decisions are not made before leaving home but at the end of each move, before carrying out the next step.

With regards to this application, I am examining two main choices: that of the destination and that of the means of transportation. In formal terms[4] the hypothesis may be stated in terms of probabilities in the following way:

$$p_{ij} \neq \prod_{h \in H} p^{H}{}_{ih} \, p^{H}{}_{hj}$$

p_{ij} is the probability for the choice of a destination j, from a given origin i, evaluated directly from i to j. p^H are probabilities calculated along the path H from i to j. i,h,and j are indices for the nodes, representing the origins or destinations according to the context.

[4] In Appendix A I give a more detailed presentation of the methodology used by this application.

Analogously, one has:

$$p_m^{ij} \neq \prod_{h\in H}\prod_{n\in N} p_n^{H,ih}\, p_m^{H,hj}$$

for the choice of the means, where m and n are for their indexation.

This provides the advantage of considering every single movement which, by restricting the attention to the main activity, would otherwise be neglected. The price to pay for this is a sensible increase in the complexity of the analysis. The number of connexions grows exponentially as the number of stops in the chain increases. On the other side, the question may be raised concerning the precision of the final results of these predictions if the number of trips is calculated in such a long succession of steps. This problem is subject to an examination here.

Let's consider the first case, that of the choice of destination. The hypothesis to be verified is: the destination chosen by a person in order to carry out an activity of primary importance, along a chain of moves beginning at home and ending at home, should differ significantly if he/she moves directly to the place where this activity is performed or, instead, if he/she performs preliminarily moves to another place for one or more alternative activities.

As to the second choice, that of the mode. Take somebody living in i who has decided to work in j. His choice could be significantly different if every day he decides to insert an additional stop to do his shopping instead of going directly to work.

Here, my intention is to verify if these two statements conform with the reality a planner may be confronted with every day. In principle, this verification should be carried out with a model which ideally puts the traveller into the context he finds himself or herself when making the decisions. The incisiveness of the factors conditioning the choice of destination and mode should be compared in order to identify possible divergences.

However, outside the fortunate case of being charged of a specific investigation to this very purpose, the data usually at one's disposal will not consent to envisage such an accurate assessment. This is my case here and the analysis will have to stay at a more general level. Moreover, as I didn't dispose of direct information about the cost of the journey and the reconstruction of the characteristics of the alternatives not beeing chosen would have caused an unjustified burden in this context, there represents further reasons for looking for a methodology kept at an unsophisticated level.

I consider the methododology related to loglinear models as adequate for the testing of hypotheses of a general nature as those in the present context. It has been developed out of the necessity of assessing the relations existing between categorical variables used to classify data in multinomial contingency tables. It offers one the possibility of deriving a kind of logit multinomial specifications which seem to be very useful in the present case.

For the sake of examplification let's restrict the analysis to the relations existing between three variables in a table - for instance mode used, activity chosen, and distance travelled – the general (saturated) model would be[5]:

$$\log\{P(Y_1=i,Y_2=h,Y_3=k)\}=u_0+u_1(Y_1=i)+u_2(Y_2=h)+u_3(Y_3=k)+u_{12}(Y_1=i)(Y_2=h)$$
$$+u_{13}(Y_1=i)(Y_3=k)+u_{23}(Y_2=h)(Y_3=k)+u_{123}(Y_1=i)(Y_2=h)(Y_3=k)$$

Each variable has binary codification. Considering now the conditional probability of one of the variables – Y_1, the mode used – and taking the other two as fixed, one comes to the multinomial logit specification:

$$\log\frac{P(Y_1=i\,|\,Y_2,Y_3)}{P(Y_1=j\,|\,Y_2,Y_3)}=w_0+w_2Y_2+w_3Y_3+w_{23}Y_2Y_3$$

This is a model with two explanatory variables. Of course, in the present context I will consider more variables, one of them referring to the kind of transfer chosen, direct or indirect.

Before going on ahead, it has to be stressed that these are not specifications of structural equations but a kind of analysis of variance for categorical variables. In such a case, relationships may well be assessed but obviously not explained. However, the latter is not my intention here.

The interpretation of the parameters goes as follows[6]. Suppose Y_1=1 if train is chosen and Y_1=0 when car is chosen. Further, Y_2=1 if work is the motive of the move and Y_2=0 if, instead, shopping is such a motive. Still further, suppose that, as calculated by the model, $\exp(w_2)$=2. In this case, 2 is the ratio between choosing train in place of car in the case of shopping, against doing that choice when going to work. The interpretation of interaction terms is a bit more complicated and will be postponed to the next section, when presenting the estimation of the parameters.

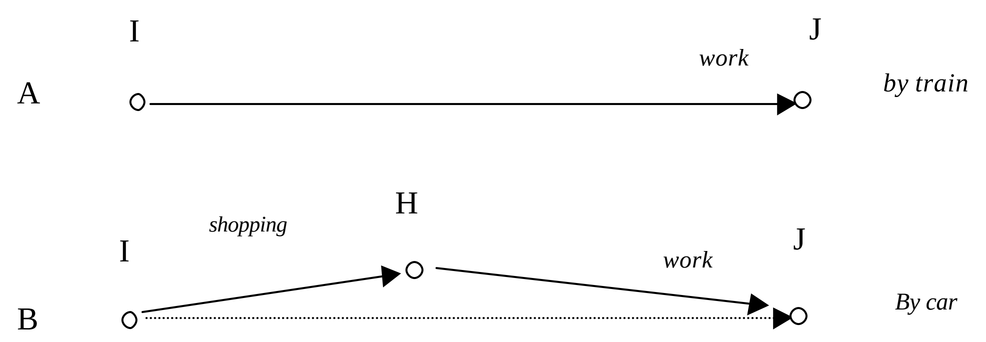
[5] The formulation follows Maddala, 1993. For a general exposition of the methodology, see Agresti, 1990. For an example of application to problems of transportation, see Rossera, 2000.

3. The clarification given by the Swiss micro-census on mobility, 1994

I used the data of the micro-census 94, the dataset on trips, completed when necessary with data from two other sets, that on vehicles used and that on personal characteristics. A sample of 5000 cases was drawn, 2500 for each kind of move. In Appendix B a short explanation is given on how the sample has been set up.

The tests I present are based on the heterogeneity that is supposed to exist between simple trips and trips organized in a chain. This difference may be easily summarized in graphical terms.

Figure 1 Distinction between direct and indirect trips



As an examplification, hypothesis A represents the case where the person moves from I to J to get to his or her workplace. Let's suppose that, due in particular to the distance involved and the service supplied, this person chooses to use the train.

In hypothesis B is presented the case where the person executes the same movement from I to J to reach his or her workplace. However, he or she uses to put a stop in between in order to do his or her shopping. In view of the inconveniences that a solution involving the use of the

[6] As SPSS is used for calculation, the restrictions for identifiability imposed on parameters identify one of the category of each varaible as a reference to which the other parameters are compared.

train with or without the support by public means would raise, he or she opts for the car for both displacements.

In the usual planning practice, the second alternative would be considered in the same way as the first. In order to test for the importance of the error incurred, I structured the data in the sample as follows.

The first case, hypothesis A, raises no problems as to the definition of origin, destination, mode, and distance. In the second case, hypothesis B, three elaborations are carried out on the initial data. First, I decide on the destination to be considered. This will be the sink of the last step before inverting the direction of the flow, back towards home. One has to be aware that, in this way, a certain degree of arbitrariness is introduced. In principle, it will not be possible, based on the dataset used, to infer on wich activity is to be considered as determinant for the whole journey. Perhaps, it would be advisable to drop the term main activity and simply consider the last activity on an outbound chain. Each activity in this position in the chain should be considered in turn and compared with the same kind of isolated activity.

Secondly, I define the activity to be considered in the case of a chain. Also in this case, I will take the last step as a reference.

Finally, the distance considered in the choice has to be determined. In principle, the most reasonable indicator seems to be to me the cumulated distance, starting from home. This should clearly be the case for journeys to work or for education or training motives. The cases of shopping or of the free time activities seem less certain. When the different moves are of the same kind, the general principle may well apply. On the other side, when shopping or free time activities are integrated as last step in a heterogeneous chain of trips, I would consider the length of the last step more important for the choice than the total distance cumulated along the chain. The data at my disposal don't allow a clear separation between the two alternatives. As a consequence, a certain degree of arbitrariness is inevitable. As for shopping, I consider the latter outcome mentioned, the heterogeneity of the trips in the chain, as more frequent in everyday life, so the length of the last step is codified as distance. In the case of free time activities the general principle is adopted. The parameters estimated will consent one to evaluate how serious this distortion may be.

3.1 Choice of the means of transportation

In this case the model used for the test included the following variables.

Dependent variable.

The choice is open between four alternatives:

- on foot, by bicycle, by moped;
- by car or motorcycle,
- by one of the following public means: bus, tramway, coach;
- by train.

The second category – car or motorcycle – was used as reference.

Independent variables.

Length of trip (distance between the origin and destination nodes). The distance has been categorized in four classes: - displacement up to 1 km; - between 1 and 5 km; between 5 and 10 km; and finally, of more than 10 km of length: The third category is taken as reference. The distance is considered from the locality at the beginning of the trip to that at the end of the trip or chain of trips (indirect displacements). In this last case the length has been summed up to the final destination, where the main activity is carried out, with the exception of the stops for shopping, where only the length of the last move has been considered, as already mentioned.

Motive for the displacement. Four main categories are distinguished: - going to work; - to engage in an activity related to education or training; - to go shopping, or – for recreation during free time. The first category represents the reference here.

Categories of travellers. VISEM considers this subdivision as a prerequisite for getting good planning results. The user of the application is invited to consider a combination of professional activity and availability of private means of transportation. I consider the five categories: - an active person disposing of a car; an active person not disposing of a car; an inactive with car; an inactive without car; a student. Also in this case the first category is used as a reference.

Time of move: A distinction is made between peak hour time and off-peak time. The first category, taken as reference, refers to the following periods of time: 0630-0800, 1130-1330, and 1630-1800.

Type of move (direct vs. indirect displacement). This is the variable most interesting in the present context. Statistical significance means in this case that there is an impact a chaining of activities exerts on the choice produced. The level of such an impact on the probability of choice of an alternative will be evaluated.

Table 1 Choice of a means of transportation, parameter estimates

	On foot, etc.		*By train*		*By public means*		*By car*
Distance							
< 1 km	**4.12**	***(21.00)***	-7.24	*(-0.54)*	-0.76	*(-1.66)*	Ref.
1 to 5 km	**1.27**	***(10.96)***	**-1.44**	***(-3.61)***	0.16	*(1.13)*	Ref.
> 10 km	**-0.70**	***(-5.94)***	**1.03**	***(4.44)***	**-1.29**	***(-8.23)***	Ref.
5 to 10 km	Ref.		Ref.		Ref.		Ref.
Group							
Active, w/o car	**1.15**	***(11.31)***	**2.16**	***(10.38)***	**2.28**	***(13.57)***	Ref.
Inactive, w/ car	-0.09	*(-0.51)*	-0.28	*(-0.46)*	**0.87**	***(2.94)***	Ref.
Inactive, w/o car	**1.37**	***(9.34)***	**2.35**	***(7.47)***	**2.84**	***(13.10)***	Ref.
Student	**1.28**	***(9.20)***	**1.84**	***(6.41)***	**2.19**	***(10.03)***	Ref.
Active w/ car	Ref.		Ref.		Ref.		
Motive							
Education	**2.34**	***(6.36)***	**1.82**	***(3.61)***	**1.21**	***(2.80)***	Ref.
Shopping	-1.19	*(-1.05)*	**-1.99**	***(-4.18)***	**-0.53**	***(-2.25)***	Ref.
Free time	-0.05	*(-0.30)*	**-0.81**	***(-3.04)***	**-1.51**	***(-2.36)***	Ref.
Work	Ref.		Ref.		Ref.		
Time							
Off-peak	0.00	*(0.04)*	-0.04	*(-0.23)*	-0.07	*(-0.55)*	Ref.
Peak	Ref.		Ref.		Ref.		
Type							
Transfer	**1.35**	***(8.14)***	**-1.12**	**(-4.60)**	0.26	*(1.30)*	Ref.
Away from home	Ref.		Ref.		Ref.		
Motive by type							
Education,							
transfer	**-1.49**	***(-3.41)***	**-1.57**	**(-2.26)**	-0.62	*(-1.17)*	Ref.
from home	Ref.		Ref.		Ref.		Ref.
Shopping,							
transfer	**-0.95**	***(-4.24)***	**1.46**	***(2.52)***	**-0.76**	***(-2.32)***	Ref.
from home	Ref.		Ref.		Ref.		Ref.
Free time,							
transfer	**-0.52**	***(-2.64)***	0.26	*(0.70)*	-0.24	*(-0.85)*	Ref.
from home	Ref.		Ref.		Ref.		Ref.
Work,							
transfer	Ref.		Ref.		Ref.		Ref.
from home							.
N = 4919	Likelihood: 697.27	DF = 912	Sign.:~1.0000				

In view of the aim pursued in the present analysis – the validation of general hypotheses – the adjustment is satisfactory. The parameters are reported in Table 1. The most important among them are significant and of the correct sign.

Distance has a strong positive effect on the displacement on foot or by light means on short distances. As for the train, this is the case on long distances. Public means should represent preferred alternatives on medium travels. In the present case, the parameter is not significant. On the other side, always relating to the use of public means, the failing adequacy of service supplied on long journey is more in evidence.

The difference concerning the categories of users are clearly delineated and strongly significant. The disposal of a car is the main element of discrimination, less so the degree of activity. In view of this fact, the first simplification that comes to mind would be to restrict the criteria for the classification of the users to the former characteristic.

The motive for undertaking a trip reveals its importance as well. It is the activities that can less easily be included into a fixed time schedule which reveal themselves as more refractary to giving up the use of the car.

Of most interest in this context is of course the evaluation of the difference existing between direct and indirect trips. A first series of parameters in Table 1 referes to this distinction. According to them, the choice of going on foot, by bike, or moped instead of using the car is about exp(1.35) = 4 times more probable. In the case of train, the same confrontation reduces this probability to a third, in the case of the use of public means instead of car, the parameter is not significant. The second of these parameters is quite plausible: the inconveniences generated by the train increase as the number of stops increases in its turn. The interpretation of the first parameter is less evident: a value of 4 could be generated by a ratio 8 to 2 as one .8 to .2 between numerator and denominator. In effect, this coefficient may be represented by the formula:

$$parameter = \ln\left\{ \frac{p_{foot,tr}}{p_{car,tr}} \Bigg/ \frac{p_{foot,out}}{p_{car,out}} \right\} = \ln\left\{ \frac{p_{foot,tr}}{p_{foot,out}} \Bigg/ \frac{p_{car,tr}}{p_{car,out}} \right\}$$

At first sight, one would expect the numerator to be the smaller member, by that generating a negative parameter. The number of stops increases, which should raise the inconveniences associated with the means mentioned. On the contrary, a positive coefficient may be due to an excessively coarse categorization of distance or to the fact that, in an urban context, the scooter could be an optimal surrogate for the car. The problem of the codification of distance will be considered below, for the moment I concentrate the attention on the further refinements one can consider in order to shed more light on this problem.

In the lower part Table 1 the interaction existing between the motive and the type of trip has been evaluated. The interpretation of the parameters is as follows:

$$parameter = \ln\left(\left\{ \frac{p_{foot,tr,educ}}{p_{car,tr,educ}} \Big/ \frac{p_{foot,out,educ}}{p_{car,out,educ}} \right\} \Bigg/ \left\{ \frac{p_{foot,tr,work}}{p_{foot,out,work}} \Big/ \frac{p_{car,tr,work}}{p_{car,out,work}} \right\} \right)$$

About half of the parameters estimated are significant. They show that emphasis given to the predilection of light means in the case of indirect movements is connected with the peculiar behaviour of working people; that students are particularly refractary to train in their indirect displacements, where shopping people don't reveal any predisposition with respect to this; finally, that public means are of limited use for shoppers.

As for the problem of distance, a look at Table 2 reveals that the greatest part of the matter was referable to the rough codification of this variable. The only change in this adjustment with respect to the previous estimation is that distance has been taken at its actual value in km, instead of beeing categorized. All parameters show a remarkable robustness, except those referring to the type of journey: the conclusion in this case is that there is no significant disparity between the mode chosen in the case of a direct displacement as opposed to an indirect one. The deviations evidenced by the examination of the interaction of motive and kind of trip carried out in the former adjustment are still visible, although with reduced significance. The conclusions presented there are to a certain degree still valid. It is to be noticed that the goodness of the fit has in this latter case substantially decreased.

Table 2 Choice of a means of transportation, parameter re-estimates

	On foot, etc.		*By train*		*By public means*		*By car*
Group							
Active, w/o car	**1.31**	***(15.06)***	**2.14**	***(10.45)***	**2.37**	***(13.77)***	Ref.
Inactive, w/ car	-0.02	*(-0.14)*	-0.33	*(-0.53)*	**0.93**	***(3.19)***	Ref.
Inactive, w/o car	**1.71**	***(13.59)***	**2.16**	***(6.90)***	**2.97**	***(13.40)***	Ref.
Student	**1.40**	***(11.80)***	**1.72**	***(5.98)***	**2.24**	***(10.28)***	Ref.
Active w/ car	Ref.		Ref.		Ref.		
Motive							
Education	**2.52**	***(7.37)***	**1.56**	***(3.16)***	**1.34**	***(3.14)***	Ref.
Shopping	0.11	*(0.79)*	**-2.17**	***(-4.64)***	**-0.50**	***(-2.18)***	Ref.
Free time	-0.19	*(-1.37)*	-0.46	*(-1.69)*	**-0.57**	***(-2.60)***	Ref.
Work	Ref.		Ref.		Ref.		
Time							
Off-peak	0.13	*(1.65)*	-0.04	*(-0.22)*	0.02	*(0.13)*	Ref.
Peak	Ref.		Ref.		Ref.		
Type							
Transfer	0.27	*(1.34)*	-0.32	(-1.15)	-0.14	*(-0.57)*	Ref.
Away from home	Ref.		Ref.		Ref.		
Motive by Type							
Education, transfer	**-1.63**	***(-3.97)***	-1.27	(-1.87)	-0.98	*(-1.79)*	Ref.
Education, from home	Ref.		Ref.		Ref.		Ref.
Shopping, transfer	**-0.61**	***(-2.94)***	**1.24**	***(2.17)***	-0.54	*(-1.60)*	Ref.
Shopping, from home	Ref.		Ref.		Ref.		Ref.
Free time, transfer	-0.34	*(-1.92)*	0.09	*(0.25)*	-0.15	*(-0.53)*	Ref.
Free time, from home	Ref.		Ref.		Ref.		Ref.
Work, transfer	Ref.		Ref.		Ref.		Ref.
Work, from home							.
N = 4919	Likelihood: 201.90	DF = 197	Sign.:=0.3903				

3.2 Choice of the destination

In this case the model used for the test included the following variables.

Dependent variable.

The final locality reached by the trip or chain of trips is chosen as its destination. As it would be impractical to consider each of them separately a kind of categorization is called for here.

In a first step the actual destinations of the trips in the sample are classified according to mobility regions determined by the Swiss Federal Statistical Office, the so-called regions of spatial mobility (MS-regions). In a successive step, the list of the metropolitan regions in Switzerland is considered (also produced by the SFSO), and the individual localities are classified according to whether they are included or not in the core regions of these agglomerates. The final classification of the destinations is into one of three categories:

- flows to the same MS region as the origin, subdivided into:
  - flows to a municipality in the core region of an agglomerate,
  - flows to a municipality at the periphery of the agglomerate;
- flows to another MS region without distinction between centre and periphery.

At first sight, this classification may be considered as too crude, in order to grasp the fine distinctions a user may consider when planning his or her way. Different points of weakness and evasiveness may be invoked. The most important are: the failing of a ranking order between agglomerates, some of whose may enjoy a true metropolitan function and attract flows from rather distant second or third order centres. Secondly, the localities I classified among the peripheral nodes, represent a numerous and heterogeneous group. Flows that in accordance with the criteria employed here stay at the level of the same peripheral area, may by a more fine examination present in the two cases, direct and indirect journeys, an orientation of a quite important qualitative divergence.

Despite these well motivated critical considerations, I maintain that, first, metropolitan “by-passes” should not be overrepresented in the this stochastical sample and, secondly, in terms of traffic flows there exist limited possibilities to greatly deviate from the main corridors of transit at a regional level.

As to the the municipality where the flow originates the sample is subdivided into two groups according to whether this same municipality lies in a central or a periferal region.

In synthesis, a fundamental distinction is operated, based on the fact that it makes a sensible difference for the orientation of a person whether he or she is living in an urban or a rural zone. Once this differentiation is made, the destinations may be classified (in decreasing order of importance, according to central place theory), by considering first those included into the core region of an agglomerate (producing local flows when the origins lie also within the same core regions), those at the periphery in the same areas, and those located in different areas.

Independent variables

All categorical variables used in the first analysis about the choice of means, except that concerning the distance covered, are used again here. They are: - motive of the trip; - the category of travellers; - the time during the day, and - the type of move, direct or indirect, whose last influence represents the principal aim of this study.

As the choice concerns the destination of the journey, some measure for the intensity of the attraction the target region is generating is necessary here. To that intent, I introduce the number of inhabitants in the individual municipalities as a co-variate.

Table 2 Choice of destination, parameter estimates

Source=Agglomeration	*Perifery, same region*		*Other region*		*Centre, same region*
Group					
Active, w/o car	**-0.54**	***(-2.33)***	**-0.55**	***(-3.49)***	Ref.
Inactive, w/ car	0.34	*(1.12)*	-0.25	*(-1.09)*	Ref.
Inactive, w/o car	**-0.61**	***(-2.17)***	**-0.87**	***(-4.46)***	Ref.
Student	**-0.87**	***(-2.56)***	**-0.97**	***(-4.84)***	Ref.
Active w/ car	Ref.		Ref.		
Motive					
Education	-0.65	*(-1.06)*	-0.43	*(-1.28)*	Ref.
Shopping	0.25	*(1.01)*	**-0.53**	***(-2.75)***	Ref.
Free time	**0.77**	***(3.43)***	**0.57**	***(3.75)***	Ref.
Work	Ref.		Ref.		
Time					
Off-peak	-0.29	*(-1.55)*	-0.04	*(-0.34)*	Ref.
Peak	Ref.		Ref.		
Type					
Transfer	**0.64**	***(3.42)***	**0.76**	***(5.96)***	Ref.
Away from home	Ref.		Ref.		
N = 2204 Likelihood: 108.22 DF = 137			Sign.= .9669		

Source=Perifery	*Perifery, same region*		*Other region*		*Centre, same region*
Group					
Active, w/o car	0.12	*(0.82)*	-0.00	*(-0.02)*	Ref.
Inactive, w/ car	0.04	*(0.18)*	0.29	*(1.19)*	Ref.
Inactive, w/o car	**0.58**	***(2.54)***	-0.09	*(-0.33)*	Ref.
Student	**0.56**	***(2.51)***	0.37	*(-1.61)*	Ref.
Active w/ car	Ref.		Ref.		
Motive					
Education	0.45	*(1.54)*	-0.28	*(-0.86)*	Ref.
Shopping	0.24	*(1.46)*	-0.35	*(-1.25)*	Ref.
Free time	**0.42**	***(2.65)***	**0.48**	***(2.76)***	Ref.
Work	Ref.		Ref.		
Time					
Off-peak	**0.34**	***(2.82)***	**0.27**	***(2.20)***	Ref.
Peak	Ref.		Ref.		
Type					
Transfer	**-.68**	***(-5.99)***	**0.27**	***(2.26)***	Ref.
Away from home	Ref.		Ref.		
N = 2792 Likelihood: 158.38 DF = 137 Sign.: =.1021					

The differences of behaviour revealed at the level of the two categories of origines are quite pronounced. In the case of the peripheral regions, the peculiarities are less in evidence. As a consequence, the quality of the adjustment is barely significant. The differences between the categories of users are less evident than in the case of mode choice. This may cast some doubt on the fruitfulness of the meticulous subdivisions proposed by the program.

Concentrating on the results concerning the different kind of types, one may see that the parameters are in all cases clearly significant. Also their interpretation is in accordance with what could be expected. Looking first at the agglomeration case, the number of flows to the periphery and to outside regions are increase in relative terms when the traveller takes a detour. In the case of a residence at the periphery, one has to take into account that the direction of the flows has been inverted. Also in this case, intraregional flows are rather discouraged in the case of deviating transfers.

All things considered, the distinction proposed by VISEM seems actually to produce an effect in the case of trip orientation.

4. Conclusions

At this point, it isn't easy to draw some clear-cut conclusions.

From a more general standpoint, I must admit a certain perplexity with regard to this desintegration of the decision process along the articulation of the travel stops. In fact, on a conceptual level the solution proposed brings nothing new in addition to what has been already attained by traditional choice analysis. It could even be completely mastered in the frame of multinomial logit methodology. It would seem to be more in line with the results of activity analysis to consider the interrelated decisions – at least in the case of movements contained into the space-time of a single day – as occurring simultaneously.

At the level of empirical findings, the postulated principle was in one case rejected – the decision concerning the choice of the means – and in the other case accepted, that related to the choice of a destination. However, the two kinds of decisions are not easily extricated from one another in the program.

Even if some foundation cannot be constested to the principles proposed by the program, the proof of its effectivenes is still open to an assessment in the practice of everyday planning.

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Appendix A

First, let's define the following sets.

$$A = \{a_1, ..., a_m, ..., a_M\}$$

is the set of the activities (work, shopping, etc.), generally indexed as a_m.

$$G = \{g_1, ..., g_h, ...g_H\}$$

is the set of categories of persons with homogeneous behaviour (active person with car, active without car, etc.), generically indexed as g_h.

$$V = \{v_1, ..., v_i, ..., v_N\}$$

is the set of nodes (vertices) of the network, with index i.

$$M = \{m_1, \ldots, m_j, \ldots, m_J\}$$

are the alternative means of transport supplied, with index j.

$$k = \{k_1, ..., k_l, ..., k_L\}$$

is a chain of L activities, where

$$k_l \in \{A\}, l = 1,.., L \quad and \quad k = 1,2,..$$

In order to derive an actual chain of trips we go through the following steps.

Phase 1. Trip generation.

For every category g_h we calculate the total number of chains of activities during a unit of time, say, a day. This for every node i.

$$n(k)_i^{g_h} = P_i^{g_h} \times f_k^{g_h} \qquad i = 1,..., N$$

n(k): number of activity chains,
P_i: number of persons living in i,
f_k: mean trip frequency in a chain of kind k during a day.
This also corresponds to the number of trips of the kind of the kind hbelonging to chain k, category g_h, origin i, that I note:

$$t(k)_i^g \quad l = 1,.., L$$

In the present study I consider the t(k)s as given and begin the analysis from Phase 2 on.

Phase 2. Trip distribution.

The individual element of a chain of activities has to be transformed into a movement on the ground, with an origin and destination. Herewith, a chain is transformed into a chain of trips. For every trip in the chain is derived as follows (for the sake of simplicity I drop the indices of the groups):

$$t(k_l)_{(i_l, i_{l+1})} = t(k_l)_{i_l} \times prob(i_l, i_{l+1})$$

where the probability is calculated in the same way as in the attraction-constrained gravity model. For the last element in the chain the probability is one.

Phase 3. Mode choice.

Each number of trips calculated in Phase 2 has to be subdivided according to the mode used.

$$t(k_l)_{(i_l, i_{l+1}),m} = t(k_l)_{(i_l, i_{l+1})} \times prob(m_j)$$

The probability is derived from the estimation of a multinomial logit model.

Appendix B

The data used are taken from the micro-census carried out by the Swiss Federal Statistical Office on the mobility behaviour in Switzerland in 1994. The universe was extended to the whole population from which a sample of 16570 housholds were drawn. The data were collected by telephone interviews and are grouped in a number of related datasets. Those of interest in the present context are, respectively, those with the data relating to the characteristics of the households, the persons in each household (40073 cases), the persons interviewed on their mobility behaviour (18020 cases), and the journeys made (58315).

The observations used for the model estimation refer to this last set of data, completed when needed with informations taken from the three other.

In a first step, a distinction was introduced between direct and indirect journeys to locations of main activities. Only outbound moves from home or an equivalent accomodation were considered, return journeys after attainment of the aim which the movement were finalised to were eliminated.

The definition of a direct movement goes without problems. Each movement followed by a return movement to home is considered as one of them. All the characteristics of the journey can be directly assessed as the origin and destination of the move are unambiguously identified.

Instead, the definition of an indirect movement is not exempt from some kinf of arbitrariness. For each circuit a person completes during a day the activity with the most moment should be identified and the corresponding location registered. In the present case, as detailed pieces of information were missing I could but consider the last activity before the inversion of the movement as the main objective of the circuit. This indirect journey takes into account more than one movement.

As to the characteristics to take into account, some raise no problems, those related to the person considered. The others have to be reconsidered. They are.

- the destination of the move, which becomes in accordance with what was said before that of the last activity before the return;
- the mode of transport, also that of the last activity:
- the distance travelled; in this case the length is cumulated with that of all intermediate activities, except in the case of shopping activities.

In a second step, a sample is drawn separately for each of the two categories of movements. 2500 journeys were sampled in each case.