

NOTE TO READER:

This document was developed in response to the need for clear, thorough documentation to be prepared in a standardized format as a part of all model development projects. The guidelines are in the form of a report template that may be used in the preparation of model documentation.

The general organization and content of template was patterned after Portland Metro's regional model documentation, as well as model documentation examples prepared by ODOT's Transportation Planning Analysis Unit. It also reflects input received from OMSC members regarding the types of information that should be included in model documentation to ensure that:

- model users have an adequate understanding of models so that they may be properly applied; and
- models may be adequately and efficiently reviewed for compliance with specific modeling requirements, such as those for air quality conformity analysis.

The first four sections of the template provide an overview of the model and model development process (Section I.), an explanation of how the overall model structure was defined (Section II.), and a description of the model zone system and networks (Sections III. and IV.). Section V. contains background information on the survey data used for model development. Section VI. describes the general types of input data that are used in the model and how the data is prepared. In Section VII., "nuts and bolts" information about the development of the individual model components is provided. Finally in Section VIII., the model validation process and validation results are presented.

In addition to the hard-copy version of the template presented in the following sections, an electronic version is provided in MS Word format on the diskette attached to the back cover.

Table of Contents

LIST OF FIGURES.....	iii
LIST OF TABLES	iv
I. INTRODUCTION	1
II. MODEL STRUCTURE	2
IDENTIFICATION OF MODEL REQUIREMENTS	2
ALTERNATIVE MODEL FORMS	2
MODEL STRUCTURE	2
III. ZONE SYSTEM.....	3
TAZ SYSTEM.....	3
DISTRICT SYSTEM.....	3
IV. NETWORKS	4
HIGHWAY NETWORK.....	4
TRANSIT NETWORK	4
V. SURVEY DATA	5
HOUSEHOLD ACTIVITY SURVEY	5
Survey Methods.....	5
Survey Data Preparation.....	5
Survey Results	5
TRANSIT ON-BOARD SURVEY	6
Survey Methods.....	7
Survey Data Preparation.....	7
Survey Results	7
VI. INPUT DATA.....	8
SOCIOECONOMIC AND LAND USE DATA	8
ACCESSIBILITY/URBAN DESIGN DATA	8
TRAVEL TIME DATA	8
Auto Skims	8
Transit Skims.....	9
Park-and-Ride Skims.....	9
TRIP COST DATA	9
OTHER INPUT DATA.....	9
VII. MODEL COMPONENTS.....	10
PRE-GENERATION.....	11

Table of Contents (cont.)

Pre-Generation Model 1	12
Pre-Generation Model 2	14
TRIP GENERATION	15
Trip Purpose 1 Trip Generation Model	16
Trip Purpose 2 Trip Generation Model	18
DESTINATION CHOICE	19
Trip Purpose 1 Destination Choice Model	20
Trip Purpose 2 Destination Choice Model	22
MODE CHOICE	23
Trip Purpose 1 Mode Choice Model	24
Trip Purpose 2 Mode Choice Model	27
TIME-OF-DAY FACTORS	28
Mode 1 Time-of-Day Factors	28
Mode 2 Time-of-Day Factors	29
SPECIAL PURPOSE MODELS	30
Special Purpose Model 1	31
Special Purpose Model 2	33
ASSIGNMENT	34
Auto Assignment	34
Transit Assignment	34
VIII. MODEL VALIDATION	35
APPENDIX A	36
APPENDIX B	38

List of Figures

Figure 1	.....
Figure 2	.....
Figure 3	.....
Figure 4	.....
Figure 5	.....
Figure 6	.....
Figure 7	.....
Figure 8	.....
Figure 9	.....
Figure 10	.....

List of Tables

Table 1	.....
Table 2	.....
Table 3	.....
Table 4	.....
Table 5	.....
Table 6	.....
Table 7	.....
Table 8	.....
Table 9	.....
Table 10	.....

I. Introduction

Brief discussion of the:

- *need for model development (i.e., the reasons for developing the model or the roles/functions it serves within the local area);*
- *general structure of the model, implementation platform (e.g., EMME/2 or R), and special features;*
- *model development process; and*
- *organization of the document.*

II. Model Structure

Identification of Model Requirements

Description of the model's design parameters and how they were identified. Parameters may include:

- *the outputs needed for desired model uses;*
- *mandated requirements, such as those for air quality analyses; and*
- *local constraints, such as limited availability of model input data or limited user expertise.*

Alternative Model Forms

Discussion of the alternative model forms considered, including:

- *key issues;*
- *potential alternatives;*
- *the advantages and disadvantages of each alternative; and*
- *the rationale for the selected alternative.*

Model Structure

Description of the model's components and linkages, with references to a model flow chart.

III. Zone System

TAZ System

Description of the model's TAZ system that includes:

- *the physical boundaries of the modeling area;*
- *a TAZ map;*
- *the TAZ geography (e.g., aggregation of census blocks); and*
- *the TAZ numbering scheme (ranges for internal vs. external zones).*

District System

Description of any district systems that may have been used in the model development process. Should include district maps and an explanation of what the district systems were used for and how they were developed.

IV. Networks

Highway Network

Description of the coded highway network, including:

- *the network structure and criteria used for determining those facilities to be included in the network;*
- *coding conventions for nodes and links (e.g., centroid connectors coded with average rather than actual distances); and*
- *node and link attributes (for links, this should at least include capacity, speed and volume-delay function code, and any special attributes such as traffic counts).*

Transit Network

Description of the coded transit network with information on:

- *transit modes;*
- *transit-only links, if applicable;*
- *coding conventions for auxiliary transit links, such as centroid connectors for transit submodes (e.g., walk, park-and-ride, kiss-and-ride) and walk networks in downtown areas and at transit stations; and*
- *transit line coding conventions, including headway calculation.*

V. Survey Data

Household Activity Survey

Brief discussion of the nature and uses of the home interview survey data for model development.

Survey Methods

Description of the sample design, survey design, and survey administration procedures.

Survey Data Preparation

Description of how the survey data was prepared for use in the model development process, including:

- *general editing and review;*
- *data transformation (e.g., determination of trip purpose);*
- *sample weighting and expansion;*
- *addition of non-survey data (e.g., interzonal travel times); and*
- *construction of observed trip tables.*

Survey Results

Description of the trip types included in the survey results presented below.

TRIP GENERATION

Discussion of highly-correlated relationships between trip generation and household characteristics, such as:

- *total weekday trips and household size;*

V. Survey Data

- *work trip rates and the number of workers; and*
- *non-work trip rates and household size*

These relationships should also be displayed in charts or tables.

DESTINATION CHOICE

Presentation and discussion of destination choice characteristics by:

- *trip purpose, such as average trip length and trip length distribution; and*
- *household type, such as the relationship between household income and average work trip length.*

MODE CHOICE

Presentation and discussion of:

- *total mode shares;*
- *tripmaking characteristics by mode (e.g., average trip length, percentage of trips by trip purpose);*
- *mode shares by trip purpose;*
- *relationships between household and traveler characteristics and mode share (e.g., mode shares by age category); and*
- *relationships between work and household location (land use type) and mode share.*

OTHER TRAVEL CHARACTERISTICS

Description of other significant travel characteristics, such as tripmaking between major origin-destination pairs.

Transit On-Board Survey

V. Survey Data

Brief discussion of the nature and uses of the transit on-board survey data for model development.

Survey Methods

Description of the sample design, survey design, and survey administration procedures.

Survey Data Preparation

Description of how the survey data was prepared for use in the model development process, including general editing and review, sample weighting and expansion, addition of non-survey data, and construction of observed trip tables.

Survey Results

Presentation and discussion of system-level ridership data, such as total transit trips and transit trips by trip purpose, income group, and submode, as well as disaggregate ridership data, such as transit trips by route and by subarea (e.g., downtown and other special generators).

VI. Input Data

VI. Input Data

Socioeconomic and Land Use Data

Listing of the socioeconomic and land use data that are used in the model. Should include a description of how the data is prepared if a special procedure is used.

Data	Input To:*	Preparation Procedure
1.	1. 2.	
2.	1. 2.	
3.	1. 2.	

* List model component name(s)

Accessibility/Urban Design Data

This data category may include such measures as land use mix index, retail or total employment within ½ mile of each zone, local intersections within ½ mile of each zone, and employment within a given transit travel time of each zone. Refer to the socioeconomic and land use data section for the format of the information to be provided.

Travel Time Data

Identification of the model components that the travel time skims are input to.

Auto Skims

Description of how and for which time periods the auto skims are prepared.

VI. Input Data

Transit Skims

Identification of the:

- *individual impedance components included in the transit skims (e.g., walk-time, first wait time, transfer time, and in-vehicle time);*
- *assumptions used for development of the skims, such as boarding penalties or weight factors, and*
- *time periods that the skims are prepared for.*

Park-and-Ride Skims

Description of how and for which time periods the park-and-ride skims are prepared.

Trip Cost Data

Identification of the model components that trip cost data are input to, as well as a description of how the costs are estimated by mode for the work and non-work trip purposes.

Other Input Data

Other input data may be required at various stages of the modeling process. These may include traffic volumes at external stations, the percentage of households within a given distance of transit service by TAZ, and input data for special generator models, such as shopping center square footage and college enrollment. Refer to the socioeconomic and land use data section for the format of the information to be provided.

VII. Model Components

Brief reiteration of the information presented in Section II on overall model structure, with references to the model flowchart. Also, explanation of the format that is used in subsequent sections to describe the individual model components (for example: “The “Definition of Variables” section within each model description provides information on the model input variables, including the variable name, description, allowable values, and preparation method if a special procedure is used.”).

Pre-Generation

Description of the pre-generation modeling step, including:

- *what is done within the step, in general, and its relationship to other steps in the modeling chain;*
- *a listing of the models that are used;*
- *the general structure of the models (i.e., model form and how they work); and*
- *the model development approach that was followed.*

Pre-Generation - Model 1

Pre-Generation Model 1

Brief description of the model's function, relationship to other model components, and basic structure.

DEFINITION OF VARIABLES

Description of the input variables, including variable name and allowable values (discrete variables) and the data preparation method if a special procedure is used.

Name	Description	Values*	Preparation Method

* Discrete variables

CALIBRATED MODEL FUNCTIONS

Listing of the model functions with calibrated coefficients.

ESTIMATED VARIABLE COEFFICIENTS

Listing of the coefficients developed in the model estimation process, together with their test statistic values.

Variable Name	Choice 1		Choice 2		Choice 3	
	Coeff.	Test Statistic	Coeff.	Test Statistic	Coeff.	Test Statistic

COMPARISON OF OBSERVED VS. ESTIMATED DATA

Comparison of the observed survey data to the model output data for the base (calibration) year. The comparisons may be at the aggregate level (e.g., total households by household size) or disaggregate level (e.g., households by household size by zonal average household size range).

Pre-Generation - Model 2

Pre-Generation Model 2

(Use the same format as for Model 1)

Trip Generation

Description of the trip generation modeling step, including:

- *what is done within the step, in general, and its relationship to other steps in the modeling chain;*
- *a listing of the trip purposes for which trip generation is performed;*
- *the general structure of the models (i.e., model form and how they work); and*
- *the model development approach that was followed.*

Trip Purpose 1 Trip Generation Model

Trip Purpose 1 Trip Generation Model

Brief description of the model's function, relationship to other model components, and basic structure.

DEFINITION OF VARIABLES

Description of the input variables, including variable name and values, and the data preparation method if a special procedure is used.

Name	Description	Values	Preparation Method

TRIP PRODUCTION RATES

Calibrated Rates

Listing of the trip production rates from the model calibration process.

Variable 1	Variable 2			
	Value 1	Value 2	Value 3	Value 4
Value 1				
Value 2				
Value 3				
Value 4				

Estimated Rates

Listing of the trip production rates from the model estimation process.

Variable 1	Variable 2			
	Value 1	Value 2	Value 3	Value 4
Value 1				
Value 2				

Trip Purpose 1 Trip Generation Model

Variable 1	Variable 2			
	Value 1	Value 2	Value 3	Value 4
Value 3				
Value 4				

COMPARISON OF OBSERVED VS. ESTIMATED DATA

Comparison of the observed survey data to the model output data for the base (calibration) year. The comparisons may be at the aggregate level (e.g., total trip productions) or disaggregate level (trip productions by zone or district).

Trip Purpose 2 Trip Generation Model

Trip Purpose 2 Trip Generation Model

(Use the same format as for the Trip Purpose 1 trip generation model).

Destination Choice

Description of the destination choice modeling step, including:

- *what is done within the step, in general, and its relationship to other steps in the modeling chain;*
- *the general structure of the models (i.e., model form and how they work); and*
- *the model development approach that was followed.*

Trip Purpose 1 Destination Choice Model

Trip Purpose 1 Destination Choice Model

Brief description of the model's function, relationship to other model components, and basic structure.

DEFINITION OF VARIABLES

Description of the input variables, including variable name and allowable values (discrete variables) and the data preparation method if a special procedure is used.

Modal Utility Functions

Name	Description	Values*	Preparation Method

* Discrete variables

Destination Choice Utility Function

Name	Description	Values*	Preparation Method

* Discrete variables

CALIBRATED UTILITY FUNCTIONS

Listing of the model functions with calibrated coefficients.

Modal Utility Functions

$$U_{Mode 1} =$$

$$U_{Mode 2} =$$

Trip Purpose 1 Destination Choice Model

-
-
-

$$U_{Mode\ n} =$$

Destination Choice Utility Function

$$U_{Zone\ i} =$$

ESTIMATED VARIABLE COEFFICIENTS

Listing of the coefficients developed in the model estimation process, together with their test statistic values.

Modal Utility Functions

Note: It is assumed that the estimated coefficients for the modal utility functions for the destination choice and mode choice models are the same. Therefore, the estimated coefficients shown in the mode choice model section may be referenced here.

Destination Choice Utility Function

Variable Name	Choice 1		Choice 2		Choice 3	
	Coeff.	Test Statistic	Coeff.	Test Statistic	Coeff.	Test Statistic

COMPARISON OF OBSERVED VS. ESTIMATED DATA

Comparison of the observed survey data to the model output data for the base (calibration) year. The comparisons may be at the aggregate level (e.g., average trip length) or disaggregate level (e.g., trip length frequency distribution).

Trip Purpose 2 Destination Choice Model

Trip Purpose 2 Destination Choice Model

(Use the same format as for the Trip Purpose 1 destination choice model).

Mode Choice

Description of the mode choice modeling step, including:

- *what is done within the step, in general, and its relationship to other steps in the modeling chain;*
- *the general structure of the models (i.e., model form and how they work);*
- *a listing of the modes/submodes represented within the models, together with the applicable market segments (e.g.; the transit walk access submode is available only for trips within ¼ mile of transit service); and*
- *the model development approach that was followed.*

Trip Purpose 1 Mode Choice Model

Trip Purpose 1 Mode Choice Model

Brief description of the model's function, relationship to other model components, and basic structure.

DEFINITION OF VARIABLES

Description of the input variables, including variable name and allowable values (discrete variables) and the data preparation method if a special procedure is used.

Name	Description	Values*	Preparation Method

* Discrete variables

CALIBRATED UTILITY FUNCTIONS

Listing of the model functions with calibrated coefficients.

$$U_{Mode 1} =$$

$$U_{Mode 2} =$$

•

•

•

$$U_{Mode n} =$$

ESTIMATED VARIABLE COEFFICIENTS

Listing of the coefficients developed in the model estimation process, together with their test statistic values.

Trip Purpose 1 Mode Choice Model

Auto Mode Utility Functions

Variable Name	Auto Submode 1		Auto Submode 2		Auto Submode 3	
	Coeff.	Test Statistic	Coeff.	Test Statistic	Coeff.	Test Statistic

Transit Mode Utility Functions

Variable Name	Transit Submode 1		Transit Submode 2		Transit Submode 3	
	Coeff.	Test Statistic	Coeff.	Test Statistic	Coeff.	Test Statistic

Non-motorized Mode Utility Functions

Variable Name	Non-motorized Submode 1		Non-motorized Submode 2		Non-motorized Submode 3	
	Coeff.	Test Statistic	Coeff.	Test Statistic	Coeff.	Test Statistic

Trip Purpose 1 Mode Choice Model

COMPARISON OF OBSERVED VS. ESTIMATED DATA

Comparison of the observed survey data to the model output data for the base (calibration) year. The comparisons may be at the aggregate level (e.g., overall mode shares) or disaggregate level (mode shares by income group).

Trip Purpose 2 Mode Choice Model

Trip Purpose 2 Mode Choice Model

(Use the same format as for the Trip Purpose 1 mode choice model).

Time-of-Day Factors

Time-of-Day Factors

Brief discussion of the use of time-of-day factors and the source of data for their development.

Mode 1 Time-of-Day Factors

Listing of the factors used for commonly modeled time periods (e.g., AM and PM one- and two-hour peaks).

Trip Purpose	Time Period			
	Time Period 1 ____ to ____	Time Period 2 ____ to ____	Time Period 3 ____ to ____	Time Period 4 ____ to ____
Purpose 1 P-A A-P Total				
Purpose 2 P-A A-P Total				
Purpose 3 P-A A-P Total				
Purpose 4 P-A A-P Total				

Time-of-Day Factors

Mode 2 Time-of-Day Factors

(Use same the same format as for the Mode 1 time-of-day factors).

Special Purpose Models

Special purpose models are developed and implemented outside of the main model structure described in the previous sections. These may include:

- *external models that are used to estimate internal-external, external-internal, and external-external travel;*
- *models for other trip types, such as truck trips; and*
- *models for special generators such as airports.*

Description should include:

- *a general definition of special purpose models and why they are needed; and*
- *a listing of the special purpose models that are used, together with their basic function.*

Special Purpose Model 1

Brief discussion of the model’s function, relationship to other model components, and general structure.

Note: If the special purpose model consists of several submodels (e.g., trip generation, trip distribution, and mode split), then the following sections should be included for each submodel, with a header line above the first section identifying the submodel.

MODEL SURVEY DATA

Description of the survey data that was used for model development, including the source of the data.

MODEL DEVELOPMENT APPROACH

Description of the primary steps involved in development of the model, including how the survey data was used and any results from the individual steps in the process.

DEFINITION OF VARIABLES

Description of the input variables, including variable name and allowable values (discrete variables) and the data preparation method if a special procedure is used.

Name	Description	Values*	Preparation Method

* Discrete variables

CALIBRATED MODEL FUNCTIONS

Listing of the model functions with calibrated coefficients.

COMPARISON OF OBSERVED VS. ESTIMATED DATA

Comparison of the observed survey data to the model output data for the base (calibration) year. The comparisons may be at the aggregate level (e.g., total airport trips) or disaggregate level (e.g., airport trips by district of origin or mode of access).

Special Purpose Models – Model 2

Special Purpose Model 2

(Use the same format as for Model 1)

Assignment

Assignment

Description of the trip assignment modeling step, including what is done within the step in general, as well as its relationship to other steps in the modeling chain.

Auto Assignment

Description of:

- *the assignment method (e.g., multi-class) and basic underlying principles;*
- *the form of volume-delay functions (e.g., conical), together with a listing of the functions in an appendix; and*
- *any special assignment procedures, such as conversion of truck trips to passenger car equivalents.*

Transit Assignment

Description of:

- *the assignment method (e.g., multi-path) and basic underlying principles;*
- *the path parameters (weighting factors) that are used and their values; and*
- *any special assignment procedures that are used.*

Note: The comparison of observed vs. estimated (assigned) trips for the trip assignment models is done as a part of the overall model validation described in the following section.

VIII. Model Validation

Model validation is an assessment of the model's overall performance by comparison of the estimated auto and transit volumes from the assignment models to observed volumes (i.e., traffic counts and transit boardings). Description of the model validation should include an explanation of the statistical comparisons that were used, followed by a presentation of the findings. Examples of aggregate and disaggregate comparisons include:

Auto Mode (assigned volumes vs. counts)

- *Screenline volumes;*
- *Scatterplots (all links plus links by facility or volume class);*
- *Percent root mean squared error (all links plus links by facility or volume class);*
- *VMT (regionwide and by district);*
- *Number and percentage of links by error range (e.g., 0% to +15%, 0% to -15%, +15% to +30%, -15% to -30%, etc.) for all links and by facility or volume class;*
- *Number and percentage of links with positive or negative error for all links and by facility or volume class; and*
- *Cumulative number and percentage of links by error range (e.g., + or - 15%, + or - 30%, etc.) for all links and by facility or volume class.*

Transit Mode (estimated vs. observed boardings)

- *Scatterplots (all routes); and*
- *Percentage error (all routes or by route type or transit submode).*

Appendix A

VOLUME DELAY FUNCTIONS

Appendix A contents here.

Appendix B

Appendix B contents here.