Appendix B3: Mode Choice Model[1]

1 INTRODUCTION

The mode choice model distributes trips for each interchange among eleven alternative modes for each of the 18 purpose groups. Zones are segmented into groups of people who have access to transit via walking or driving or both, and those who do not have transit access. Utilities are then calculated for all the 11 modes available using the appropriate skims and other costs like fares, parking costs, vehicle operating costs, tolls, etc. A logit-based mode choice is then run assuming the (dis)utilities of modes not available to a particular market segment are very low, so that no trips are assigned to those sub-modes. Trips for all the sub-modes are aggregated among all the market segments to yield total trips by sub-modes for each interchange. Table B3-1 lists the mode classification.

Table B3-1. Mode Classification

Mode	Mode Choice Classification
Transit	Transit
Auto Driver	Auto D
Auto Passenger	Auto P
Walk	Non-Motorized
Bike	Non-Motorized
Other	N/A

2 MODE CHOICE

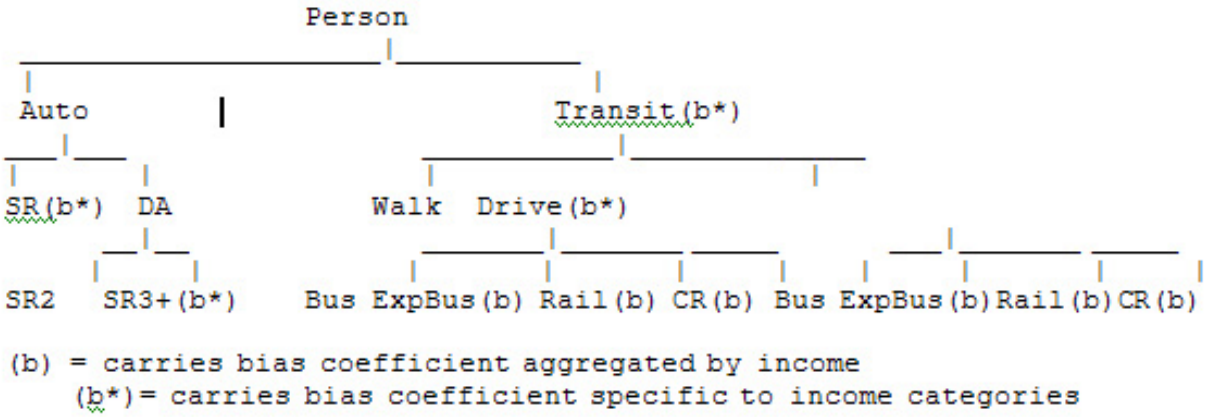
Person trip mode choice is an adaptation of the most recent BMC nested logit mode choice model, shown in Figure B3-1.[2] The modes defined above were

[1] This Appendix is adopted from the Maryland Statewide Transportation Model (MSTM): User Guide, prepared for State Highway Administration. The Draft Guide is available through National Center for Smart Growth and Education (NCSGRE) and it will be available in Fall 2012.

[2] This section draws heavily from the BMC Calibration Report: "Travel Forecasting Model Calibration Report," prepared for Maryland Transit Administration by William G Allen Jr., 21 August 2006. Some or all of the modifications made by Parsons Brinckerhoff for Baltimore Region new-starts analyses were incorporated also depending on review of results and experience gained in that work.

aggregated into these nests. The figure indicates the modes and sub-modes that are incorporated in the model. Rail includes LRT and Metro and the Commuter Rail (CR) includes AMTRAK services as well as MARC commuter rail. All local bus services are included under the Bus and express bus and commuter bus services are included in the ExpBus modes.

Figure B3-1. Structure of MSTM Mode Choice Model



Mode choice is based on generalized utility functions for auto and transit travel. Separate utilities were developed to represent peak and off-peak conditions. Home-based work trips and Non-home based work trips are based on peak period travel characteristics while other purposes are based on off-peak characteristics. Auto utilities for each auto mode include driving time and cost, terminal time and parking costs at the attraction end, and tolls. Transit utilities for each transit mode include walk and drive-access times, initial wait time, in-vehicle time, and transfer time. Bias constants or mode specific constants are included as indicated in Figure B3-4 and Table B3-2 below which list all the variables included in the utility expression for each mode and sub-mode.

These variables are described in the BMC Calibration Report as follows. All monetary units were based on year 2000 dollars:

- **In-Vehicle Time** (IVT) (minutes): Run time from the network. This is Single Occupancy Vehicle (SOV) path time for Drive Alone (DA), High Occupancy Vehicle (HOV) path time plus carpool access time for Shared Ride 2 and 3 (SR2 and SR3) (which accounts for additional circulation and pick-up time for carpools). For SR2, access time is defined as the minimum of either 10 minutes or 12% of the in-vehicle time (MIN(0.120*IVT,10)); for SR3, it is the minimum of 15 minutes or 19.9% of the in-vehicle time (MIN(0.199*IVT,15)). Those functions were adopted from the old BMC model. For Transit, if the run time for each submode does not use that submode, the path is considered invalid and the submode is considered unavailable. Commuter rail run time is factored by 0.75, to reflect the fact that such trips tend to be longer and the riding experience is generally more pleasant than on other types of transit (more seating room, more amenities on-board, etc.).

- **Terminal Time** (minutes): Sum of the times for the production and attraction zones. Computed from a look-up table based on the zonal area types (see section1.4). For SR2, add 1.1 minutes to reflect additional waiting time; for SR3, add 2.5 min.

- **Auto Operating Cost** (cents): Incremental cost of driving (i.e., excludes all fixed costs of vehicle ownership). Computed as distance from the network times: 9.9 cents/mile in year 2000 dollars. About 58% of that cost (5.76 cents/mi) is fuel; the rest (4.14 cents/mi) is maintenance, tires, and oil. The fuel component was calculated using a cost of $1.314/gallon (year 2000 dollars) and an average on-road fuel efficiency of 22.8 mpg. For SR2, divide by 2. For SR3, divide by the average 3+ occupancy by purpose (derived from the Baltimore home interview survey).

- **Auto Tolls** (cents): Toll cost from the network. For SR2, divide by 2. For SR3, divide by the average 3+ occupancy by purpose.

- **Auto Parking Cost** (cents): Computed by the parking cost model for the attraction zone. For SR2, divide by 2. For SR3, divide by the average 3+ occupancy by purpose.

- **Transit Walk Time** (minutes): Sum of transit transfer walk time, from the network, plus computed production zone access to transit time, plus computed attraction zone egress from transit time. Access and egress times are multiplied by adjustment factors to reflect the difficulty or ease of walking.

- **Initial Wait Time** (7.5 min or less, in minutes): Initial wait time is the time spent waiting
  for the first transit vehicle, from the network. This is the amount of the initial wait time that is equal to or less than 7.5 minutes. Several urban areas have found that the first increment of wait time is more important to mode choice than the second increment. This also helps the modeling of routes with very long headways (e.g., 60+ minutes). TP+, as with most such software packages, computes the wait time as half the headway, but that does not reflect the fact that people tend to schedule their arrivals for long-headway routes, leading to shorter actual wait times than half the headway.

- **Initial Wait Time** (over 7.5 minutes, in minutes): This is the increment of initial wait time that exceeds 7.5 minutes, if any.

- **Transfer Time** (minutes): This is the time spent waiting for the second (and any subsequent) transit vehicles, from the network.

- **Number of Transfers**: In TP+, this is computed from the network as the total number of transit routes boarded, minus one.

- **Transit Fare** (cents): Computed from the network as the sum of the boarding fare and any transfer fares. For drive-access, it also includes the cost of driving to the

Park and Ride (PnR) lot, computed as the drive-access distance times: 9.9 cents/mile.

- **Drive-Access Time** (minutes): The time spent driving to a transit PnR lot or station, computed from the network using over-the-road distance and speed.

Table B3-2. Variables Included in Utility Expressions

	Mode								
Variable	**DA/SR**	**Wbus**	**WEBus**	**WRail**	**WCRail**	**Dbus**	**Debus**	**DRail**	**DCRail**
In Vehicle Time	X	X	X	X	X	X	X	X	X
Terminal Time	X								
Auto Operating Cost	X								
Auto Tolls	X								
Auto Parking Cost	X								
Walk Time		X	X	X	X	X	X	X	X
Initial Wait Time (under 7.5 min.)		X	X	X	X	X	X	X	X
Initial Wait Time (over 7.5 min.)		X	X	X	X	X	X	X	X
Transfer Time		X	X	X	X	X	X	X	X
Number of Transfers		X	X	X	X	X	X	X	X
Transit Fare		X	X	X	X	X	X	X	X
Drive Access Time						X	X	X	X

Table B3-3. Nesting Coefficients

Nest	**Value**
Walk Transit Route (Bus, Rail, MARC)	0.30
Drive Transit Route (Bus, Rail, MARC)	0.30
Transit Access (Walk vs. Drive)	0.65
Shared Ride Occupancy (2 vs. 3+)	0.30
Auto Mode (Drive Alone vs. Shared Ride)	0.65