CAMBRIDGE SYSTEMATICS

Model User Guide

2010 Travel Behavior Inventory

Final

user guide

prepared for

Metropolitan Council

prepared by

Cambridge Systematics, Inc.

June 25, 2015

www.camsys.com

report

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Cambridge Systematics, Inc.
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1.0 Introduction

This free-standing report provides a User's Guide on how the **Population Synthesizer** and the 49 components of the **Activity Model Framework** developed in TourCast have been combined with the **truck model, special generator model** and the **external model** to describe every individual's travel and their activities within detailed time and space constraints.

This report goes into great detail on how the **TourCast activity based model** has been **implemented within Cube**, a modeling software framework. The report provides a "how to" guide to users in the Metropolitan Council and members of the transportation community who will be using this model. This guide should be used along with the **Model Estimation and Validation Report** to provide the full background to this model.

To put the activity modeling work in a broad context, we provide a summary of the four major categories of models that exist in the ABM framework:

- **Long-term Models.** This category includes captures decisions with a longer time horizon including as the location of one's regular workplace, school location, vehicle availability, and transit and toll transponder pass ownership.
- **Daily Activity Patterns** simulated through a series of models including:
  - Daily activity pattern model that determines the number and types of activities in which an individual is expected to participate;
  - Mandatory tour generation (work, university, and school);
  - School escorting, which simulates whether children with a school tour are escorted by another family member;
  - Joint non-mandatory tour participation, which simulates the number of tours undertaken jointly by members of the same household; and
  - Individual non-mandatory tour generation.
- **Tour Level Models** incorporate interrelationships among trips that are components of a tour which typically departs from home, visits one or more activity locations, and then returns home. Tour-level models provide an improved way to account for mode, time-of-day, and joint travel decisions.
- **Trip/Stop Level Models**. Within each tour, non-primary stops are modeled as intermediate stops. For tours with intermediate stops, separate models that capture the destination of the stop, the mode of travel, and the time-of-day of travel are developed. These models are constrained by the choices already made at the tour-level and therefore, allow for a more realistic decision-making process for every individual trip.

2.0 Installation and Implementation Overview

The Metropolitan Council activity based model (ABM) is powered by TourCast is built to take advantage of multi-core processors within a single machine running the Windows Server or Windows 7 operating system.

2.1 HARDWARE REQUIREMENTS

Below are the requirements for an efficient ABM operation. The program will work on systems with less RAM and processors, e.g. a laptop with 8GB RAM and 4 cores, although it will perform better on the configuration defined below:

- Hard disk capacity:
  - ~50GB per scenario
- RAM requirements
  - 16GB
- CPU requirements
  - 8-16 core processors
  - Processor speed matters nearly as much as number of cores, e.g. a 3.4GHz i7 processor with 4 cores may outperform a 2.4GHz Xeon processor set with 24 cores

2.2 SOFTWARE REQUIREMENTS

These are the minimum requirements to run the ABM with TourCast

- PopGen
- Cube 6.1.1 (Aug 05 2014 or later) with Cube Cluster
  - Confirm that the Program Files\Cube\Voyager directory contains the cubevoyager.lci file. The LCI file is the same for both 32 and 64 bit, copy it from your 32 bit directory if it is not present.
- ArcGIS version 10.0 or higher
- Python 2.6 or 2.7 (Python 3.x has not been tested)
  - Ensure that Python.exe is included in the PATH variable
- Visual Studio Redistributable or Visual Studio 2010 or later

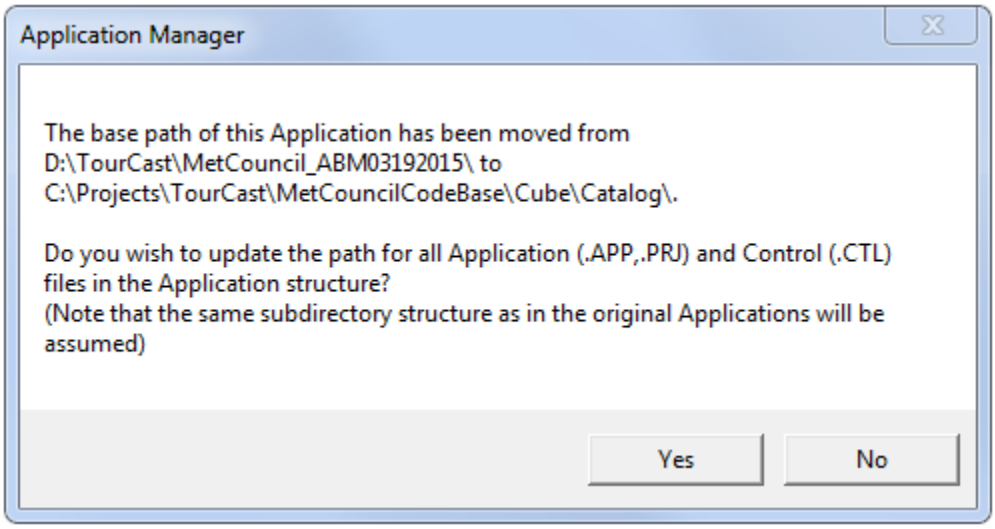
  - http://www.microsoft.com/en-us/download/confirmation.aspx?id=30679

- TourCast binaries and configuration scripts (included as part of model zip file)

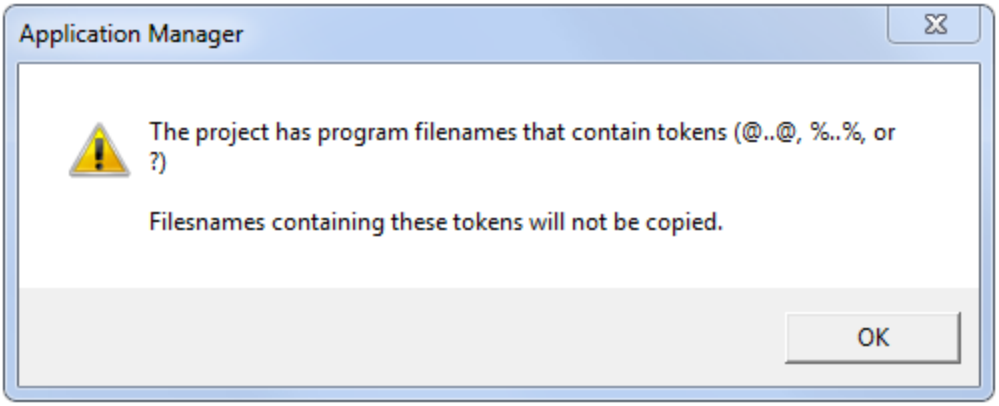
2.3 INSTALLATION PROCESS

This section describes the process to install the model.

1. Ensure that the required software is present
2. Choose a location on the computer to unzip the model. The intermediate and final data will be generated within the model folder, so select a location that has sufficient storage (~30GB per speed feedback).
   - NOTE: do not install the model to a directory that begins with a lowercase "t". Cube scripts interpret "/t" as a tab character.
3. Using Cube, open the MetCouncil.cat security catalog file. Click "Yes" when prompted to update the Application structure path.



You may also see the following warning message appear several times as the path is updated, they are benign and you can just click "OK" to each one:



Once the catalog is open, you should see the Root application group. Details of each application group are provided in the following Catalog Overview section.

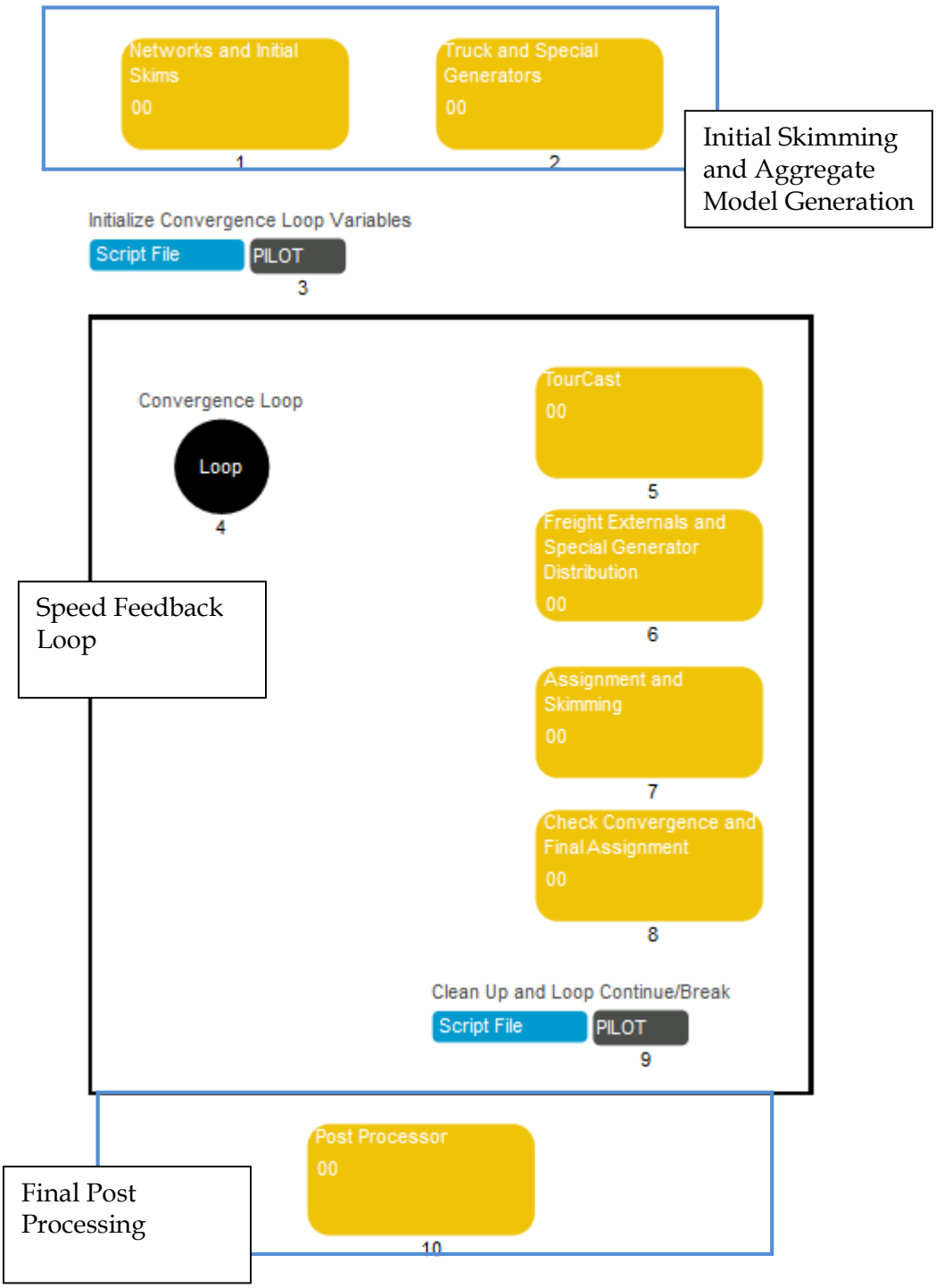
2.4 FOLDER STRUCTURE

Within the catalog directory that has been expanded there are the following folders:

- **Cube**: Cube application group (*.APP) and script files (*.S)
- **Input**: synthesized population, highway factors, and external/special generator parameters
    - **freight**: freight model parameters
    - **network**: geodatabase and transit line file
    - **skims**: loaded highway and transit skims to prime first iteration (optional)
    - **transit**: transit factor, line, fare, and system files.
- **Doc:** user documentation and validation reports
- **TourCast:**
    - **bin:** TourCast executables and libraries
    - **logs:** log output from TourCast
    - **script:** TourCast model component configuration files

2.5 CATALOG OVERVIEW

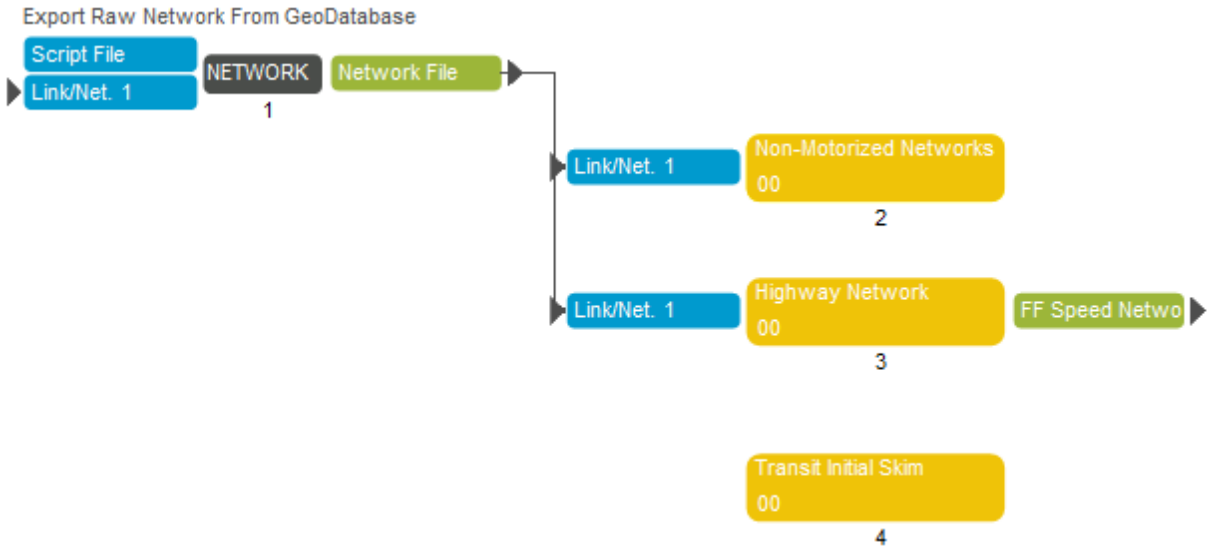
At a high level MetCouncil ABM catalog is organized with initial skimming and trip generation, a speed feedback loop, and a post processor group.



Initial Skimming and Aggregate Model Generation

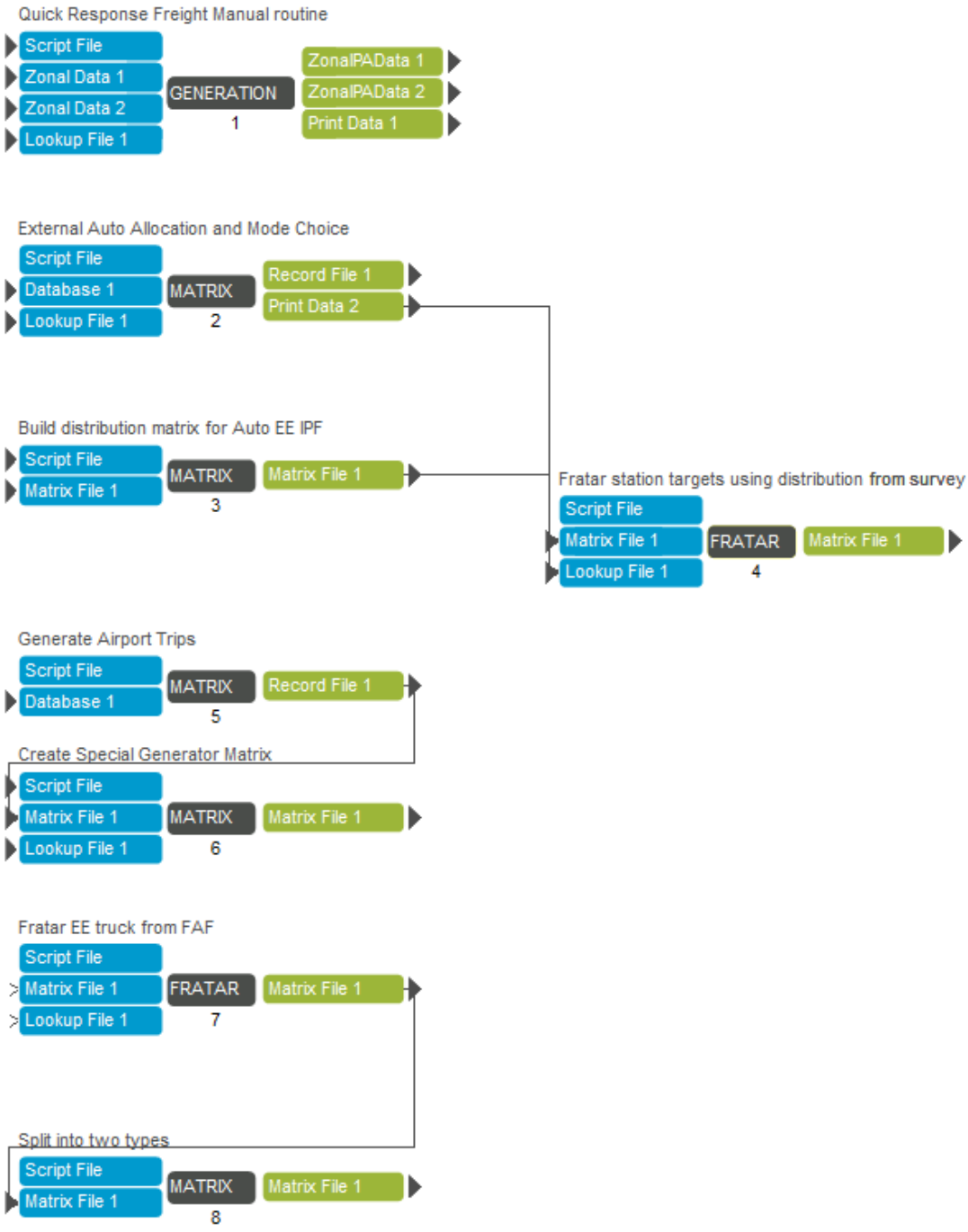
The initial skimming and aggregate model generation includes model operations that do not change across speed feedback iterations, such as unloaded networks and special generator productions. Also, the skim inputs are prepared in these application groups for the first iteration.

Networks and Initial Skims – Group 1



This group exports the complete network from the geodatabase, which includes highway, transit and non-motorized links. Free-flow skims are generated for the non-motorized modes at a daily level, highway for four time periods, and transit for a peak and off-peak time period. The highway network application group also produces a network for static assignment for each of the time periods with their specific reversible lane configurations.

Truck and Special Generators – Group 2



This group models the part of external model components that are constant across speed-feedback iterations.

Truck model: generate productions and attractions.

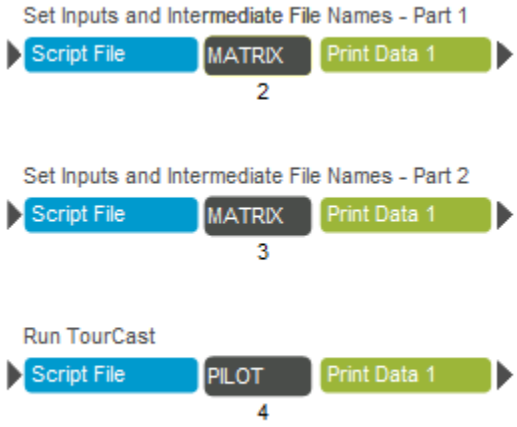
External model: distribute auto and truck trips between stations through a fratar process.

Airport: generate trips to the airport at each zone.

Speed Feedback Loop

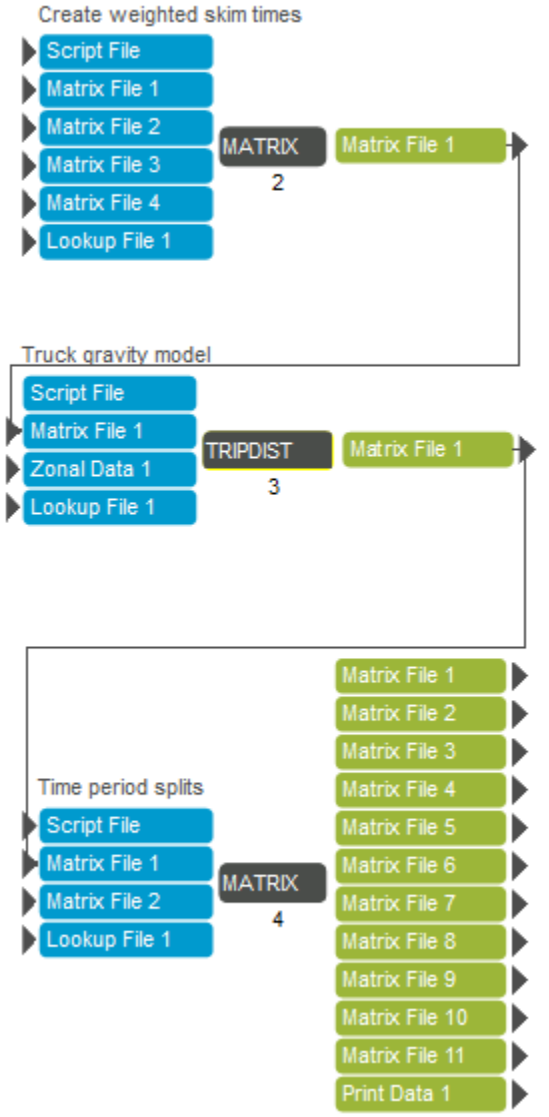
Each speed feedback loop begins with the disaggregate demand models powered by TourCast. Next the aggregate models are updated with the current iteration skim data and distribution of person trips from TourCast. The trip tables from the disaggregate and aggregate models are then combined for highway and transit assignment. After the first iteration, the assigned link volume is compared to the convergence threshold. If the current iteration results are within the convergence threshold, then a final set of highway assignments and transit assignments are completed and the loop exits.

TourCast – Group 5



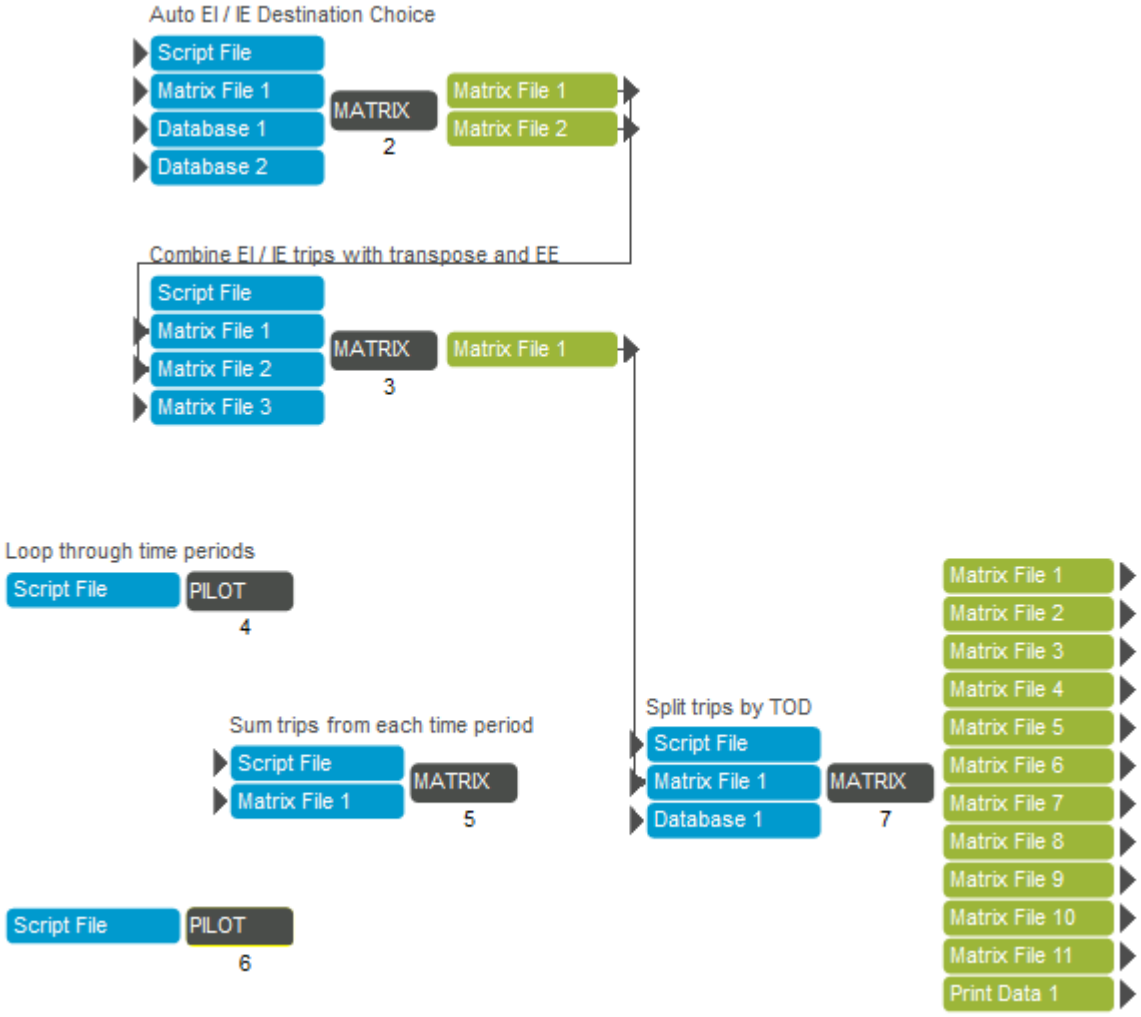
TourCast runs by calling the ModelEngine.exe file in the TourCast\bin folder of the catalog and passing the component configuration file(s) as arguments. In order to call an external program from within Cube Catalog and capture error codes from the external program, a batch program needs to be dynamically created and called. The first two Matrix programs within this application group set the input and output file names for this speed feedback iteration and the Pilot program assembles the TourCast calls according to the components selected through the scenario manager.

Freight – Group 6.1



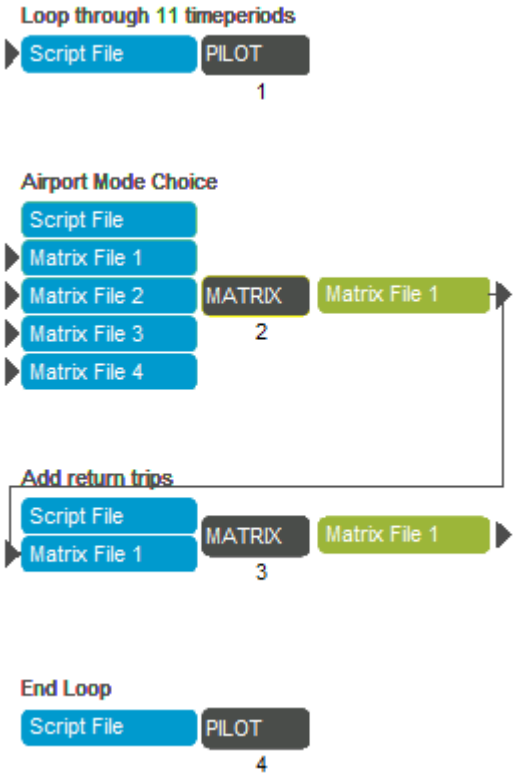
This group uses the weighted skim times from the previous iteration assignment, or the free-flow skims if the initial iteration, to distribute the internal to internal (II) truck trips (TRIPDIST 3). The distributed II trips and the external-external (EE) truck trips are combined (MATRIX 4) and split into the 11 time periods for assignment.

External Autos – Group 6.2



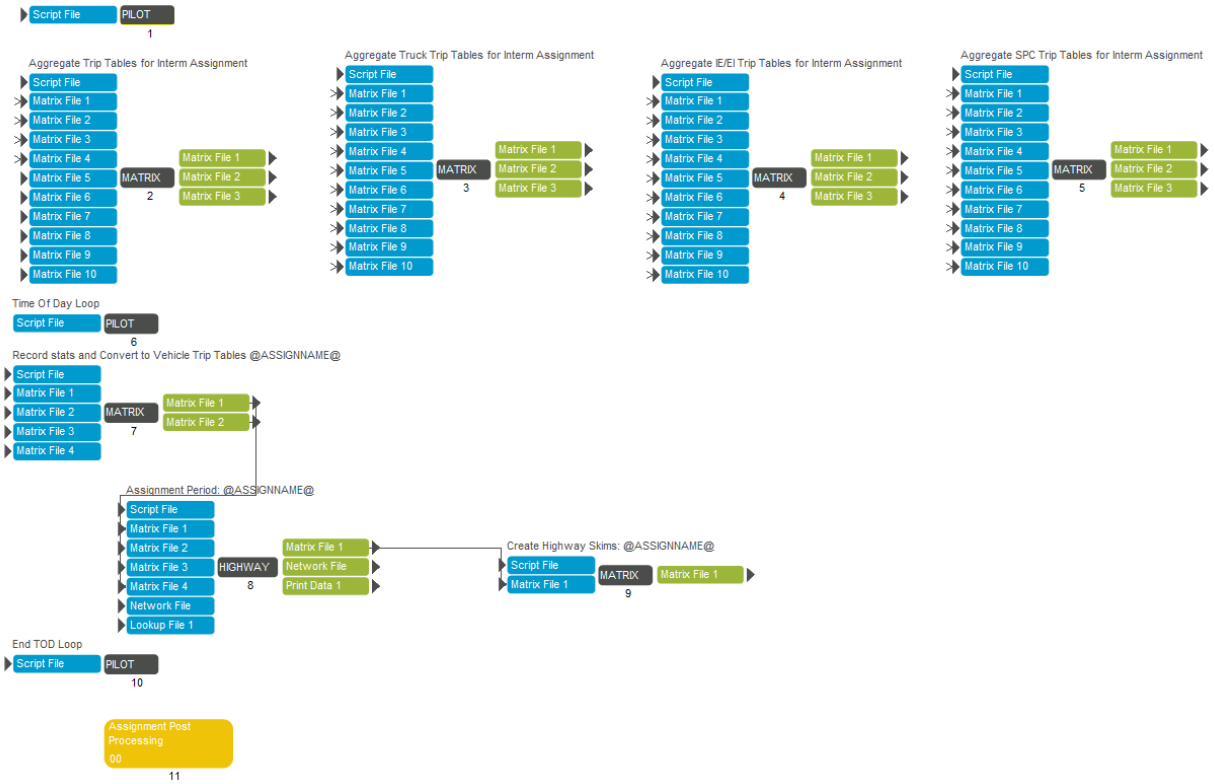
This group first runs a destination choice on the external-internal (EI) and internal-external (IE) trips using the AM Peak skim from the previous iteration (MATRIX 2). The EI and IE trips are then combined with the external-external trips and split by time of day. The time of day splits are determined by calculating the time of day splits from the TourCast person trip tables (PILOT4 – PILOT 6).

Special Generator – Group 6.3



This group applies the mode choice model for each time period to produce the mode splits for airport trips (MATRIX 2). The airport return trips are added as well as additional trips that account for drop-off and pick-up activity (MATRIX 3).

Highway Assignment – Group 7.1

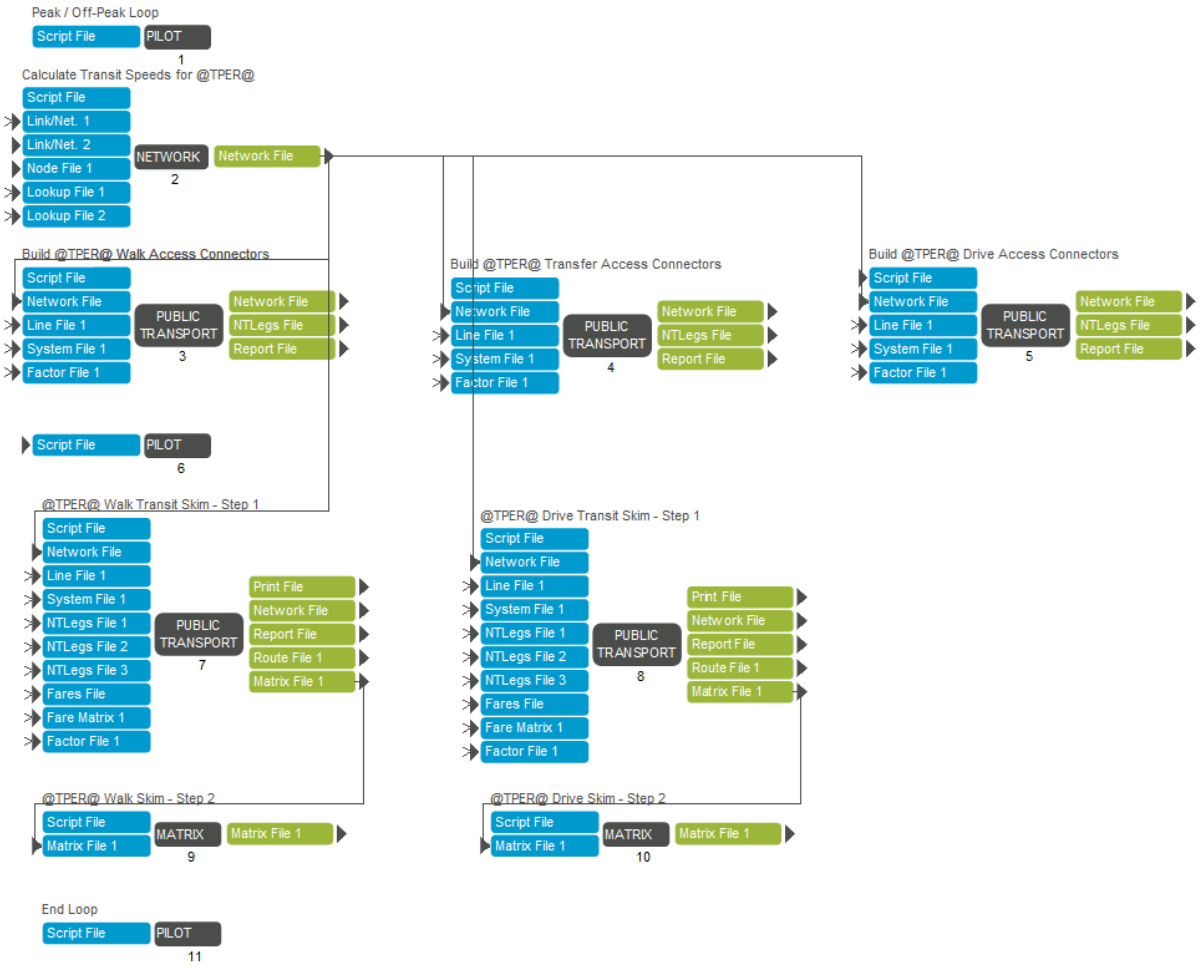


This highway assignment is the convergence loop assignment that only assigns four time periods, as opposed to the final highway assignment that assigns eleven time periods. Therefore, the first step in this group is to aggregate the eleven time period tables into four time periods (MATRIX 2 – MATRIX 5).

The group then loops through each time period, converts from person to vehicle trip tables (MATRIX 7), runs the assignment and collects skims (HIGHWAY 8 – MATRIX 9).

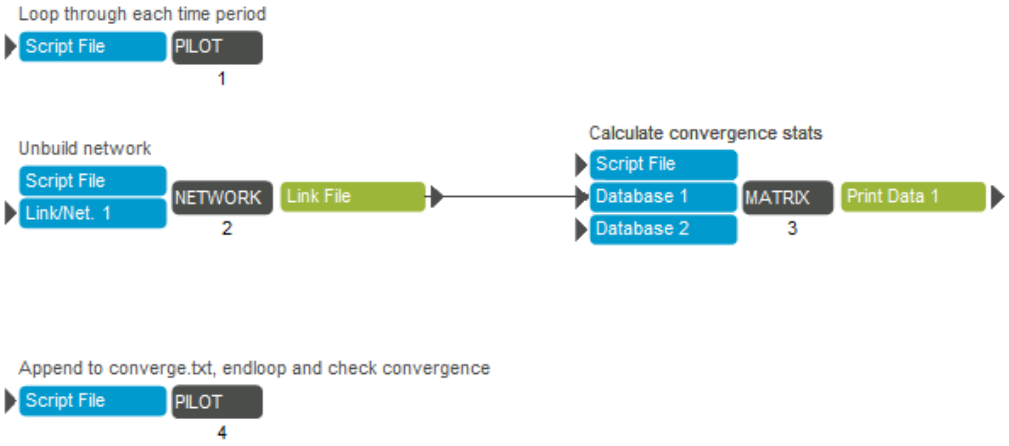
The last step of the highway assignment is to combine the four assignment networks into a single loaded network and export the results to a CSV file for reporting (Assignment Post Processing 11).

Transit Skims – Group 7.2



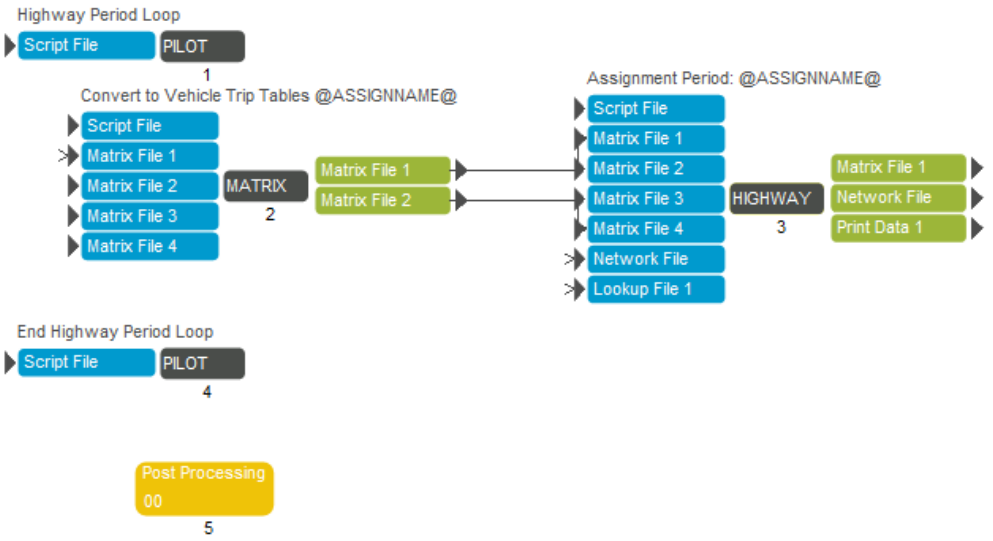
This group updates the transit speeds and access connectors according to the highway assignment results from the previous step. Next, the updated speeds are used to generate a new set of transit skims. This is done for the peak and off-peak time periods.

Convergence Check – Group 8.3



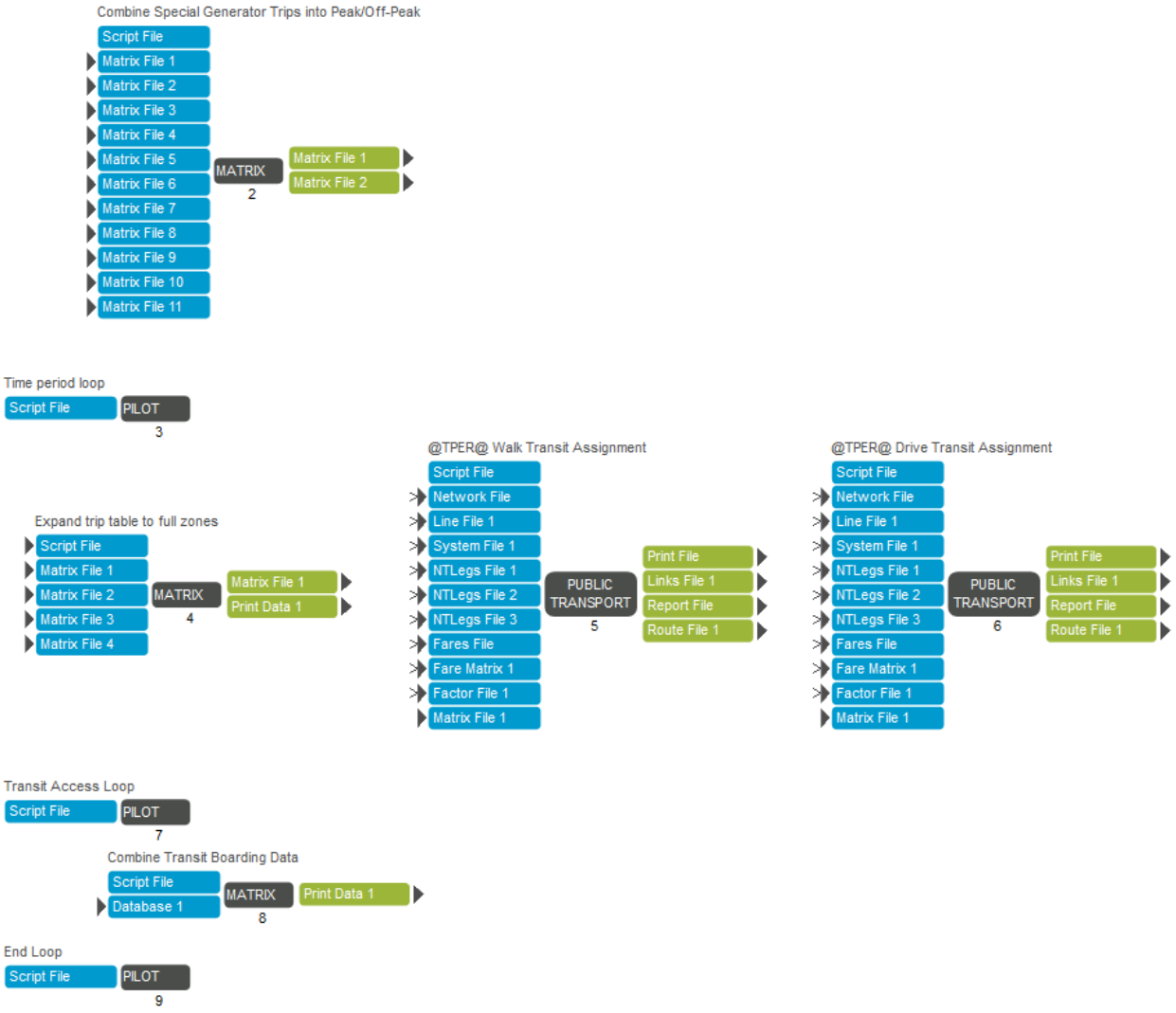
After the second iteration, the highway assignments are compare to the previous iteration to see if the highway volume has changed in a manner greater than the convergence thresholds. Convergence is checked for each time period and the speed feedback loop continues if convergence is not reached for all time periods. The convergence status is appended to the **converge.txt** file in the scenario directory.

Assign Highway and Transit – Group 8.7



If convergence has been reached, then the eleven time period highway assignment and transit assignment are run. The post processing step at the end of the eleven time period assignment combines the results of each time period as well as the results from the four time period assignment into a single network for analysis.

Transit Assignment – Group 8.7.5



This group assigns the walk-transit and drive-transit trip tables for peak and offpeak periods. To avoid Cube errors where a trip is assigned to an interchange with no transit path, trips without a path are removed from the table (MATRIX 4). The number of trips removed is recorded in the **XIT_TRIP_PRN_@ITER@_@TPER@.trp** file.

Final Post Processing

Currently all post processing is done within the speed feedback loop. This application group is kept as a placeholder for future post processing that may be added.

3.0 Preparing a Model Run

3.1 INPUT DATA AND PARAMETER FILES

The input files required to run the ABM are the following:

- Highway, Non-Motorized, and Transit Network
- Synthesized Population
- Zonal data
- Aggregate model parameters
- TourCast component configuration files

This section describes the input files and their contents at a high level.

Network

- Stored in a GeoDatabase
  - Highway (including non-motorized links)
    - » Single network for entire day
    - » Built into time-period networks within the catalog operation
  - Transit
    - » Also stored in GeoDatabase to maintain consistency with highway links
- Transit line file associated with highway network
  - Selected lines exported from highway network
- Non-motorized network
  - Includes special bike/walk links and excludes limited access links
  - Links are categorized by type with different effective bike speeds and factors applicable to each.
- Highway and Transit network parameters are defined in text files in the inputs directory.
- Fields are defined in **Appendix A**

Synthesized population

- Population synthesizer produces Households and Persons dbf files
  - Associated with a zone

  - Person categorized by type, age
  - Households categorized by income
  - Other fields generated to reduce computations in TourCast
- Fields are defined in **Appendix A**

Socio-economic data

Data associated with each zone

- Households and Employment
  - Totals
  - Mixed use density = $\frac{(\text{HH density}) * (\text{Employment Density})}{\max(1, (\text{HH density}) + (\text{Employment Density}))}$
- University Enrollment
  - Within the zone and a buffer around the zone
- Accessibilities
  - Highway accessibility and transit accessibility to employment. These accessibility measures are computed as follows:

    A_i = Accessibility for TAZ_i

    $$A_i = \ln\left(1 + \sum_j TotEmp_j \cdot \exp\left[\frac{-C \cdot T_{ij}}{\overline{T}}\right]\right)$$

    Where:

    $TotEmp_j$ = Total employment in TAZ_j.

    T_{ij} = Peak non-HOV auto travel time or transit time from TAZ_i to TAZ_j.

    $$\overline{T} = \frac{\sum_j \sum_i T_{ij}}{\text{Number of zone pairs}}$$

    Note: For transit, only pairs with transit connection are counted

    $$C = \begin{cases} 10 \text{ for auto accessibility} \\ 15 \text{ for transit accessibility} \end{cases}$$

    Acc_i = Ratio of auto accessibility during the peak hours to transit accessibility during the peak hours

    $$Acc_i = A_{i,Auto} \Big/ 1 + A_{i,Transit}$$

  - Walk-transit access
- School Location
  - Nearest 10 schools by type to each zone
- Area Type and Terminal Time

- Population and employment density are used to determine a zones area type. To smooth out the effect of neighboring zones of different characteristics, a zone's area type is determined by the population and employment density of itself and each of the zones that border the zone. For example, if a zone borders three other zones, its own density and that of the other three zones are combined to establish the density that is used to determine the area type. Table 3-1 shows the population and employment density thresholds that are used to determine the area types. This is similar to the previous process, with minor changes to create a smoother transitions between zone types.
- Terminal time is directly correlated with area type.

Table 3-1: Area Type Population and Employment Densities

Description	Area type	Pop Density		Emp. Density	
		Low	High	Low	High
Rural	1	0	500	0	3,000
Developing	2	500	3,000	0	2,500
Developed	3	3,000	5,000	0	4,000
Residential Core	4	5,000	1,000,000	0	20,000
Business Core	5	0	1,000,000	20,000	1,000,000
Other Buss. Core	6	0	5,000	2,500	20,000

Fields names and descriptions are defined in **Appendix A**

Aggregate model parameters

Aggregate model parameters define the production and attraction rates, time of day and mode splits for the following:

- Truck Model
- External Trips
- Airport Trips

The aggregate model parameter files are identified in **Appendix A**.

TourCast component configuration files

Each disaggregate demand model includes a main configuration file and may require several configuration files to be fully defined. The configuration files define the following:

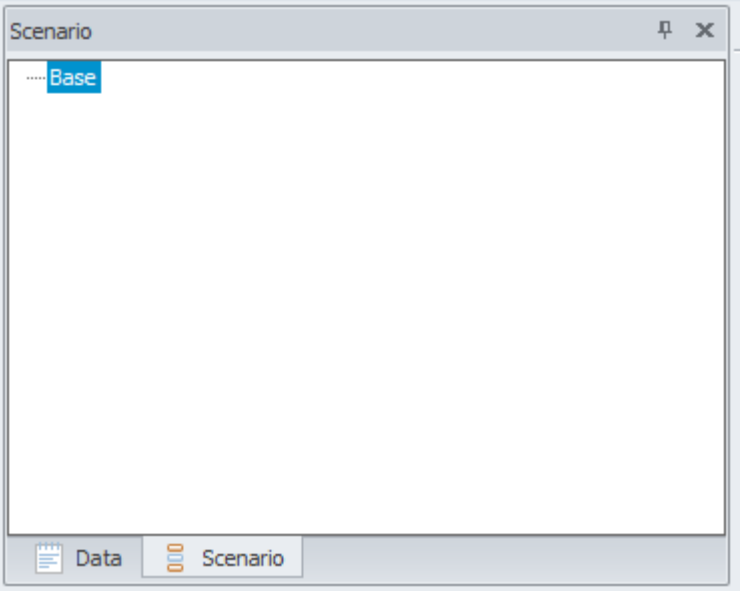
- Component type
- Alternatives

- Variables and coefficients
- Nest structure
- Model parameters
- Segmentation

The configuration files associated with each component are defined in **Appendix A.**

3.2 CUBE CATALOG SCENARIO MANAGER

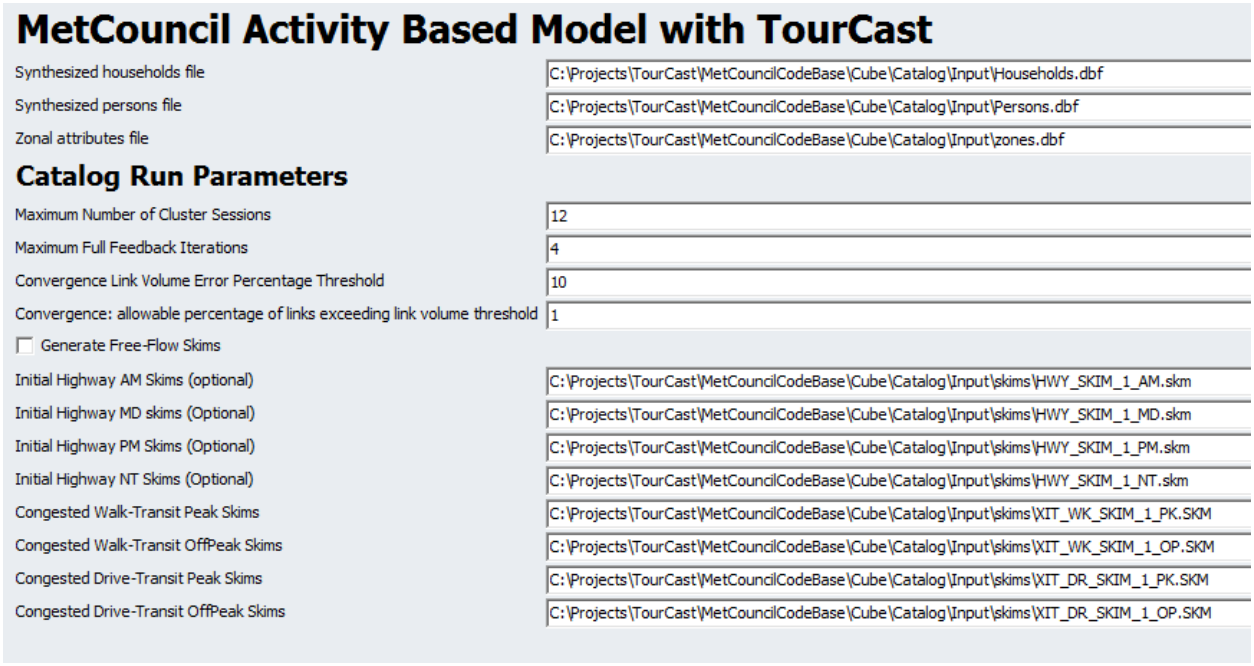
The catalog scenario manager can be used to specify the scenario input files and parameters. To access the scenario manager, open the MetCouncil_ABM.cat security catalog file in Cube and double click the desired scenario in the Scenario window.



The scenario manager is contains four pages, organized by:

- Major Inputs and Run Parameters;
- TourCast Operational Control;
- Highway and Non-Motorized Parameters; and
- Public Transit

Major Inputs and Run Parameters

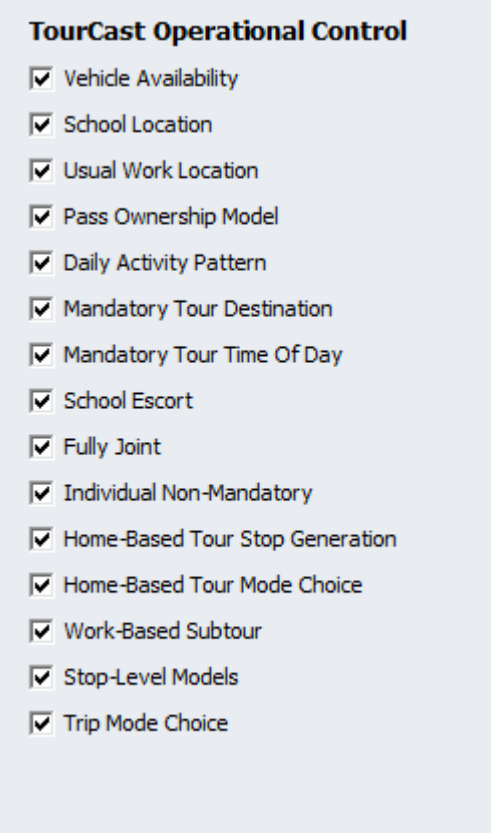


The Major Inputs specified in the first three lines are the synthesized population household and persons file and the zonal attributes. By default, these files are stored in the Inputs folder in the catalog directory.

The Catalog Run Parameters specify the catalog parameters and initial skim inputs:

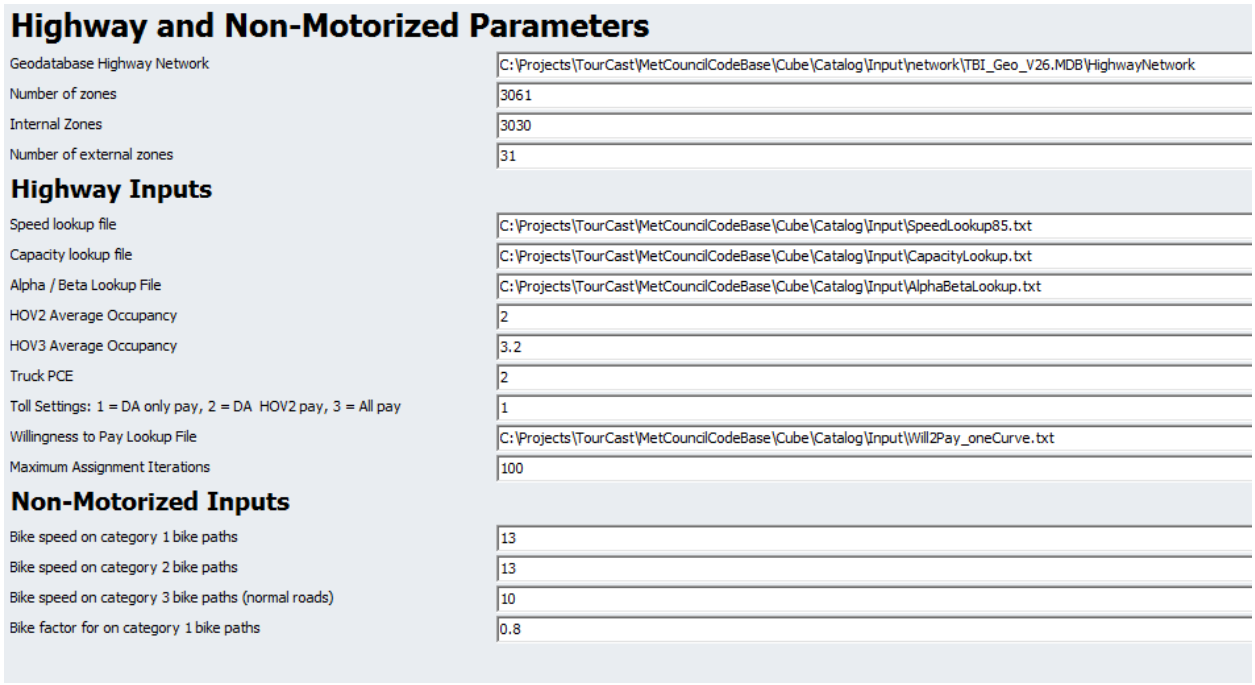
- Maximum number of Cluster Sessions: this should be set to a value less than or equal to the number of CPU cores in the computer.
- Convergence Criteria: the catalog will run speed feedback iterations until either the convergence thresholds are reached or the Maximum Full Feedback Iterations is met. The convergence criteria is applied by time period and is met if fewer than 1% of links differ in volume by more than 10% (numbers from configuration shown in figure above).
- Convergence can be hastened by using highway and transit skim inputs from a previous model run. These skim files are specified in the 8 lines at the bottom of this tab. These files will be used as the initial skim inputs unless the **Generate Free-Flow Skims** box is checked.

TourCast Operational Control



The second tab of the Scenario Manager interface contains a series of check-boxes that are associated with the TourCast component groups in their order of execution. By default, all TourCast components are selected. NOTE: the TourCast components are loosely coupled, but deselecting component(s) means that some input data to downstream components will not be generated and must be made available in the scenario directory manually. This will be discussed further in the section on Running a Partial Model.

Highway and Non-Motorized Parameters



Highway and Non-Motorized Parameters

Geodatabase Highway Network	C:\Projects\TourCast\MetCouncilCodeBase\Cube\Catalog\Input\network\TBI_Geo_V26.MDB\HighwayNetwork
Number of zones	3061
Internal Zones	3030
Number of external zones	31
Highway Inputs	
Speed lookup file	C:\Projects\TourCast\MetCouncilCodeBase\Cube\Catalog\Input\SpeedLookup85.txt
Capacity lookup file	C:\Projects\TourCast\MetCouncilCodeBase\Cube\Catalog\Input\CapacityLookup.txt
Alpha / Beta Lookup File	C:\Projects\TourCast\MetCouncilCodeBase\Cube\Catalog\Input\AlphaBetaLookup.txt
HOV2 Average Occupancy	2
HOV3 Average Occupancy	3.2
Truck PCE	2
Toll Settings: 1 = DA only pay, 2 = DA HOV2 pay, 3 = All pay	1
Willingness to Pay Lookup File	C:\Projects\TourCast\MetCouncilCodeBase\Cube\Catalog\Input\Will2Pay_oneCurve.txt
Maximum Assignment Iterations	100
Non-Motorized Inputs	
Bike speed on category 1 bike paths	13
Bike speed on category 2 bike paths	13
Bike speed on category 3 bike paths (normal roads)	10
Bike factor for on category 1 bike paths	0.8

This section specifies the highway network and parameters files and specifics on the highway network build and assignment.

In the first section, the geodatabase and highway network are specified along with the network zone size with internal and external zone ranges.

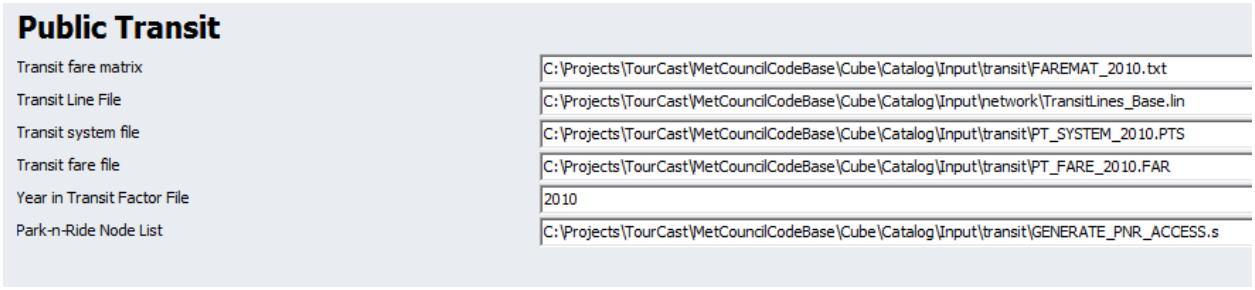
The **Highway Inputs** section contains:

- Static assignment parameter files with speed, capacity, and alpha/beta to be associated with each link;
- Average occupancy for HOV2 and HOV3 modes, which is used to convert from TourCast person trip outputs to vehicle trips for assignment;
- Truck PCE: passenger car equivalents of each truck;
- Toll parameters, including the modes that will be required to pay a toll and the lookup file containing the willingness to pay (value of time) curve segmented by income category and trip purpose.
- Maximum iterations to run for the highway static assignment

The **Non-Motorized Inputs** section contains:

- Effective bike speed on the three category of bike paths and a benefit factor for category 1 bike paths. These are used to generate a weighted bike time skim to be input into TourCast.

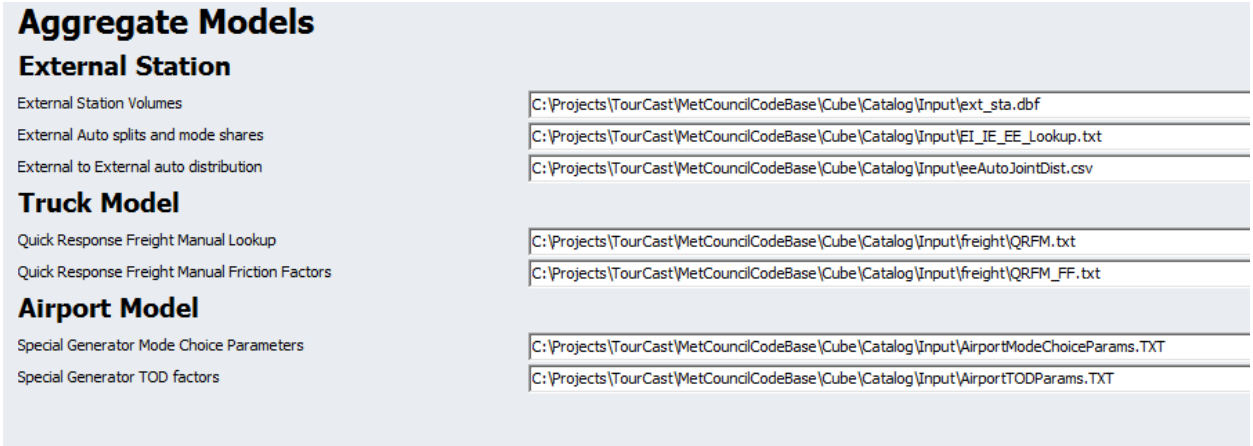
Public Transit



This section specifies the public transit inputs. The transit input files are stored in the Inputs\Transit folder. The scenario keys specify:

- Transit line file that describes the path, operating time, and headway of each route;
- Transit fare and system files that describe parameters for each transit mode; and
- Year in Transit Factor File that is the character string in the Peak/OffPeak walk/drive transit factor files, which are assumed to be of the format (PK/OP)_(WK/DR)_YEAR.FAC where the "YEAR" is specified in this key. The transit factor files are described in this manner to avoid repetitive script sequences within the catalog across the two time periods.
- List of park and ride nodes.

Aggregate Models



The aggregate model inputs are segmented by external stations, truck model inputs, and the airport model inputs.

- The External Station inputs specify the vehicle volume targets at each external station, their splits by auto and truck and the split by occupancy for autos.
- The truck model keys specify the Quick Response Freight Manual parameters that are used to generate, split by time, and distribute truck trips in the model.
- The airport model keys specify the mode choice parameters and time of day factors for airport trips. The airport trips generation rate is scripted in the Airport Generation application group.

4.0 Population Synthesizer

4.1 SYNTHESIZED POPULATION GENERATOR

The synthesized population generator (PopGen) is an open source software developed by Arizona State University. It helps generate disaggregate synthetic population data for a region at any required geographic level by using distributions of household and person variables of interest and a sample of household data compiled from national data sources such as the 2005-2009 5 percent Public Use Micro Sampled Data (PUMS).

The software utilizes a standard iterative proportional fitting algorithm (IPF) to draw households from the sample data such that marginal distributions from the selected households match the distribution of the control data for the variables under consideration. The data inputs to PopGen are the following:

- Typically, households need to be synthesized at a TAZ level. Therefore, a geographic correspondence file must be developed that helps relate TAZs to county and PUMS information.
- Files that outline household and person level control totals for all variables of interest at the TAZ level.
- Sample files that contain sample household and person level information. As described above, PopGen draws households using selection probabilities to match the marginal distributions.

PopGen uses a iterative proportional updating algorithm for estimating household weights. The algorithm estimates sample household weights such that both household and person distributions are matched. So, based on a household's composition and the marginals that are provided as input, PopGen develops weights for households defined in the sample data. The following variables were defined as control target variables at a household and person level:

The synthesized population generator is run separately from the ABM Cube Catalog interface. The household and person files generated by PopGen are specified for use in the model through the scenario manager described below.

Step 1 – Preparation of the Input Files for PopGen

There is a total of five input files that need to be prepared. They include:

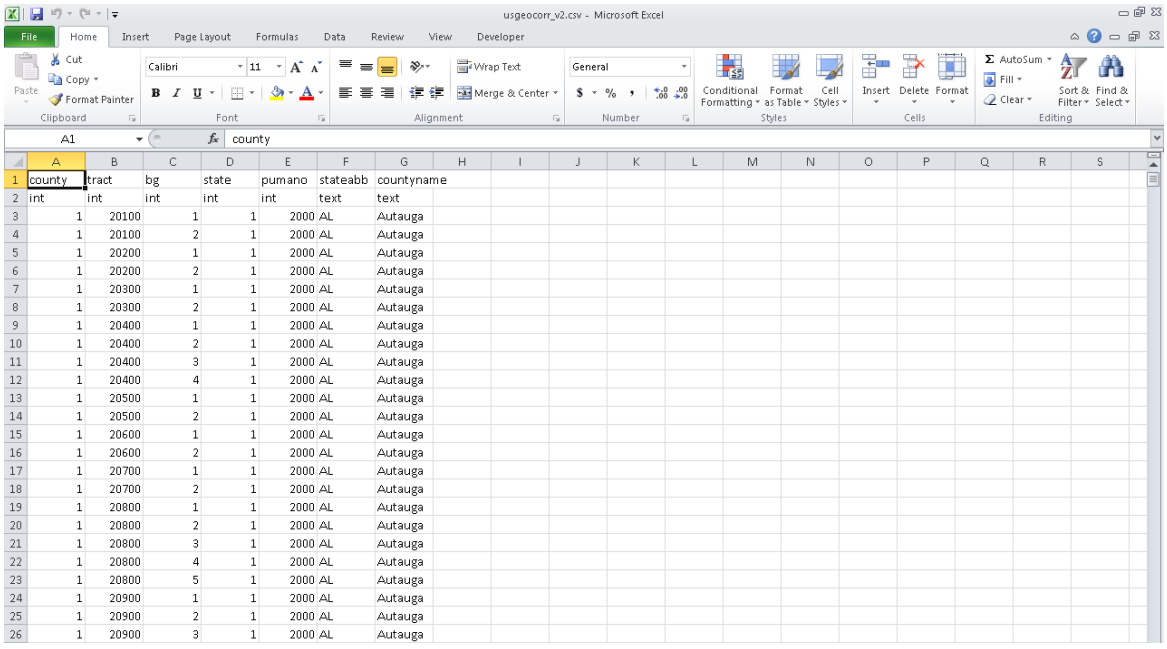
- Geographic correspondence file used to organize data by geography;
- Household file that provides the marginal control totals for households at a detailed zonal level provided by the Metropolitan Council;
- Person file that provides the marginal control totals for individuals at a detailed zonal level provided by the Metropolitan Council;

- Household sample file with regional distributions of household attributes and interrelationships based on the 2005-2009 PUMS data; and
- Person sample file with regional level distributions of individual characteristics based on the same 2005-2009 PUMS data.

The **geographic correspondence file** is shown in **Figure 4.1**. This needs to be prepared first and provides the basis for organizing the household and person level data by geography. This file connects geographies at different levels of detail including:

- County;
- Tract;
- Traffic analysis zone "bg" (TAZ);
- State;
- PUMA number "pumano";
- State abbreviation "stateabb"; and
- County name "countyname".

Figure 4.1 Data Fields in the Geographic File



usgeocorr_v2.csv - Microsoft Excel

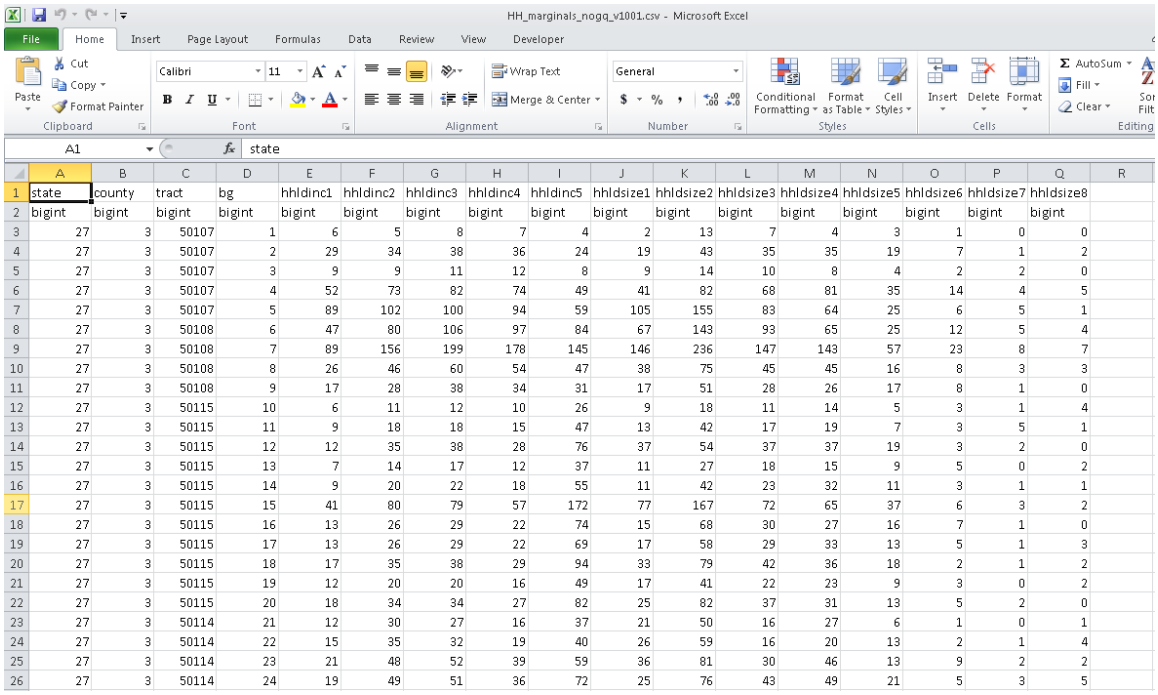
	A	B	C	D	E	F	G
1	county	tract	bg	state	pumano	stateabb	countyname
2	int	int	int	int	int	text	text
3	1	20100	1	1	2000	AL	Autauga
4	1	20100	2	1	2000	AL	Autauga
5	1	20200	1	1	2000	AL	Autauga
6	1	20200	2	1	2000	AL	Autauga
7	1	20300	1	1	2000	AL	Autauga
8	1	20300	2	1	2000	AL	Autauga
9	1	20400	1	1	2000	AL	Autauga
10	1	20400	2	1	2000	AL	Autauga
11	1	20400	3	1	2000	AL	Autauga
12	1	20400	4	1	2000	AL	Autauga
13	1	20500	1	1	2000	AL	Autauga
14	1	20500	2	1	2000	AL	Autauga
15	1	20600	1	1	2000	AL	Autauga
16	1	20600	2	1	2000	AL	Autauga
17	1	20700	1	1	2000	AL	Autauga
18	1	20700	2	1	2000	AL	Autauga
19	1	20800	1	1	2000	AL	Autauga
20	1	20800	2	1	2000	AL	Autauga
21	1	20800	3	1	2000	AL	Autauga
22	1	20800	4	1	2000	AL	Autauga
23	1	20800	5	1	2000	AL	Autauga
24	1	20900	1	1	2000	AL	Autauga
25	1	20900	2	1	2000	AL	Autauga
26	1	20900	3	1	2000	AL	Autauga

The **household marginal file** is shown in **Figure 4.2**. This file contains the total number of households at the traffic analysis zone ("bg") and provides information about household income and household size.

- **Household income** is provided with four income categories that are converted into five income categories by using the 2007-2011 ACS summaries at a county level[1].
- **Household size** is broken down into eight categories by grouping together households with eight or more members.

A first basic check that can be carried out is to ensure the consistency in the estimates of total households. The estimate of households in the region and at the TAZ level by income categories should equal the sum of households by household size. All entries in this table should be integers.

Figure 4.2 Household Marginal Totals File



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	state	county	tract	bg	hhldinc1	hhldinc2	hhldinc3	hhldinc4	hhldinc5	hhldsize1	hhldsize2	hhldsize3	hhldsize4	hhldsize5	hhldsize6	hhldsize7	hhldsize8	
2	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	
3	27	3	50107	1	6	5	8	7	4	2	13	7	4	3	1	0	0	
4	27	3	50107	2	29	34	38	36	24	19	43	35	35	19	7	1	2	
5	27	3	50107	3	9	9	11	12	8	9	14	10	8	4	2	2	0	
6	27	3	50107	4	52	73	82	74	49	41	82	68	81	35	14	4	5	
7	27	3	50107	5	89	102	100	94	59	105	155	83	64	25	6	5	1	
8	27	3	50108	6	47	80	106	97	84	67	143	93	65	25	12	5	4	
9	27	3	50108	7	89	156	199	178	145	146	236	147	143	57	23	8	7	
10	27	3	50108	8	26	46	60	54	47	38	75	45	45	16	8	3	3	
11	27	3	50108	9	17	28	38	34	31	17	51	28	26	17	8	1	0	
12	27	3	50115	10	6	11	12	10	26	9	18	11	14	5	3	1	4	
13	27	3	50115	11	9	18	18	15	47	13	42	17	19	7	3	5	1	
14	27	3	50115	12	12	35	38	28	76	37	54	37	37	19	3	2	0	
15	27	3	50115	13	7	14	17	12	37	11	27	18	15	9	5	0	2	
16	27	3	50115	14	9	20	22	18	55	11	42	23	32	11	3	1	1	
17	27	3	50115	15	41	80	79	57	172	77	167	72	65	37	6	3	2	
18	27	3	50115	16	13	26	29	22	74	15	68	30	27	16	7	1	0	
19	27	3	50115	17	13	26	29	22	69	17	58	29	33	13	5	1	3	
20	27	3	50115	18	17	35	38	29	94	33	79	42	36	18	2	1	2	
21	27	3	50115	19	12	20	20	16	49	17	41	22	23	9	3	0	2	
22	27	3	50115	20	18	34	34	27	82	25	82	37	31	13	5	2	0	
23	27	3	50114	21	12	30	27	16	37	21	50	16	27	6	1	0	1	
24	27	3	50114	22	15	35	32	19	40	26	59	16	20	13	2	1	4	
25	27	3	50114	23	21	48	52	39	59	36	81	30	46	13	9	2	2	
26	27	3	50114	24	19	49	51	36	72	25	76	43	49	21	5	3	5	

The **person marginal file** is shown in **Figure 4.3**. This contains total persons by traffic analysis zone ("bg") and provides information about individuals' gender, age, employment status and student status:

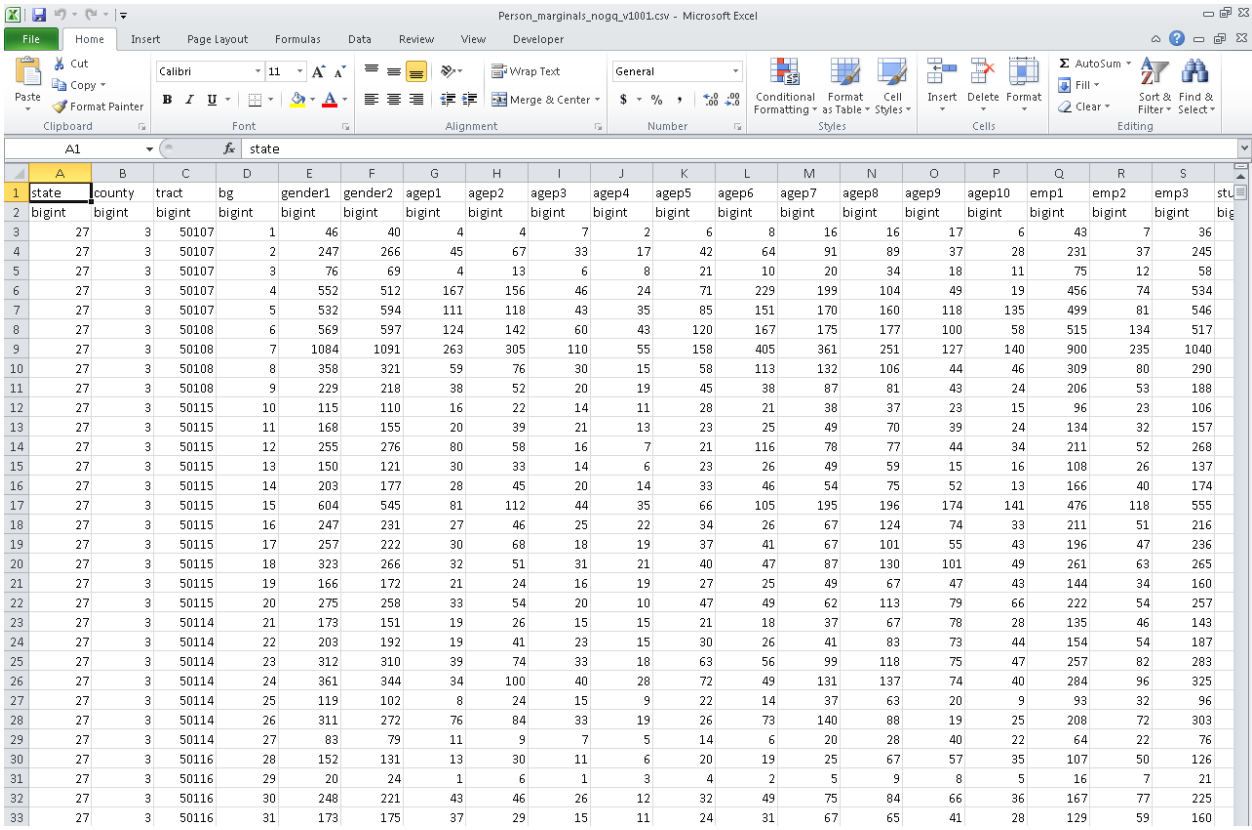
- Individuals' **gender** (male versus female);

[1] Household income categories included less than $25,000; between $25,000 and $50,000; between $50,000 and $75,000; between $75,000 and $100,000; and greater than $100,000. Metropolitan Council's land use model forecasts four income categories which are as follows: less than $35,000, between $35,000 and $59,999, between $60,000 and $99,999, and greater than $100,000. For purposes of model application, it was necessary to convert these four categories into the five income categories. County level factors were created using the 2007-2011 ACS data to make this conversion.

- Distribution of **age** using ten categories (ess than 6 years; 6 to 12 years; 13 to 15 years; 16 to 17 years; 18 to 24 years; 25 to 34 years; 35 to 44 years; 45 to 54 years; 55 to 64 years; 65 and over);
- Individual **employment status** using three categories (full time, part time, and unemployed); and
- **Student status** differentiating between students and nonstudent.

Similar to the household file, basic checks that can be carried out are to compare the estimates of total persons across the four variables are the same both for the region as a whole but also at the individual TAZ level. All entries in this table should be integers.

Figure 4.3 Person Marginal Totals File



Person_marginals_nogq_v1001.csv - Microsoft Excel

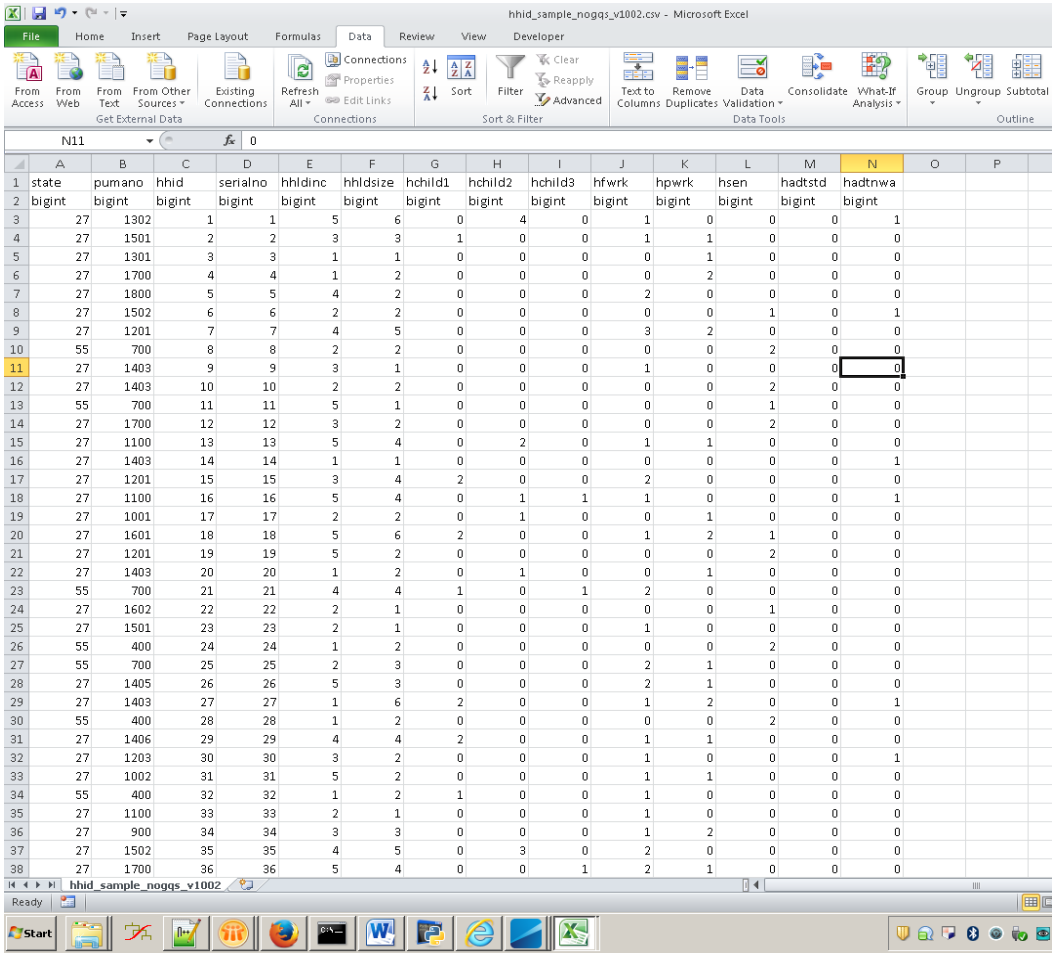
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	state	county	tract	bg	gender1	gender2	agep1	agep2	agep3	agep4	agep5	agep6	agep7	agep8	agep9	agep10	emp1	emp2	emp3
2	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint
3	27	3	50107	1	46	40	4	4	7	2	6	8	16	16	17	6	43	7	36
4	27	3	50107	2	247	266	45	67	33	17	42	64	91	89	37	28	231	37	245
5	27	3	50107	3	76	69	4	13	6	8	21	10	20	34	18	11	75	12	58
6	27	3	50107	4	552	512	167	156	46	24	71	229	199	104	49	19	456	74	534
7	27	3	50107	5	532	594	111	118	43	35	85	151	170	160	118	135	499	81	546
8	27	3	50108	6	569	597	124	142	60	43	120	167	175	177	100	58	515	134	517
9	27	3	50108	7	1084	1091	263	305	110	55	158	405	361	251	127	140	900	235	1040
10	27	3	50108	8	358	321	59	76	30	15	58	113	132	106	44	46	309	80	290
11	27	3	50108	9	229	218	38	52	20	19	45	38	87	81	43	24	206	53	188
12	27	3	50115	10	115	110	16	22	14	11	28	21	38	37	23	15	96	23	106
13	27	3	50115	11	168	155	20	39	21	13	23	25	49	70	39	24	134	32	157
14	27	3	50115	12	255	276	80	58	16	7	21	116	78	77	44	34	211	52	268
15	27	3	50115	13	150	121	30	33	14	6	23	26	49	59	15	16	108	26	137
16	27	3	50115	14	203	177	28	45	20	14	33	46	54	75	52	13	166	40	174
17	27	3	50115	15	604	545	81	112	44	35	66	105	195	196	174	141	476	118	555
18	27	3	50115	16	247	231	27	46	25	22	34	26	67	124	74	33	211	51	216
19	27	3	50115	17	257	222	30	68	18	19	37	41	67	101	55	43	196	47	236
20	27	3	50115	18	323	266	32	51	31	21	40	47	87	130	101	49	261	63	265
21	27	3	50115	19	166	172	21	24	16	19	27	25	49	67	47	43	144	34	160
22	27	3	50115	20	275	258	33	54	20	10	47	49	62	113	79	66	222	54	257
23	27	3	50114	21	173	151	19	26	15	15	21	18	37	67	78	28	135	46	143
24	27	3	50114	22	203	192	19	41	23	15	30	26	41	83	73	44	154	54	187
25	27	3	50114	23	312	310	39	74	33	18	63	56	99	118	75	47	257	82	283
26	27	3	50114	24	361	344	34	100	40	28	72	49	131	137	74	40	284	96	325
27	27	3	50114	25	119	102	8	24	15	9	22	14	37	63	20	9	93	32	96
28	27	3	50114	26	311	272	76	84	33	19	26	73	140	88	19	25	208	72	303
29	27	3	50114	27	83	79	11	9	7	5	14	6	20	28	40	22	64	22	76
30	27	3	50116	28	152	131	13	30	11	6	20	19	25	67	57	35	107	50	126
31	27	3	50116	29	20	24	1	6	1	3	4	2	5	9	8	5	16	7	21
32	27	3	50116	30	248	221	43	46	26	12	32	49	75	84	66	36	167	77	225
33	27	3	50116	31	173	175	37	29	15	11	24	31	67	65	41	28	129	59	160

The **household sample file** layout is shown in **Figure 4.4**. This file contains a sample of households (hhid) in each PUMA and traffic analysis zone ("bg") broken down by household income, household size and other household level variables. This file is built using the 2005-2009 PUMS data and provides the underlying distributions of household attributes in the region.

Finally, the **person sample file** shown in Figure 4.5 contains a sample of individual members of a household by state, pumano, hhid, gender, age, student status,

employment status, and household income. This file is also built using the 2005-2009 PUMS data and provides the distributions of individual characteristics in the region.

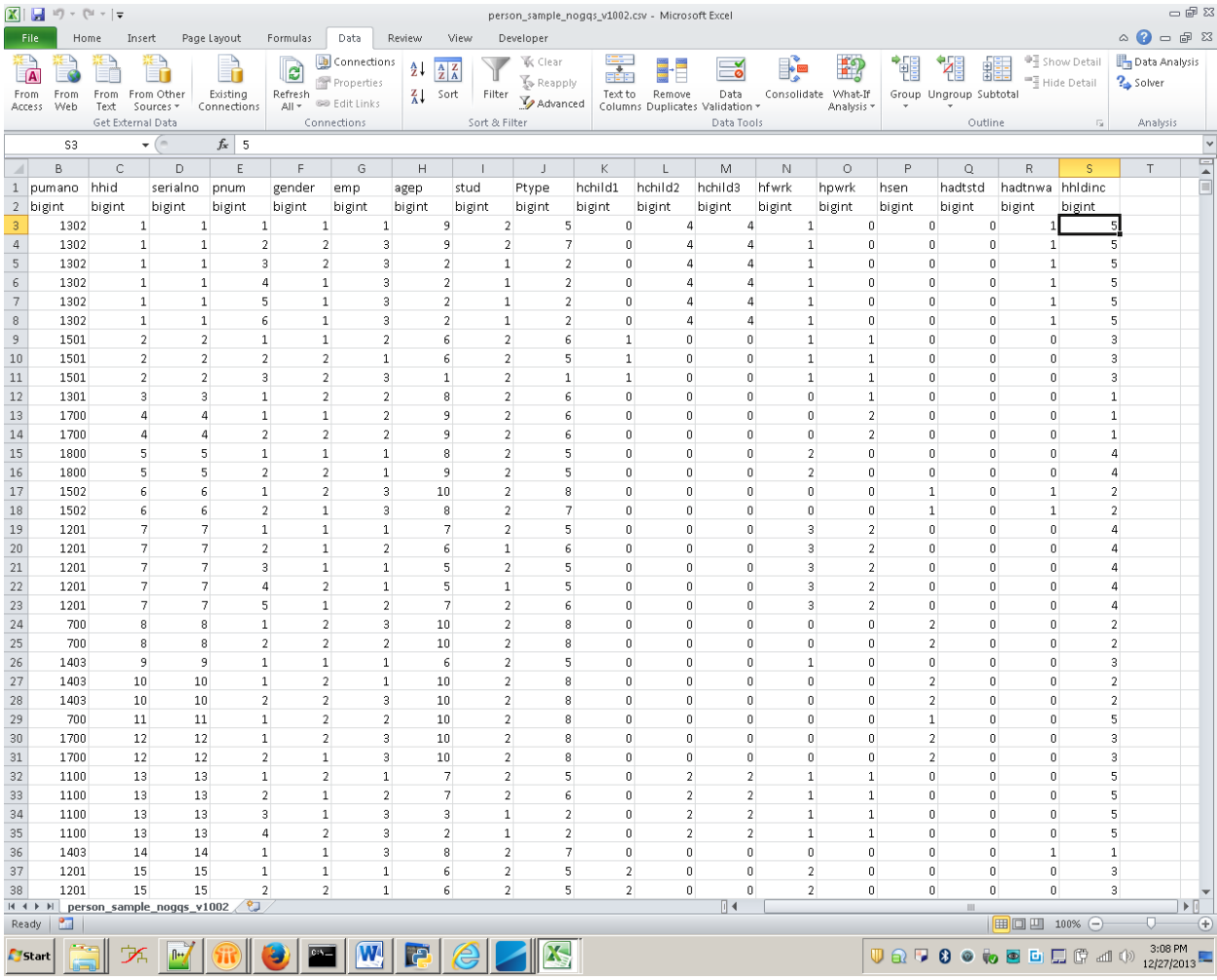
Figure 4.4 Household-Level Sample File



hhid_sample_noggs_v1002.csv - Microsoft Excel

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	state	pumano	hhid	serialno	hhldinc	hhldsize	hchild1	hchild2	hchild3	hfwrk	hpwrk	hsen	hadtstd	hadtnwa
2	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint
3	27	1302	1	1	5	6	0	4	0	1	0	0	0	1
4	27	1501	2	2	3	3	1	0	0	1	1	0	0	0
5	27	1301	3	3	1	1	0	0	0	0	1	0	0	0
6	27	1700	4	4	1	2	0	0	0	0	2	0	0	0
7	27	1800	5	5	4	2	0	0	0	2	0	0	0	0
8	27	1502	6	6	2	2	0	0	0	0	0	1	0	1
9	27	1201	7	7	4	5	0	0	0	3	2	0	0	0
10	55	700	8	8	2	2	0	0	0	0	0	2	0	0
11	27	1403	9	9	3	1	0	0	0	1	0	0	0	0
12	27	1403	10	10	2	2	0	0	0	0	0	2	0	0
13	55	700	11	11	5	1	0	0	0	0	0	1	0	0
14	27	1700	12	12	3	2	0	0	0	0	0	2	0	0
15	27	1100	13	13	5	4	0	2	0	1	1	0	0	0
16	27	1403	14	14	1	1	0	0	0	0	0	0	0	1
17	27	1201	15	15	3	4	2	0	0	2	0	0	0	0
18	27	1100	16	16	5	4	0	1	1	1	0	0	0	1
19	27	1001	17	17	2	2	0	1	0	0	1	0	0	0
20	27	1601	18	18	5	6	2	0	0	1	2	1	0	0
21	27	1201	19	19	5	2	0	0	0	0	0	2	0	0
22	27	1403	20	20	1	2	0	1	0	0	1	0	0	0
23	55	700	21	21	4	4	1	0	1	2	0	0	0	0
24	27	1602	22	22	2	1	0	0	0	0	0	1	0	0
25	27	1501	23	23	2	1	0	0	0	1	0	0	0	0
26	55	400	24	24	1	2	0	0	0	0	0	2	0	0
27	55	700	25	25	2	3	0	0	0	2	1	0	0	0
28	27	1405	26	26	5	3	0	0	0	2	1	0	0	0
29	27	1403	27	27	1	6	2	0	0	1	2	0	0	1
30	55	400	28	28	1	2	0	0	0	0	0	2	0	0
31	27	1406	29	29	4	4	2	0	0	1	1	0	0	0
32	27	1203	30	30	3	2	0	0	0	1	0	0	0	1
33	27	1002	31	31	5	2	0	0	0	1	1	0	0	0
34	55	400	32	32	1	2	1	0	0	1	0	0	0	0
35	27	1100	33	33	2	1	0	0	0	1	0	0	0	0
36	27	900	34	34	3	3	0	0	0	1	2	0	0	0
37	27	1502	35	35	4	5	0	3	0	2	0	0	0	0
38	27	1700	36	36	5	4	0	0	1	2	1	0	0	0

Figure 4.5 Person-level Sample File



	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	pumano	hhid	serialno	pnum	gender	emp	agep	stud	Ptype	hchild1	hchild2	hchild3	hfwrk	hpwrk	hsen	hadtstd	hadtnwa	hhldinc	
2	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	bigint	
3	1302	1	1	1	1	1	9	2	5	0	4	4	1	0	0	0	1	5	
4	1302	1	1	2	2	3	9	2	7	0	4	4	1	0	0	0	1	5	
5	1302	1	1	3	2	3	2	1	2	0	4	4	1	0	0	0	1	5	
6	1302	1	1	4	1	3	2	1	2	0	4	4	1	0	0	0	1	5	
7	1302	1	1	5	1	3	2	1	2	0	4	4	1	0	0	0	1	5	
8	1302	1	1	6	1	3	2	1	2	0	4	4	1	0	0	0	1	5	
9	1501	2	2	1	1	2	6	2	6	1	0	0	1	1	0	0	0	3	
10	1501	2	2	2	2	1	6	2	5	1	0	0	1	1	0	0	0	3	
11	1501	2	2	3	2	3	1	2	1	1	0	0	1	1	0	0	0	3	
12	1301	3	3	1	2	2	8	2	6	0	0	0	0	1	0	0	0	1	
13	1700	4	4	1	1	2	9	2	6	0	0	0	0	2	0	0	0	1	
14	1700	4	4	2	2	2	9	2	6	0	0	0	0	2	0	0	0	1	
15	1800	5	5	1	1	1	8	2	5	0	0	0	2	0	0	0	0	4	
16	1800	5	5	2	2	1	9	2	5	0	0	0	2	0	0	0	0	4	
17	1502	6	6	1	2	3	10	2	8	0	0	0	0	0	1	0	1	2	
18	1502	6	6	2	1	3	8	2	7	0	0	0	0	0	1	0	1	2	
19	1201	7	7	1	1	1	7	2	5	0	0	0	3	2	0	0	0	4	
20	1201	7	7	2	1	2	6	1	6	0	0	0	3	2	0	0	0	4	
21	1201	7	7	3	1	1	5	2	5	0	0	0	3	2	0	0	0	4	
22	1201	7	7	4	2	1	5	1	5	0	0	0	3	2	0	0	0	4	
23	1201	7	7	5	1	2	7	2	6	0	0	0	3	2	0	0	0	4	
24	700	8	8	1	2	3	10	2	8	0	0	0	0	0	2	0	0	2	
25	700	8	8	2	2	2	10	2	8	0	0	0	0	0	2	0	0	2	
26	1403	9	9	1	1	1	6	2	5	0	0	0	1	0	0	0	0	3	
27	1403	10	10	1	2	1	10	2	8	0	0	0	0	0	2	0	0	2	
28	1403	10	10	2	2	3	10	2	8	0	0	0	0	0	2	0	0	2	
29	700	11	11	1	2	2	10	2	8	0	0	0	0	0	1	0	0	5	
30	1700	12	12	1	2	3	10	2	8	0	0	0	0	0	2	0	0	3	
31	1700	12	12	2	1	3	10	2	8	0	0	0	0	0	2	0	0	3	
32	1100	13	13	1	2	1	7	2	5	0	2	2	1	1	0	0	0	5	
33	1100	13	13	2	1	2	7	2	6	0	2	2	1	1	0	0	0	5	
34	1100	13	13	3	1	3	3	1	2	0	2	2	1	1	0	0	0	5	
35	1100	13	13	4	2	3	2	1	2	0	2	2	1	1	0	0	0	5	
36	1403	14	14	1	1	3	8	2	7	0	0	0	0	0	0	0	1	1	
37	1201	15	15	1	1	1	6	2	5	2	0	0	2	0	0	0	0	3	
38	1201	15	15	2	2	1	6	2	5	2	0	0	2	0	0	0	0	3	

Step 2 – Open PopGen and Load Input Files

The opening screen of Pop Gen is shown in Figure 4.6.

Figure 4.7 shows the screen where the geographic resolution for the Population Generator is defined.

Figure 4.8 shows the definition of the marginal totals for households and persons and the location in the respective directories.

Figure 4.6 PopGen Opening Screen

Figure 4.7 Definition of Geographic Resolution in PopGen

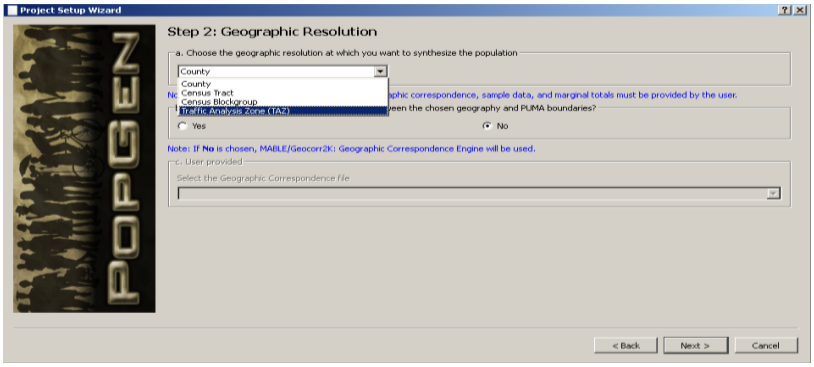
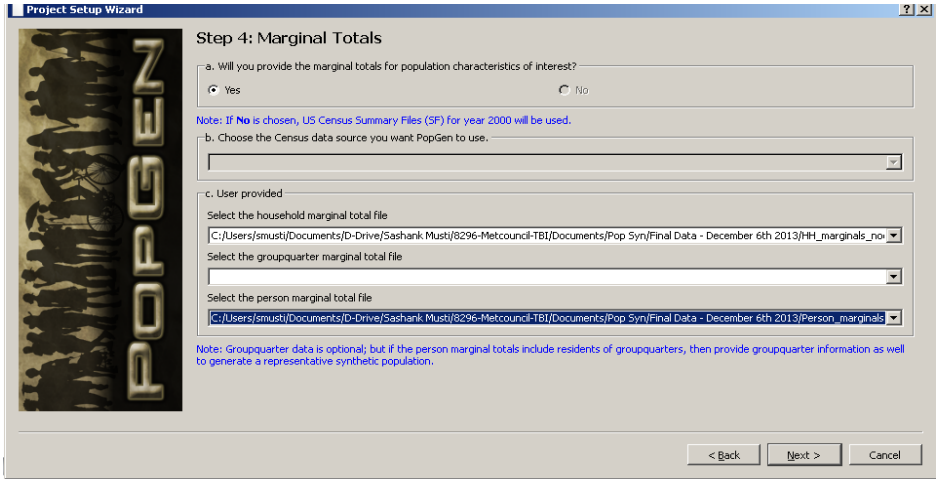


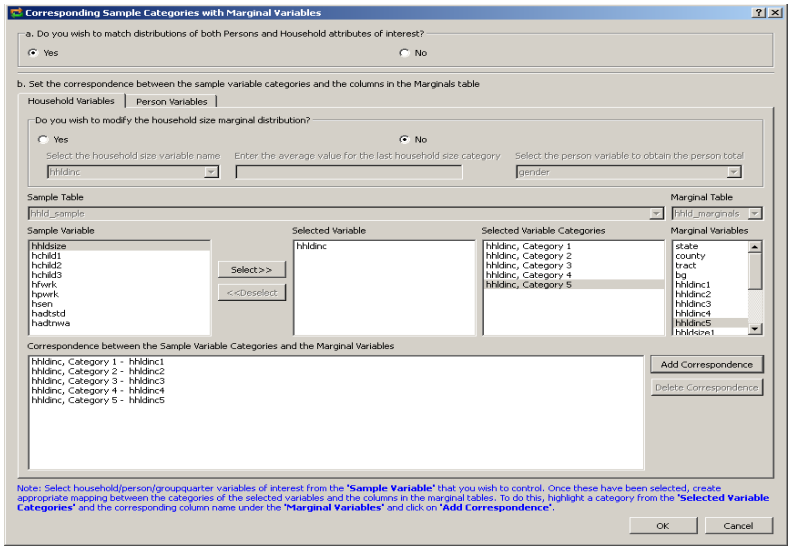
Figure 4.8 Definition of Marginal Totals



Step 3 - Set Control Targets

In **Figure 4.9** we show how the control targets for the region are defined both for household and person characteristics.

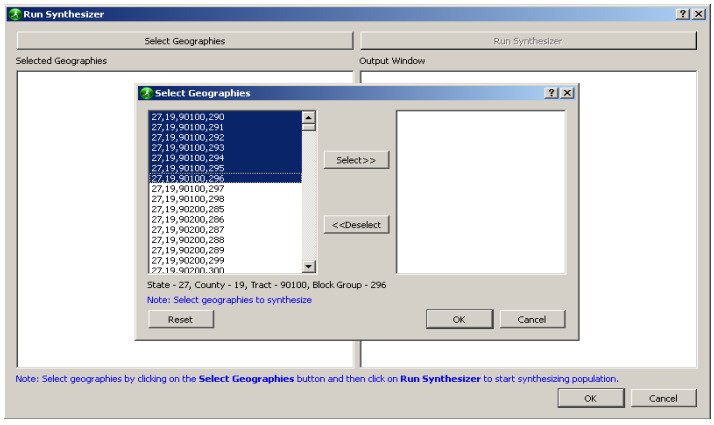
Figure 4.9 PopGen Household and Person Control Totals



Step 4 - Select Zones for Synthesizing the Population

This is the final step where the zones and the level of geographic detail that are selected to apply PopGen are defined as shown in **Figure 4.10**.

Figure 4.10 Geographic Detail for PopGen



Step 5: Run PopGen

After the input files have been prepared and loaded, the geographic resolution has been defined, and the control totals and geography have been set, PopGen is set up and ready to run as the last step in the process.

4.2 RUNNING POPGEN TO GET A SYNTHETIC POPULATION

This section highlights how PopGen is used to develop a synthetic population that closely matches household marginal totals. Details about the comparison of PopGen results with the control totals provided by the Metropolitan Council are provided in the file titled ***"PopGen Detailed Comparisons.xlsx".***

Household Characteristics Comparison

Table 4.1 compares the synthetic household outputs from PopGen to the TAZ level marginal totals provided by Metropolitan Council. Synthetic household outputs match the TAZ marginal totals almost perfectly. **Table 4.1** shows that the household income of the synthetic population matches the marginals for three different geographic comparisons: (a) the entire study area, (b) Minnesota counties only and (c) Wisconsin counties only.

Table 4-1 Household Income Coparison – PopGen vs. Marginal Totals

Region	Household Income	Synthetic Households		MetCouncil TAZ Marginal Totals	
		Count	Percentage	Count	Percentage
Study Area	Less than $25,000	228,089	16.7%	228,589	16.8%
	$25,000-$50,000	286,486	21.0%	286,481	21.0%
	$50,000-$75,000	261,494	19.2%	261,496	19.2%
	$75,000-$99,999	203,938	15.0%	204,081	15.0%
	$100,000+	383,148	28.1%	382,510	28.1%
	Total	1,363,155	100.0%	1,363,157	100.0%
MN	Less than $25,000	217,064	16.7%	217,527	16.8%
	$25,000-$50,000	271,794	20.9%	271,804	20.9%
	$50,000-$75,000	247,866	19.1%	247,876	19.1%
	$75,000-$99,999	193,502	14.9%	193,640	14.9%
	$100,000+	368,125	28.4%	367,505	28.3%
	Total	1,298,351	100.0%	1,298,352	100.0%
WI	Less than $25,000	11,025	17.0%	11,062	17.1%
	$25,000-$50,000	14,692	22.7%	14,677	22.6%
	$50,000-$75,000	13,628	21.0%	13,620	21.0%
	$75,000-$99,999	10,436	16.1%	10,441	16.1%
	$100,000+	15,023	23.2%	15,005	23.2%
	Total	64,804	100.0%	64,805	100.0%

Table 4.2 compares household size information of the synthetic households to the TAZ level marginal totals provided by Metropolitan Council. Synthetic household outputs are again very similar to the TAZ marginal totals and the distributions match closely.

Table 4-2 Household Size Comparison – PopGen vs. Marginal Totals

Region	Household Size	Synthetic Households		MetCouncil TAZ Marginal Totals	
		Count	Percentage	Count	Percentage
Study Area	1	374,771	27.5%	374,208	27.5%
	2	454,828	33.4%	453,796	33.3%
	3	210,297	15.4%	210,040	15.4%
	4	191,307	14.0%	191,056	14.0%
	5	83,065	6.1%	83,247	6.1%
	6	29,407	2.2%	29,852	2.2%
	7	10,832	0.8%	11,537	0.8%
	8	8,648	0.6%	9,421	0.7%
	Total	1,363,155	100.0%	1,363,157	100.0%
MN	1	359,846	27.7%	359,337	27.7%
	2	430,835	33.2%	429,874	33.1%
	3	199,907	15.4%	199,676	15.4%
	4	181,756	14.0%	181,520	14.0%
	5	78,935	6.1%	79,109	6.1%
	6	28,076	2.2%	28,499	2.2%
	7	10,491	0.8%	11,136	0.9%
	8	8,505	0.7%	9,201	0.7%
	Total	1,298,351	100.0%	1,298,352	100.0%
WI	1	14,925	23.0%	14,871	22.9%
	2	23,993	37.0%	23,922	36.9%
	3	10,390	16.0%	10,364	16.0%
	4	9,551	14.7%	9,536	14.7%
	5	4,130	6.4%	4,138	6.4%
	6	1,331	2.1%	1,353	2.1%
	7	341	0.5%	401	0.6%
	8	143	0.2%	220	0.3%
	Total	64,804	100.0%	64,805	100.0%

Person Level Characteristics Comparison

Table 4.3 compares the distribution of employed individuals in the synthetic population outputs with the TAZ level marginal totals. As is the case with household-level variables, the distributions for the employment status variable replicate control totals very well.

Table 4-3 Employment Status Comparison – PopGen vs. Marginal Totals

Region	Employment Status	Synthetic Population		MetCouncil TAZ Marginal Totals	
		Count	Percentage	Count	Percentage
Study Area	Full-time Employed	1,358,937	39.7%	1,360,472	39.5%
	Part-time Employed	442,598	12.9%	450,124	13.1%
	Unemployed	1,620,236	47.4%	1,630,220	47.4%
	Total	3,421,771	100.0%	3,440,816	100.0%
MN	Full-time Employed	1,293,213	39.7%	1,294,903	39.5%
	Part-time Employed	422,158	13.0%	429,137	13.1%
	Unemployed	1,541,831	47.3%	1,551,259	47.4%
	Total	3,257,202	100.0%	3,275,299	100.0%
WI	Full-time Employed	65,724	39.9%	65,569	39.6%
	Part-time Employed	20,440	12.4%	20,987	12.7%
	Unemployed	78,405	47.6%	78,961	47.7%
	Total	164,569	100.0%	165,517	100.0%

Table 4.4 compares the synthetic population data with the TAZ level marginal totals across the student status dimension. Again, these distributions show that the PopGen outputs are in line with the TAZ marginal totals.

Table 4-4 Student Status Comparisons – PopGen vs. Marginal Totals

Region	Student Status	Synthetic Population		MetCouncil TAZ Marginal Totals	
		Count	Percentage	Count	Percentage
Study Area	Student	869,825	25.4%	883,802	25.7%
	Non Student	2,551,946	74.6%	2,557,014	74.3%
	Total	3,421,771	100.0%	3,440,816	100.0%
MN	Student	828,683	25.4%	842,031	25.7%
	Non Student	2,428,519	74.6%	2,433,268	74.3%
	Total	3,257,202	100.0%	3,275,299	100.0%
WI	Student	41,142	25.0%	41,771	25.2%
	Non Student	123,427	75.0%	123,746	74.8%
	Total	164,569	100.0%	165,517	100.0%

Table 4.5 compares the synthetic population's age profile to the TAZ level distribution. The similarity between these two distributions show that the PopGen outputs closely match the TAZ marginal totals at three different geographic comparisons including the (a) entire full study area, (b) Minnesota counties only and (c) Wisconsin counties only.

Table 4-5 Age Distribution Comparisons – PopGen vs. Marginal Totals

Region	Age	Synthetic Population		MetCouncil TAZ Marginal Totals	
		Count	Percentage	Count	Percentage
Study Area	Less than 6	288,104	8.4%	290,090	8.4%
	6 to 12	336,060	9.8%	338,644	9.8%
	13 to 15	144,172	4.2%	145,458	4.2%
	16 to 17	96,910	2.8%	99,806	2.9%
	18 to 24	281,745	8.2%	288,606	8.4%
	25 to 34	494,944	14.5%	497,180	14.4%
	35 to 44	477,331	13.9%	478,655	13.9%
	45 to 54	537,867	15.7%	538,371	15.6%
	55 to 64	396,280	11.6%	396,064	11.5%
	65 and Over	368,358	10.8%	367,942	10.7%
	Total	3,421,771	100.0%	3,440,816	100.0%
MN	Less than 6	274,482	8.4%	276,310	8.4%
	6 to 12	319,470	9.8%	321,993	9.8%
	13 to 15	136,988	4.2%	138,224	4.2%
	16 to 17	92,243	2.8%	94,989	2.9%
	18 to 24	269,499	8.3%	275,834	8.4%
	25 to 34	474,275	14.6%	476,460	14.5%
	35 to 44	454,137	13.9%	455,461	13.9%
	45 to 54	510,781	15.7%	511,309	15.6%
	55 to 64	375,962	11.5%	375,666	11.5%
	65 and Over	349,365	10.7%	349,053	10.7%
	Total	3,257,202	100.0%	3,275,299	100.0%
WI	Less than 6	13,622	8.3%	13,780	8.3%
	6 to 12	16,590	10.1%	16,651	10.1%
	13 to 15	7,184	4.4%	7,234	4.4%
	16 to 17	4,667	2.8%	4,817	2.9%
	18 to 24	12,246	7.4%	12,772	7.7%
	25 to 34	20,669	12.6%	20,720	12.5%
	35 to 44	23,194	14.1%	23,194	14.0%
	45 to 54	27,086	16.5%	/ 27,062	16.3%
	55 to 64	20,318	12.3%	20,398	12.3%
	65 and Over	18,993	11.5%	18,889	11.4%
	Total	164,569	100.0%	165,517	100.0%

Table 3.6 compares the synthetic population's gender outputs to the TAZ level marginal control totals. These distributions again show that the PopGen outputs closely match the TAZ marginal totals at the level of the study area, Minnesota counties and Wisconsin counties.

Table 4-6 Gender Comparisons – PopGen vs. Marginal Totals

Region	Gender	Synthetic Population		MetCouncil TAZ Marginal Totals	
		Count	Percentage	Count	Percentage
Study Area	Male	1,686,382	49.3%	1,697,596	49.3%
	Female	1,735,389	50.7%	1,743,220	50.7%
	Total	3,421,771	100.0%	3,440,816	100.0%
MN	Male	1,603,957	49.2%	1,614,510	49.3%
	Female	1,653,245	50.8%	1,660,789	50.7%
	Total	3,257,202	100.0%	3,275,299	100.0%
WI	Male	82,425	50.1%	83,086	50.2%
	Female	82,144	49.9%	82,431	49.8%
	Total	164,569	100.0%	165,517	100.0%

Results indicate that the total number of households for the study region match the marginal control totals perfectly. The slight difference in the population arises because of the capping of household size category to 8 to include larger households within this group.

4.3 SUPPORTING POPGEN DOCUMENTATION

Additional details about the comparison of PopGen results with the control totals provided by the Metropolitan Council are provided in **Appendix B** in the file titled ***"PopGen Detailed Comparisons.xlsx".***

We have also provided in **Appendix C** the detailed documentation provided by Arizona State University related to the Population Synthesizer PopGen. A total of nine sessions is included that cover:

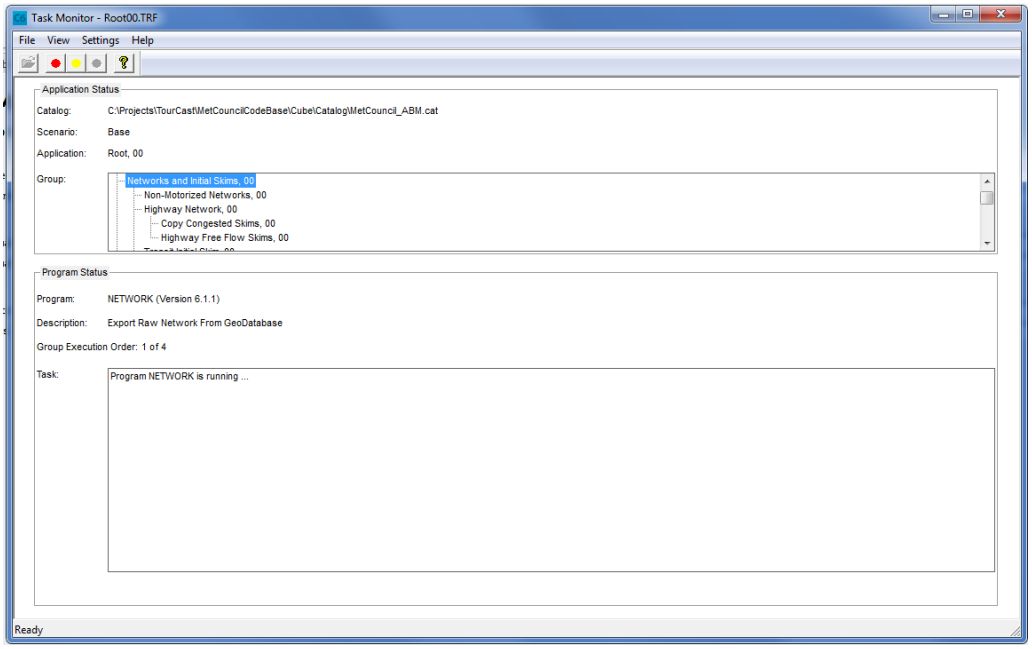
- Installation;
- Data Structure;
- Project Setup using Census or user provided data;
- Modifying data and setting up a PopGen run;
- Running PopGen to generate a synthetic population; and
- Exporting results and visualizing the final output

5.0 Running the Entire Model

Once all of the input files are created and mapped using the scenario manager, running the entire model is as simple as clicking "Run" from the scenario manager.

Task Monitor Window

While the catalog is running, the progress can be monitored through the Task Monitor window, which will display the current application group being executed. Even when Cube Cluster is in operation, the Task Monitor window will still be present.



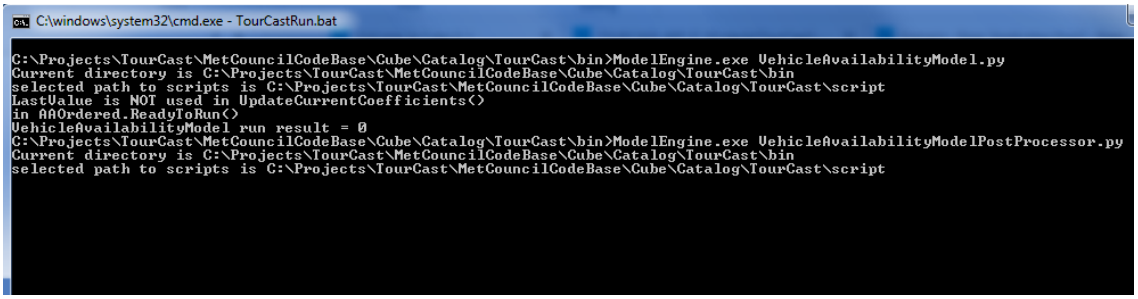
TourCast Operating Window

TourCast is executed through a dynamically built batch command **TourCastRun.bat** in the Cube folder. When TourCast is called, the Task Monitor will display

Executing: "start /wait TourCastRun.bat"

and two command prompt windows will open. One window is present to carry error codes back to Cube and will not display any output. The other window shows the status of each component execution. Once the TourCast components are complete, control will return to Cube to run the next set of components.

The call to each component is indicated by a new ModelEngine.exe call. Each component will end with a run result. A run result of "0" indicates success.



If there is an error, this window will be paused. It is good practice to copy the full text of this window if there is an error to assist in debugging. Once the text is copied, press any key and close the windows. This will return control to Cube and the catalog run will end with an error.

Model outputs

A reliable way to monitor the model status is to examine the output files. Each file has the speed feedback iteration number included.

Catalog outputs files are defined in Appendix A.

TourCast output files are defined in Appendix A.

Model reports

Highway assignment summaries

- csv file linked to excel spreadsheet in Doc folder
- Loaded networks with Daily and Period results
- Comparison networks between iterations and convergence (4 time period) and final assignment (11 time periods)

5.2 RUNNING A SINGLE APPLICATION GROUP

A single application group can be run in the catalog as long as all variables are defined. Within the speed feedback loop, at least the iteration variable ITER needs to be defined. This can be done by creating a Pilot program in the application group with the following text:

ITER = 1

For example, to run iteration 1.

Running TourCast only

TourCast can be run individually by running within the TourCast application group. Note that the scenario manager configuration settings are active if TourCast is run using the Run Application control. Alternatively, TourCast can be run by calling ModelEngine.exe directly with the desired component

configuration file. Please see the TourCastRun.bat file in the Cube folder for examples.

5.3 PREPARING A NEW SCENARIO

To build a new scenario, the following inputs potentially need to be updated:

- Highway Network
- Transit Line File
- Zonal data (sociodemographics)
- External station volumes
- Synthesized population

6.0 List of Appendices

Appendix A. IO File and TourCast Component Map

Appendix B. Detailed PopGen Comparisons at the County Level

Appendix C. PopGen Docuentation by Arizona State University

- Appendix C Session 1_Introduction.pdf
- Appendix C Session 2_Installation.pdf
- Appendix C Session 3_Data Structures.pdf
- Appendix C Session 4_CensusData_ProjectSetup.pdf
- Appendix C Session 5_UserProv_ProjectSetup.pdf
- Appendix C Session 6_ModifyingData.pdf
- Appendix C Session 7_ConfiguringProjects.pdf
- Appendix C Session 8_GeneratingSyntheticPopulation.pdf
- Appendix C Session 9_VisualizationExporting_Results.pdf