Modal Split for MASQ London Restaurant

In transport planning, modal split represents a method used to determine the potential number of trips by mode or, in other words, the share of different modes of transport and pedestrian trips in the total transport needs.

Each survey area was classified into one of the following land-use categories: central business district, broader central district, suburbs, residential and other built-up areas. By a stepwise multi-regression analysis, the following relative trip generation parameters were determined: household size, car ownership (motorization degree), and household income. The analysis also included some other parameters, such as: - The influence of the district distance from the central business district on trip generation, and - Accessibility to mass public transport lines (expressed in travel time), but they did not show any significant correlation and were excluded from the further analysis. The survey included trips by car, mass public transport, bicycle and pedestrian trips, as well as the total number of trips in the central business district.

Modal split models used to simulate the selected mode are mostly based on official statistics (the number of inhabitants in the district, motorization degree, income, etc.) but may also include the data provided by transport studies (travel time or distance).

The trip matrix or O-D matrix obtained from the trip distribution is sliced into number of matrices representing each mode. Two types of mode choice models are i.e. binary mode choice and multinomial mode choice.

Mode choice

The choice of transport mode is probably one of the most important classic models in transport planning. Public transport modes make use of road space more efficiently than private transport. Also, they have more social benefits like if more people begin to use public transport, there will be less congestion on the roads and the accidents will be less. Again, in public transport, we can travel with low cost. In addition, the fuel is used more efficiently. Main characteristics of public transport is that they will have some particular schedule, frequency etc.

On the other hand, private transport is highly flexible. It provides more comfortable and convenient travel. It has better accessibility also. The issue of mode choice, therefore, is probably the single most important element in transport planning and policy making. It affects the general efficiency with which we can travel in urban areas. It is important then to develop and use models which are sensitive to those travel attributes that influence individual choices of mode.

The factors may be listed under three groups:

Characteristics of the trip maker: The following features are found to be important:

- car availability and/or ownership;
- possession of a driving license;
- household structure (young couple, couple with children, retired people etc.);
- income;
- decisions made elsewhere, for example the need to use a car at work, take children to school, etc;
- residential density.

Characteristics of the journey: Mode choice is strongly influenced by:

- The trip purpose; for example, the journey to work is normally easier to undertake by public transport than other journeys because of its regularity and the adjustment possible in the long run;
- Time of the day when the journey is undertaken.
- Late trips are more difficult to accommodate by public transport.

Characteristics of the transport facility: There are two types of factors. One is quantitative and the other is qualitative. Quantitative factors are:

- relative travel time: in-vehicle, waiting and walking times by each mode;
- relative monetary costs (fares, fuel and direct costs);
- availability and cost of parking
- Qualitative factors which are less easy to measure are:
- comfort and convenience
- reliability and regularity
- protection, security

A good mode choice should include the most important of these factors.

Types of modal split models

Trip-end modal split models

A model that is applied immediately after trip generation is called trip-end modal split model. The modal split models of this time related the choice of mode only to features like income, residential density and car ownership.

The advantage is that these models could be very accurate in the short run, if public transport is available and there is little congestion. Limitation is that they are insensitive to policy decisions example: Improving public transport, restricting parking etc. would have no effect on modal split according to these trip-end models.

Trip-interchange modal split models

This is the post-distribution model; that is modal split is applied after the distribution stage. This has the advantage that it is possible to include the characteristics of the journey and that of the alternative modes available to undertake them. It is also possible to include policy decisions. This is beneficial for long term modeling.

Aggregate and disaggregate models

Mode choice could be *aggregate* if they are based on zonal and inter-zonal information. They can be called *disaggregate* if they are based on household or individual data.

Binary logit model

Binary logit model is the simplest form of mode choice, where the travel choice between two modes is made. The traveler will associate some value for the utility of each mode. if the utility of one mode is higher than the other, then that mode is chosen. But in transportation, we have disutility also. The disutility here is the travel cost. This can be represented as

$$c_{ij} = a_1 t^v_{ij} + a_2 t^w_{ij} + a_3 t^t_{ij} + a_4 t_{nij} + a_5 F_{ij} + a_6 \phi_j + \delta \tag{1}$$

Study case:

Trip Generation Rate

Total daily trips are calculated by making an assumption on the trip data collection.

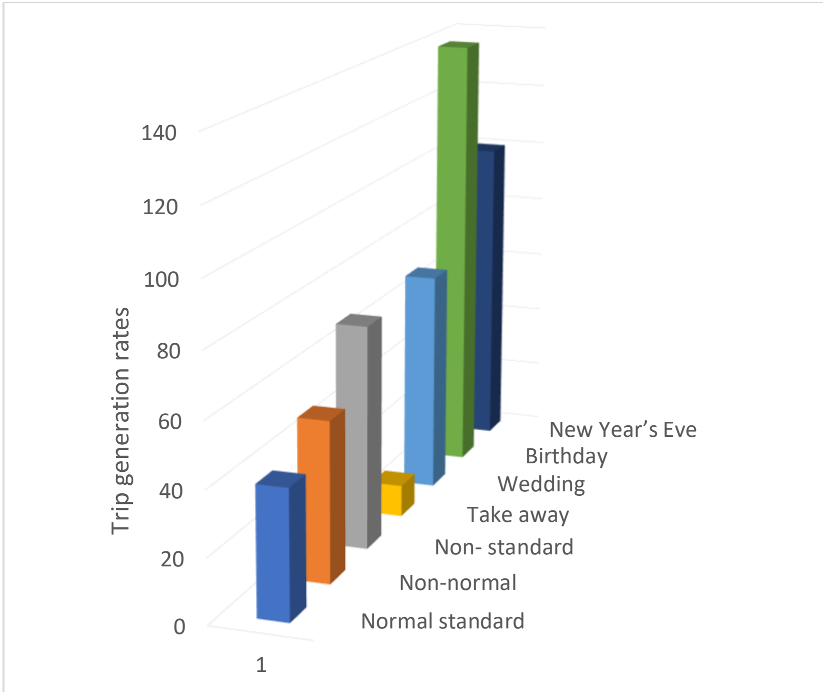
For household trip rate

1. Home-based work (HBW) = not exists
2. Home-based Other (HBO) = Recreational trip
3. Non-home-based (NHB) = Recreational trip

Table 12.7 Trip Generation Rates by Trip Purpose and Employee Category

	Attractions per Household	*Attractions per Nonretail Employee*	*Attractions per Downtown Retail Employee*	*Attractions per Other Retail Employee*
HBW	—	1.7	1.7	1.7
HBO	1.0	2.0	5.0	10.0
NHB	1.0	1.0	3.0	5.0

Trip Purpose	**Number of customers**		**Type of trip**	**Factors multiplied**	**Factors multiplied**
	Sun-Thurs	**Fri-Sat**			
Normal standard opening hours	40 diners/day	50 diners/day	HBO	400	500
Non-standard opening hours	Anyway = 70 diners/day		HBO	119	
Take away/home deliveries	10 diners/day	15 diners/day	HBO	50	75
				= 524	= 694
Wedding	1 event in a month = 70 guests		NHB	350	
Birthday	2 events in a month = 70 guests/ event		NHB	350	350
				= 1050	
New Year's Eve/Christmas days	100 diners/day		NBO	300	
				= 300	



Mode share

The specific travelling mode are cars, trains, bus, bicycle and walking. The mode share between these modes and percentage of travelling users are used as assumption.

Mode choice

The choice of travels mode is determined by the utility function. There is a link between the travel cost and time.

Modal split

Factors influencing mode choice are following;

Availability of parking
Income
Availability of transit
Auto ownership
Type of trip
Work trip more likely transit
Special trip – trip to airport or baseball stadium served by transit
Shopping, recreational trips by auto
Old and young are more likely to be transit dependent

Roadway Infrastructure Planning

The modal split effects the road and traffic conditions that will need the following improvements.

- Network operation
- Lane width improvement
- Lane increasing in numbers
- Phasing
- Monitoring
- Management and Policy making

LOGIT MODEL

Model may be separated by trip purposes
Utility function: measures satisfaction derived from choices
Disutility function: represents generalized costs of each choice

There may be probability that 50 % users chose to travel by car while 40 % users prefer to use bus.

In which the remaining users can chose the 5 % by bicycle, 3 % walking in-case of short distance and 2 % by train to commute to a longer distance.

Calculates the probability of selecting a particular mode

Mode Choice

(Logit)

$$P_{ij} = \frac{e^{\text{transit utility}_{ij}}}{e^{\text{transit utility}_{ij}} + e^{\text{auto utility}_{ij}}}$$

Pij = Probability of using transit for a trip between Zone i to Zone j

Transit untility$_{ij}$ = f (transit level of service$_{ij}$, income$_i$)

Auto utility$_{ij}$ = f (highway level of service$_{ij}$, income$_{ij}$

Utility functions for auto and transit
U = ak– 0.35t1 – 0.08t2 – 0.005c
ak = mode specific variable
t1 = total travel time (minutes)
t2 = waiting time (minutes)

c = cost (penny)

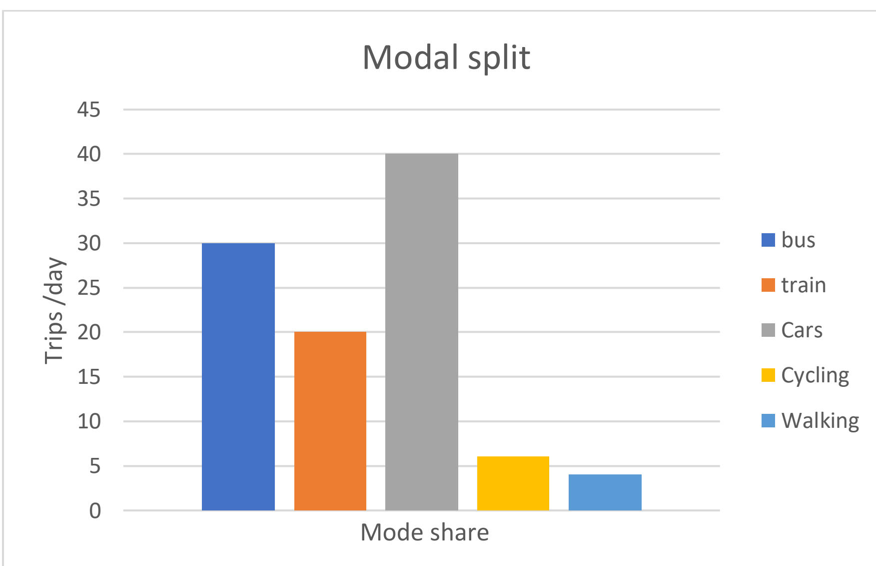
Trip Distribution

All the trips will be distributed to home, works, etc. For distribution, gravity model is used which is based upon the income level, population level and socio-economic factors.

The total trips distributed from the restaurants are approximately 1874.

MODAL SPLIT

Mode of transport (passenger mode)		Total vehicle distance driven (million vehicle miles; vkm)	Number of trips	Total person mobility distance (million person miles)
Public or collective mode	bus	1-12 miles	20	30
	Train	12-25 miles	30	100
Private mode	Private cars (max. 8 seats)			
	as a driver	12-20 miles	15	10
	as a passenger	n.a.		
	Taxi	n.a.		
	Cycling (including electric bikes)	1-12 miles	10	2
	Walking	1-4 miles	25	1



Trip Assignment

Trip Assignment is the procedure by which the planner/engineer predicts the paths the trips will take. For example, if a trip goes from a suburb to downtown, the model predicts the specific streets or transit routes to be used

Minimum-Path Techniques:

Minimum-path techniques are based on the assumption that travelers want to use the minimum impedance route between two points. here are three common methods for trip assignment: all or nothing, diversion, and capacity restraint.

All-or-Nothing

All-or-nothing is often referred to as the minimum path algorithm. The minimum path, or tree, represents the minimum time path between two zone centroids and is assigned all of the traffic volume between the zones in question. As volumes and travel times increase, the results of this method become more unreliable.

As an example of this method, imagine that zones A and B are connected by ten separate routes. Route 3.0 has the shortest travel time which means that, according to this model, all trips from A to B will use route 3.0.

Diversion

Diversion is the allocation of trips to two or more possible routes in a designated proportion that depends on some specified criterion. In most cases the criterion that is used is time, although some also use distance and generalized cost. Diversion is very similar to the all-or-nothing’ method, except that portions of the total number of trips are allocated to different routes, with fewer trips being given to those routes with longer travel times.

Capacity Restraint

There are two basic characteristics common to capacity restraint models; (i) they are non-linear relationships and (ii) they use the volume-capacity ratio or v/c as a common factor. The underlying premise of a capacity restraint model is that the travel time on any link is related to the traffic volume on that link. This is analogous to the level of service (LOS) criterion, where LOS A corresponds to a low v/c and a higher vehicle speed. LOS E and the corresponding v/c = 1 represents capacity.

Capacity restraint models assign traffic to possible routes in an iterative manner:

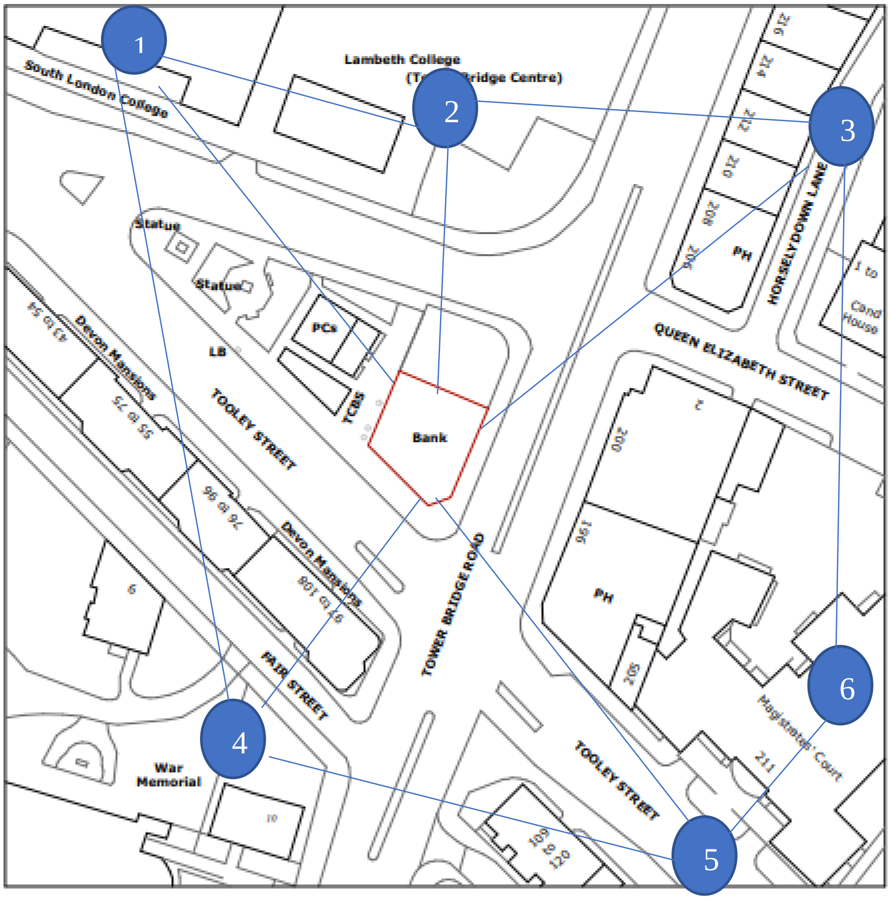
1. A portion of the total traffic volume is assigned to the link with the shortest travel time.
2. Travel times for all possible links are calculated again, since volumes have changed.
3. Another portion of the traffic volume remaining to be assigned is allocated to the link that now has the shortest travel time.
4. The travel time for all links are calculated and revised if changes result.
5. The process of incremental assignments, followed by calculation of revised shortest travel times, by link, continues until all trips have been assigned.

The capacity restraint model used by FHWA is applied in an iterative manner. The adjusted link speed and/or its associated travel impedance is computed using the following capacity restraint function:

$T=T_o[1+0.15(V/C)^4]$

Where:
T= balance travel time (at which traffic V can travel on a highway segment)
T_o= free flow travel time: observed travel time (at practical capacity) times 0.87
V= assigned volume

C = practical capacity



Routes	Impedance Time	Traffic Flow veh/min
Point 1-Masq	**3 min**	**300 veh**
Point 2-Masq	**4 min**	**250 veh**
Point 3-Masq	**5 min**	**100 veh**
Point 4-Masq	**2 min**	**150 veh**
Point 5-Masq	**5 min**	**250 veh**
Point 6-Masq	**6 min**	**200 veh**

The respective traffic count is assumed according to peak hours, busy spots and road capacity.