SOUTH JERSEY TRAVEL DEMAND MODEL (SJTDM) IMPROVEMENTS

FY 2011-2012

USER'S GUIDE

October 2012

URS *in association with*

RESOURCE SYSTEMS GROUP, WHITEHOUSE GROUP, AND TECHNIQUEST

The preparation of this report has been financed in part by the US Department of Transportation, Federal Highway Administration. This document is disseminated under the sponsorship of the US Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents of its use thereof.

Table of Contents

1.0 Introduction 1
2.0 Model Installation 2
2.1 System requirements 2
2.2 Installation procedure 2
2.3 Directory Structure 2
3.0 Model Structure 3
3.1 Model Application/Flow Chart 3
3.2 Catalog Keys 9
4.0 Model Input and Output Data 10
4.1 Input Data Files 10
4.2 Output Data Files 11
4.3 Network Attributes 12
5.0 Model Execution 15
5.1 Full Model Execution 15
5.2 Single Application Group Execution 15
6.0 Model Summaries/Reports 17
6.1 Model Output Files for Spreadsheet Summaries 17
6.2 Cube Reports 17
7.0 Common Analysis Tasks 19
7.1 Socioeconomic Data Update 19
7.2 Highway Network Update 20
7.3 Transit Network Update 24
7.3.1 Internal Transit Network Coding 24
7.3.2 External-Internal Transit Network Coding 28
7.4 Select Link Analysis 30
7.5 Turning Movement Volume Display 31
7.6 Development of new Cube Reports 34
7.7 Development of new scenario/run year 35
7.8 Subarea extraction/assignment 36
7.9 TAZ Splits 38
7.10 Sensitivity Tests 39
7.10.1 Network Tests 39
7.10.2 Socioeconomic Growth Tests 41
7.10.3 Trip Rate Tests 41
7.10.4 Toll Rate Tests 44

Tables

Table 3-1: Catalog Keys in SJTDM 9
Table 4-1: SJTDM Input Files 10
Table 4-2: SJTDM Output Files 11
Table 4-3: Input Highway Network Link Attributes 12
Table 4-4: Loaded Highway Network Link Attributes 13

Table 4-5: Transit Network Attributes 14
Table 6-1: Model Output Files for Spreadsheet summaries 17
Table 6-2: Cube Report descriptions 18
Table 7-1: TAZ System in SJTDM 39

Figures

Figure 3-1: SJTDM Model Flow Chart (Application Manager) 3
Figure 3-2: Sub-steps in Trip Generation Step 6
Figure 3-3: Sub-steps in Non-recreational Trip Generation 7
Figure 3-4: Sub-steps in Recreational Trip Generation 8
Figure 5-1: SJTDM Scenario Run Window 15
Figure 5-2: Illustration of running selected application group in Cube 16
Figure 5-3: Task Monitor during a single application group run 16
Figure 6-1: Cube Report for SJTDM Mode Choice Step 18
Figure 7-1: Socioeconomic Input Data file location in SJTDM application 19
Figure 7-2: Socioeconomic Input Data file opened in Cube 20
Figure 7-3: Input highway network location in SJTDM application 21
Figure 7-4: Input highway network opened in Cube 22
Figure 7-5: Feature Explorer in Cube 23
Figure 7-6: Example Log File created using Cube 24
Figure 7-7: SJTDM transit route file opened in Cube 25
Figure 7-8: SJTDM Transit Network in Cube 26
Figure 7-9: Display selected transit route 27
Figure 7-10: Transit Route Editing dialog box 28
Figure 7-11: Level of Service file location in SJTDM application 29
Figure 7-12: LOS input file in dbf format 30
Figure 7-13: Location of highway assignment script in SJTDM application 32
Figure 7-14: Show Output Intersection Data button 33
Figure 7-15: Turning movement volume display in Cube 34
Figure 7-16: Cube Reports Definition 35
Figure 7-17: Creation of new Scenario in SJTDM Scenario Manager 36
Figure 7-18: Polygon definition for subarea network 37
Figure 7-19: Zone/Node renumbering for subarea network 38
Figure 7-20: Speed-capacity table location in SJTDM application 40
Figure 7-21: Speed-Capacity Table in SJTDM 41
Figure 7-22: Location of Production and Attraction rate files in SJTDM application 42
Figure 7-23: Non-recreational Trip Production File 43
Figure 7-24: Non-recreational Trip Attraction File 44
Figure 7-25: Location of Toll File in SJTDM application 45
Figure 7-26: Toll File 46

1.0 Introduction

As part of the South Jersey Model Improvement Project (SJMIP), SJTPO retained the URS team to migrate the regional travel demand model to Cube/Voyager and implement several enhancements to develop a model that is more state-of-the-practice. The model is now more user-friendly as well as transparent and utilizes only the Cube/Voyager suite. The previous version of the model utilized several software components such as CENTRAL, FORTRAN, CLIPPER, MINUTP and TP+.

Travel demand models involve numerous files and processes and can be challenging to comprehend and use without proper documentation. This document aims to provide a user with instructions to install the model, understand the modeling input and output files and the overall model structure and provides step-by-step instruction to run the model for various scenarios. Examples of various analysis tasks that are commonly performed using travel demand models are also provided. It is expected that the user is familiar with the Cube/Voyager package.

2.0 Model Installation

This section provides system requirements and instructions for installing the SJTDM.

2.1 System requirements

Prior to installing the SJTDM, it is required that the Cube/Voyager software and the associated license be installed. The instructions to install those can be obtained from Citilabs. The latest available version of Cube at this time, version 6.0.1, was used to develop the model. It is recommended that about 3GB of hard disk space be reserved per model run scenario. About 10 GB of hard disk space would be sufficient for the entire model setup including the base year and one future year run. The model has been tested on Windows XP and Windows 7 operating systems. The model is expected to run faster on a machine with more RAM and multiple cores, but a minimum of 3 GB RAM and 4 cores is recommended.

2.2 Installation procedure

The SJTDM installation simply requires copying the entire 'SJTDM' folder provided as part of the installation DVD on any directory. For instance, it could be placed under 'C:\SJTDM' or 'C:\projects\SJTDM'. It is recommended that the model be placed under 'C:\SJTDM'.

SJTDM v3.3 scenario file paths are updated automatically, regardless of where the user places the model in the local computer drive.

2.3 Directory Structure

After installation, the SJTDM may be opened by double clicking the catalog file ***sjtdm*.cat** located under the 'SJTDM' directory. The model inputs are located under SJTDM\Inputs\Scenarios\Base\ and the outputs are stored under SJTDM\Scenarios\Base\. It is important for the user to keep this directory structure intact in order for the model to function properly.

The catalog currently consists of a single *parent* scenario (***Scenarios***) which contains a *child* scenario ***Base***. The ***Base*** scenario contains additional *child* scenarios such as y2010 and y2040. The user may create any number of scenarios, for any analysis year, as the need and data becomes available. It is recommended that added scenarios are managed within the current catalog file (***sjtdm.cat***).

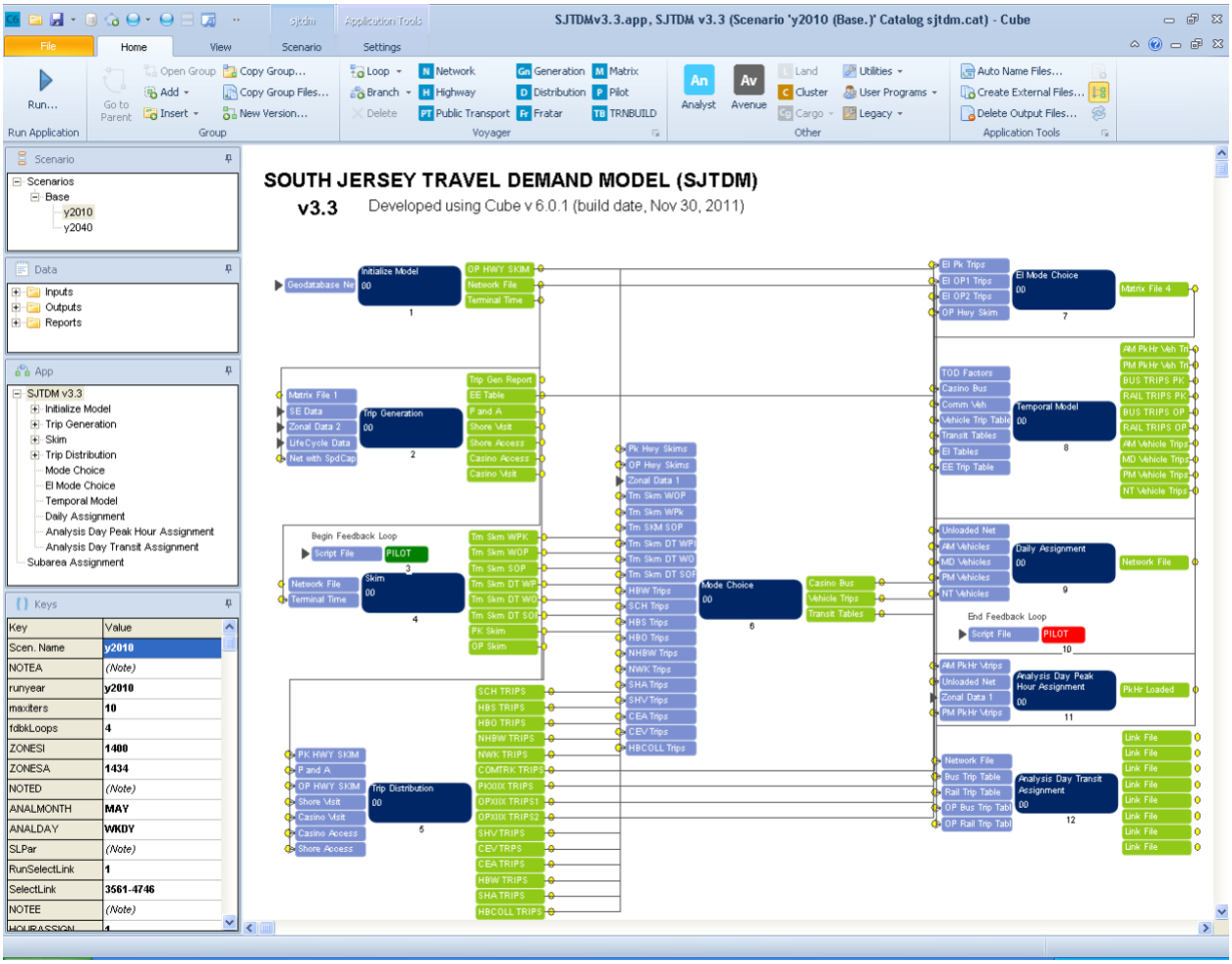
3.0 Model Structure

The SJTDM is a standard 4-step model encompassing the trip generation, trip distribution, mode choice and assignment steps. This section describes the model structure within the Cube modeling environment.

3.1 Model Application/Flow Chart

Once the model catalog is opened in Cube, the flow chart of the modeling steps will be displayed, as shown in Figure 3.1.

Figure 3-1: SJTDM Model Flow Chart (Application Manager)



The flow chart environment is known as the 'Application Manager' within the Cube suite and is unique to the Cube travel demand modeling software. It depicts the sequence of execution of the modeling steps along with all the inputs and outputs for every step. The inputs, outputs and the modeling processes are color coded to aid differentiation. All of the input files can simply be double-clicked within this environment to open, view and edit it. The ability to add comments for every step makes this environment self-documenting. A user has the ability to run the entire application or only parts of the application via the Application Manager (this is described in detail in Chapter 5).

The 'Scenario Manager' in Cube, depicted by the left portion of the screenshot in Figure 3-1, is complementary to the Application Manager in that it allows a convenient means to organize and run multiple scenarios within the same application. The Scenario Manager has two modes, the Model Developer mode and the Model Applier mode. If the former is set via the Catalog properties, then all features of the catalog and its applications are available for edit and display. If instead the Model Applier option is set, the user is generally restricted to changing data values rather than changing the structure of the data. For example, the Applier can change the value of a key for a scenario, but cannot change the catalog key properties, or add a new key, or delete a key. Double-clicking an application will open it in read-only mode when in Applier mode. The SJTDM application has been setup to open in the Applier mode by default.

A description of each of the major steps within the SJTDM chain is provided below:

The SJTDM application is comprised of 12 steps. This section provides a brief description of the function of each step.

1. **Initialize Model**

   In this step, the speed-capacity table and tolls are read and appended to the input geodatabase network. The initial off-peak highway skims are also generated in this step.

2. **Trip Generation**

   The non-recreational and recreational trip generation processes are performed in this step. The primary outputs are the zonal productions and attractions by trip purpose.

3. **Begin Feedback Loop**

   This step contains the beginning of the feedback loop and the number of loops can be specified here. The number of feedback loops is set to 4 by default and is recommended for conformity runs. For a quick model run especially for testing purposes, this can be changed to 1.

4. **Skim**

   The peak and off-peak highway skims and the transit skims for the 3 transit time periods and two access modes (walk-access and drive access) are generated here.

5. **Trip Distribution**

   The trip distribution for the non-recreational and recreational purposes is performed here. Trip length frequency distributions are also generated.

6. **Mode Choice**

   The trip tables obtained from the trip distribution step are partitioned into the various highway and transit modes in this step.

7. **EI Mode Choice**

   This step performs the mode choice for the EI trip purposes. This is performed separately for three external geographies namely Philadelphia Center, rest of

Philadelphia County and Camden. The travel time and cost for auto, bus and rail from external stations to these geographies are used as input to perform this mode split.

8. **Temporal Model**

   In this step, the daily level II and EI trips by mode are added together and then partitioned among the 4 time periods in the model. The seasonal factors by trip purpose are also applied in this step. The primary outputs of this step are the highway and transit trip tables ready to be assigned to the networks.

9. **Daily Assignment**

   This step performs the advanced toll diversion highway assignment. The primary outputs are the loaded networks by time of day and a daily loaded network with statistics such as VMT, lanemiles, Level of Service as well as V/C ratio and Congested speeds for each of the time periods.

10. **End Feedback Loop**

    This step closes the loop started in step 3 and copies the loaded highway network and highway skims from the current loop into a separate directory FBLoopFiles located within the run directory.

11. **Analysis Day Peak Hour Assignment**

    The peak hour highway assignments are performed in this step. The primary outputs are the loaded highway networks with peak hour volumes. Note that this is performed only once outside the feedback loop.

12. **Analysis Day Transit Assignment**

    Transit assignment for the two modes (bus and rail) and two access modes (walk and drive) are performed separately in this step. The primary outputs are link loadings of the route ridership. Note that this is also performed only once outside the feedback loop.

    Each of the above steps contains sub-steps in a parent-child relationship. The parent level of the Trip Generation Step is shown in Figure 3-1. The sub-steps can be seen in Figure 3-2, which comprise of steps to generate external-external matrix, non-recreational trip generation, recreational trip generation, combining productions and attractions and creation of a database file for reporting purposes. The non-recreational trip generation step is also composed of sub-steps shown in Figure 3-3. The recreational trip generation step is composed of sub-steps shown in Figure 3-4.

Figure 3-2: Sub-steps in Trip Generation Step

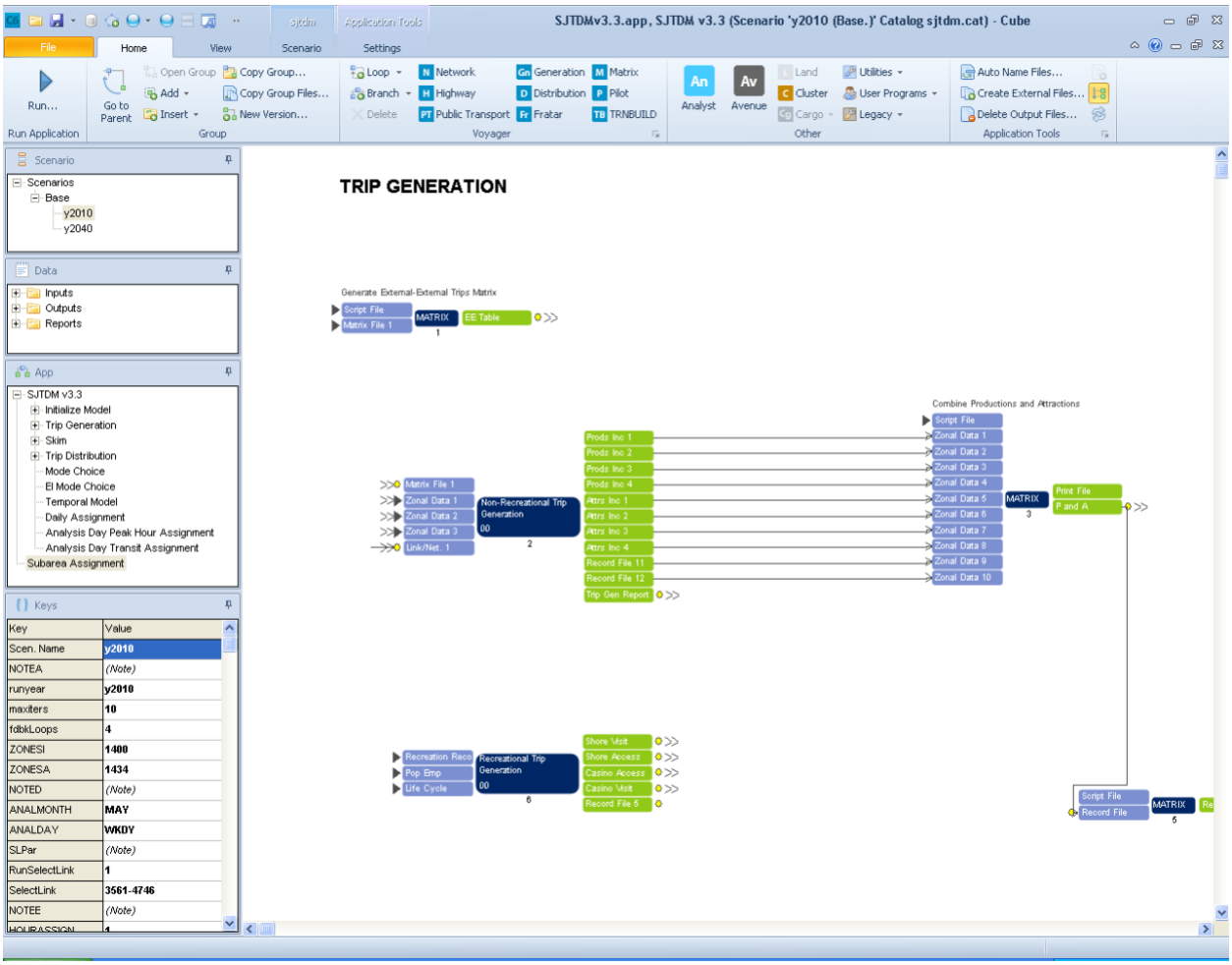


Figure 3-3: Sub-steps in Non-recreational Trip Generation

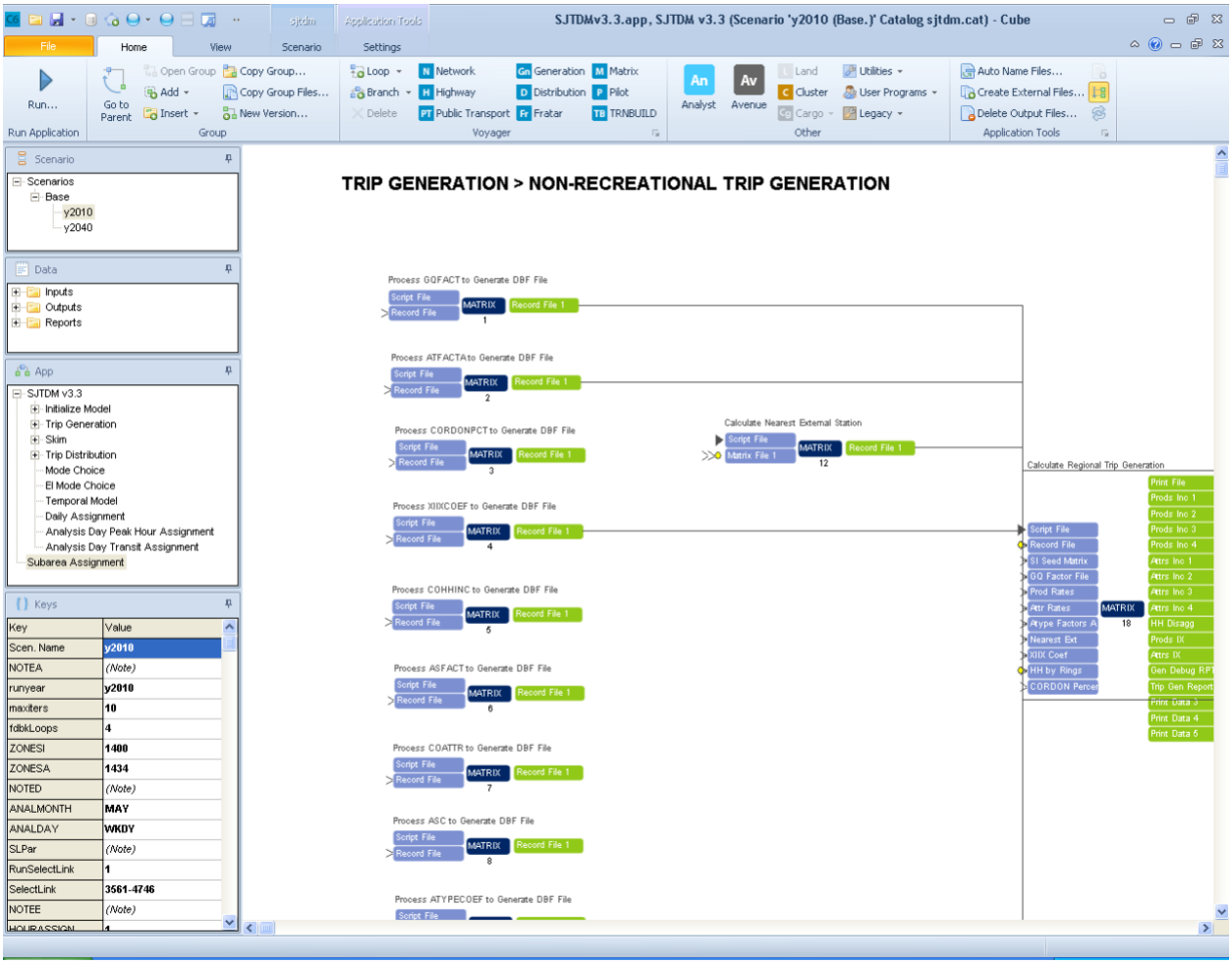
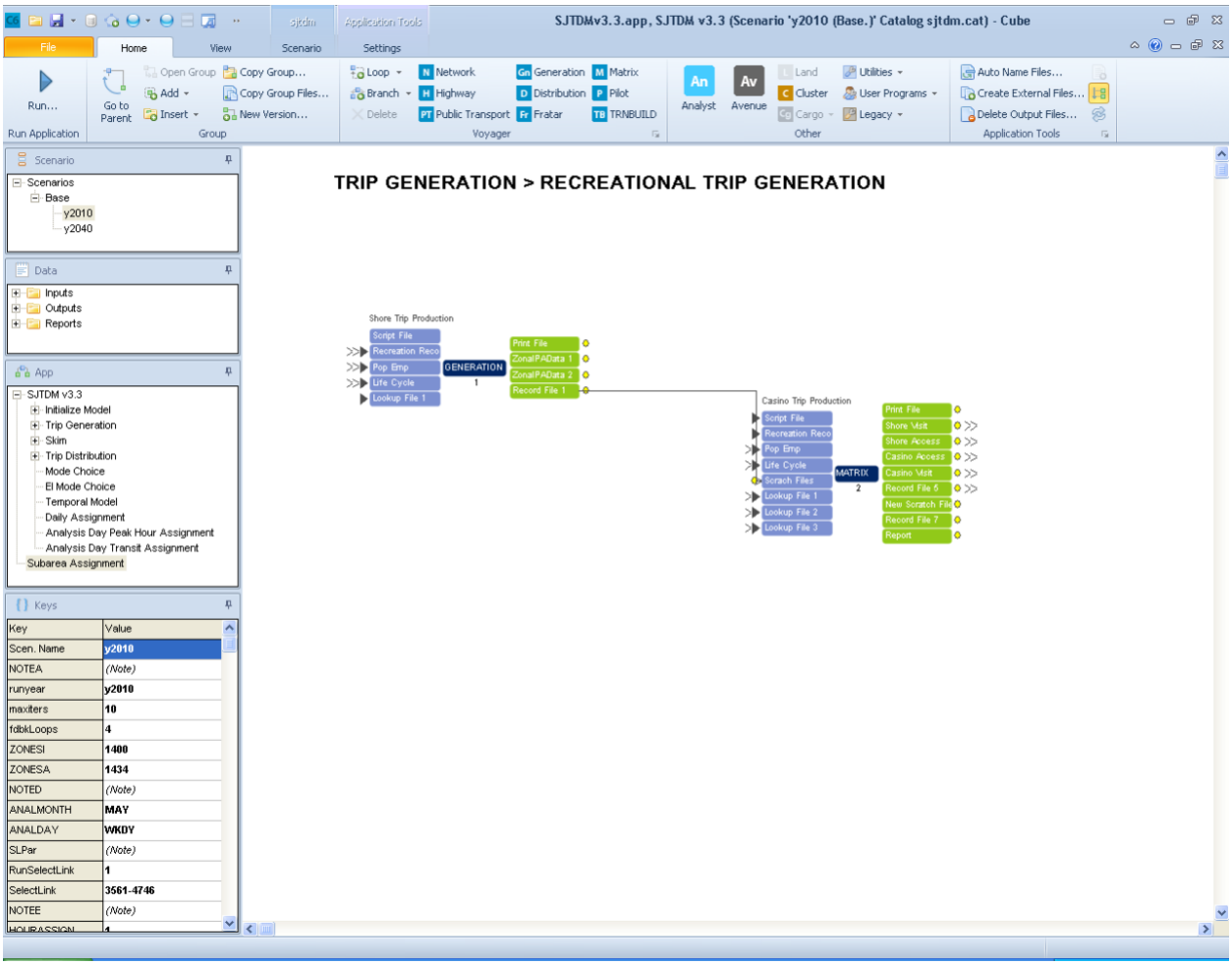


Figure 3-4: Sub-steps in Recreational Trip Generation



3.2 Catalog Keys

Catalog keys are used to provide a user with a convenient way to access and modify the primary model parameters that could be varied for a model run. Keys can be files, numbers, Boolean or character strings. These could be varied or kept same across scenarios. For instance, the ANALMONTH refers to the analysis month that could vary by scenario whereas the ZONESI key refers to the last internal zone number which should be the same across scenarios. Keys are sometimes used to enable some parameters to be more transparent to the user.

The following table provides a description of important *catalog keys* in the SJTDM that the user may need to update for a particular scenario run.

Table 3-1: Catalog Keys in SJTDM

Name	Description
runyear	Model Run Year
maxiters	Maximum No. of Equilibrium Assignment Iterations
fdbkLoops	Number of Feedback Loops
ZONESI	Last Internal Zone Number
ZONESA	Last External Zone Number
ANALMONTH	Analysis month for temporal model
ANALDAY	Analysis day for temporal model
SelectLink	A-node and B-node of link for performing select link assignment
HOURASSIGN	Boolean variable to control whether to run peak hour assignment
AMPEAKHOUR	Morning peak hour period selection for peak hour assignment
PMPEAKHOUR	Evening peak hour period selection for peak hour assignment

4.0 Model Input and Output Data

This section describes all the input files that are required for a model run as well as the relevant output files generated from each model step.

4.1 Input Data Files

The primary input files required for any scenario model run are shown in Table 4-1 along with their description and model step used.

Table 4-1: SJTDM Input Files

Filename	Description	Step Used
Network.mdb	Geodatabase of highway network	Initialize model
Tolls.dbf	Toll data	Initialize model
TCARDS.DAT	Turn penalties	Initialize model
ALLLINE.DAT	Transit Lines	Initialize model\Transit skims
RAILFARE.DAT	Rail fares	Initialize model\Transit skims
PNR_BUS.DAT	Bus PnR Catchment zone list	Initialize model\Transit skims
PNR_Rail.DAT	Rail PnR Catchment zone list	Initialize model\Transit skims
BUSLINK.DAT	Casino Shuttle to AC Rail Station Links	Initialize model\Transit skims
RAILLINK.DAT	AC Rail Links	Initialize model\Transit skims
RLXFLINK.DAT	Rail Station to Highway Node Links	Initialize model\Transit skims
RAILNODE.DAT	AC Rail Nodes	Initialize model\Transit skims
SJM_EE{XX}.DBF	EE Trip file	Trip Generation\Non-Rec TG
SJMZDAT.DBF	PnR data (cost, type)	Trip Generation\Non-Rec TG
CORDONPCT.DBF	% Allocation of EI trips to externals	Trip Generation\Non-Rec TG
SJMZPOP.DBF	SE data	Trip Generation\Non-Rec & Rec TG
SJMLIFE.DBF	% HH by Lifecycle	Trip Generation\Non-Rec & Rec TG
SJMREC.DBF	Recreational input data	Trip Generation\Rec TG
CASINOEQV.DAT	Casino zonal characteristic for casino bus occupancy	Mode Choice
EI_distribution.csv	% Distribution from externals to 4 geographies	EI Mode Choice
EI_LOS_PhillyCtr.csv	Modal Time and Cost data from externals to Philly Ctr	EI Mode Choice
EI_LOS_PhillyOther.csv	Modal Time and Cost data from externals to Philly Other	EI Mode Choice
EI_LOS_Camden.csv	Modal Time and Cost data from externals to Camden	EI Mode Choice

Note - XX refers to scenario year

All of the above input files can be opened and edited within the Cube application environment. It is important to ensure that these files are present especially when preparing and launching a new model scenario run.

4.2 Output Data Files

The primary output files generated in each step of the model are shown in Table 4-2.

Table 4-2: SJTDM Output Files

Filename	Description	Step Generated
PANDA.DBF	Non-recreational Productions and Attractions	Non-recreational Trip Generation
SJRECTGSHORE.DBF	Recreational Shore Productions and Attractions	Recreational Trip Generation
SJRECTGACCESS.DBF	Recreational Access Productions and Attractions	Recreational Trip Generation
SJRECTGCAS.DBF	Recreational Casino Productions and Attractions	Recreational Trip Generation
SJRECTGEVT.DBF	Recreational Event Productions and Attractions	Recreational Trip Generation
{XX}TRIPS.MAT	Trip Distribution Output - (XX - Trip purpose)	Trip Distribution
SJM{XX}.MAT	I-I Mode Choice Output - (XX- Trip Purpose)	I-I Mode Choice
ModalTrips.PRN	I-I Mode Choice Summary Print File	I-I Mode Choice
EI_Split_MC.MAT	E-I Mode Choice Output	E-I Mode Choice
{XX}VTRIPS.MAT	Highway Trip Table (XX - Time of Day)	Temporal Model
BusTrips_{XX}.MAT	Bus Trip Table (XX - PK, OP)	Temporal Model
RailTrips_{XX}.MAT	Rail Trip Table (XX - PK, OP)	Temporal Model
{XX}LOADED.NET	Loaded Network (XX - Time of Day)	Highway Assignment
HWYLOADS_TD.NET	Daily loaded network	Highway Assignment
TASSN_XX_YY	Transit Link Output (XX - Mode, YY - PK, OP)	Transit Assignment

4.3 Network Attributes

A description of the unloaded highway link attributes are provided in Table 4-3. These attributes should be reviewed and updated accordingly whenever a user adds a link or needs to modify attributes of an existing link as a result of project coding effort. Note that a few attributes shown in the table, which are related to signalization, are not being used in the current model but are being preserved for future use when the data becomes available.

Table 4-3: Input Highway Network Link Attributes

Field	Description
A	A node - The node number of the upstream end of the link
B	B node - The node number of the downstream end of the link
DISTANCE	Link distance (in hundredths of a mile with an implied decimal)
FC	Functional Class
AT	Area Type
FT	Facility Type
LANES	Number of Lanes
SPDADD	Speed Lookup Adjustment (Additive in %)
SPDSUB	Speed Lookup Adjustment (Subtracted in %)
CAPADD	Capacity Lookup Adjustment (Additive in %)
CAPSUB	Capacity Lookup Adjustment (Subtracted in %)
NSIG	Number of Signals (Not used - for future use)
ARRTYPE	Arrival Type Indicator (Not used - for future use)
GC	Green to Cycle Ratio (Not used - for future use)
CYCLE	Cycle length (Not used - for future use)
NAME	Street Name
COUNTY	County Code
TOLLROAD	Toll Road Indicator (=1 if Toll Road)
TOLL	Toll (cents)
COUNT_SPRING	Spring counts conducted in this study and AADT counts from other sources
COUNT_SUMMER	Summer counts conducted in this study

Table 4-4 provides a list of the major loaded highway network link attributes. Note that in the table, '_1' represents results of the first assignment. If the input network already had the loaded attributes appended with '_1', the loaded volumes will be appended with '_2' (i.e 1 more than the input network's assignment #).

Table 4-4: Loaded Highway Network Link Attributes

Field	Description
V_1	Combined volume from all modes
TIME_1	congested link travel time (min)
VC_1	volume-to-capacity ratio
CSPD_1	congested speed (mph)
VDT_1	vehicle-distance traveled (vehicle-miles)
VHT_1	vehicle-hours traveled
V1_1	loaded volume for free-SOV mode
V2_1	loaded volume for toll-SOV mode
V3_1	loaded volume for free-HOV mode
V4_1	loaded volume for toll-HOV mode
V5_1	loaded volume for free-comm veh mode
V6_1	loaded volume for toll-comm veh mode
V7_1	loaded volume for free-truck mode
V8_1	loaded volume for toll-truck mode
V9_1	select link loaded volume for free-SOV mode
V10_1	select link loaded volume for toll-SOV mode
V11_1	select link loaded volume for free-HOV mode
V12_1	select link loaded volume for toll-HOV mode
V13_1	select link loaded volume for free-comm veh mode
V14_1	select link loaded volume for toll-comm veh mode
V15_1	select link loaded volume for free-truck mode
V16_1	select link loaded volume for toll-truck mode
VT_1	bi-directional total loaded volume from all modes
V1T_1	bi-directional total loaded volume for free-SOV mode

Table 4-5 presents a description of transit network attributes. Whenever a user edits the transit network, these attributes should be reviewed or modified as needed.

Table 4-5: Transit Network Attributes

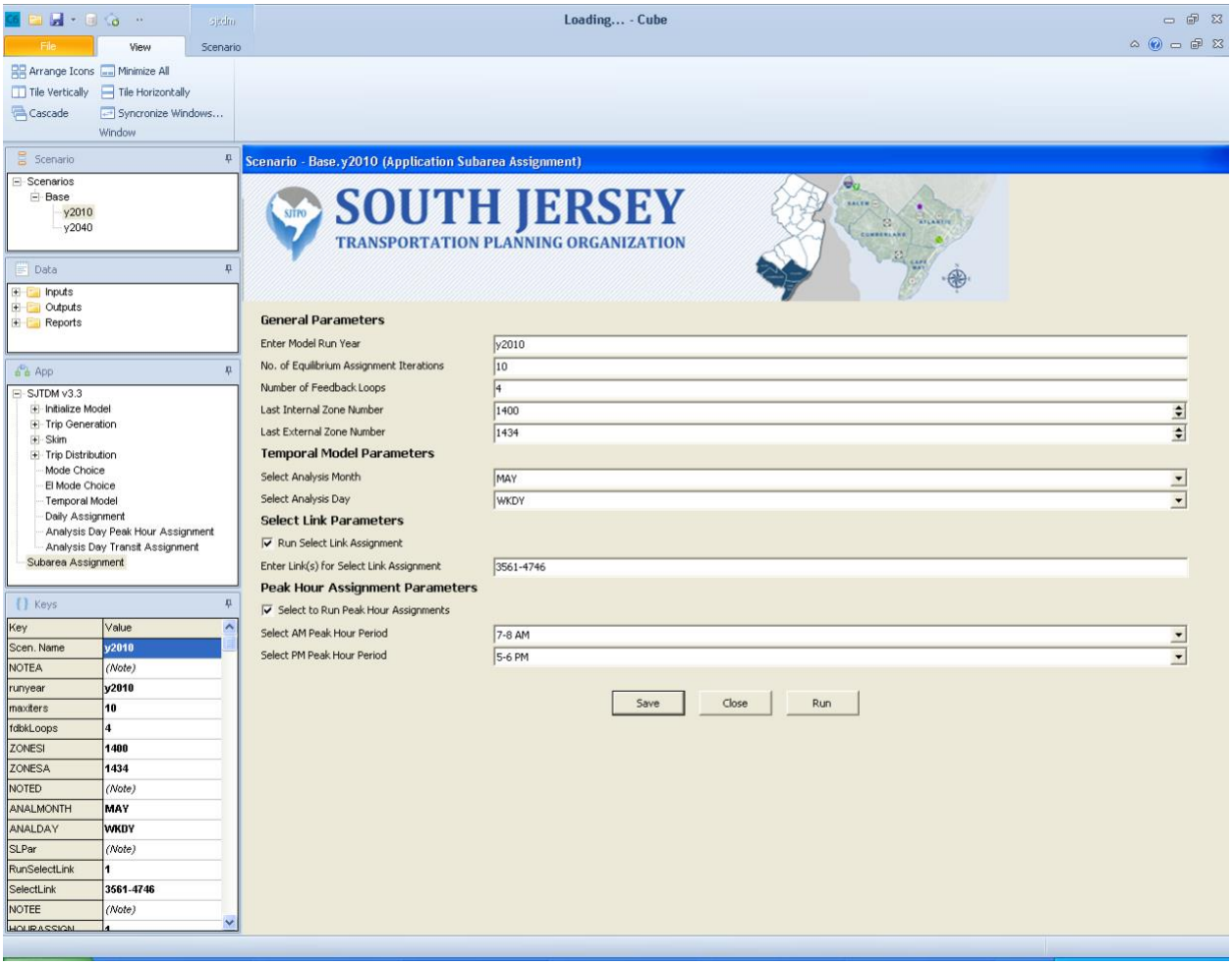
Attribute	Value	Description
Mode	1	Casino Shuttle (Atlantic City Rail Station to Casinos)
	2	Local Jitney-Type Service, includes AC and OC Jitneys
	3	NJ Transit Local Bus
	4	NJ Transit Regional Bus
	5	Atlantic City Rail Line
	13	Sidewalk
	16	Walk Access Connector
	17	Drive-Access Connector
Owner	1	NJ Transit (South Jersey Region)
	2	NJ Transit (DVRPC Region)
	4	Private Operator Jitney (AC routes)
	6	Salem County
	7	Five-Mile Beach Electric Railway Company
Period	1	Winter AM Peak
	2	Winter Off-Peak
	3	Summer Off-Peak

5.0 Model Execution

5.1 Full Model Execution

Once the catalog is opened in Cube and the SJTDMv3.3 application is launched, the entire model chain can be executed by first double-clicking a particular scenario, check the model parameters to ensure they are correct and then press the "Run" button to start the full model run. **Figure 5–1** shows the scenario run window. The model set to perform 4 feedback loop iterations. A complete model run with 4 feedback loops on a computer with 3.5 GB RAM and 4 cores requires about 9 hours.

Figure 5-1: SJTDM Scenario Run Window



5.2 Single Application Group Execution

If the user needs to run only a selected component of the SJTDM, especially useful during sensitivity testing to evaluate the effect of a change on a particular modeling step, this can be accomplished by double-clicking a 'Parent' step (such as 'Initialize Model') and then clicking the 'Run Application' button and checking the 'Run Current Group Only' checkbox. This is shown in Figure 5-2. Upon hitting OK, a task monitor window will launch which displays the progress of the execution of that step, as shown in Figure 5-3.

Figure 5-2: Illustration of running selected application group in Cube

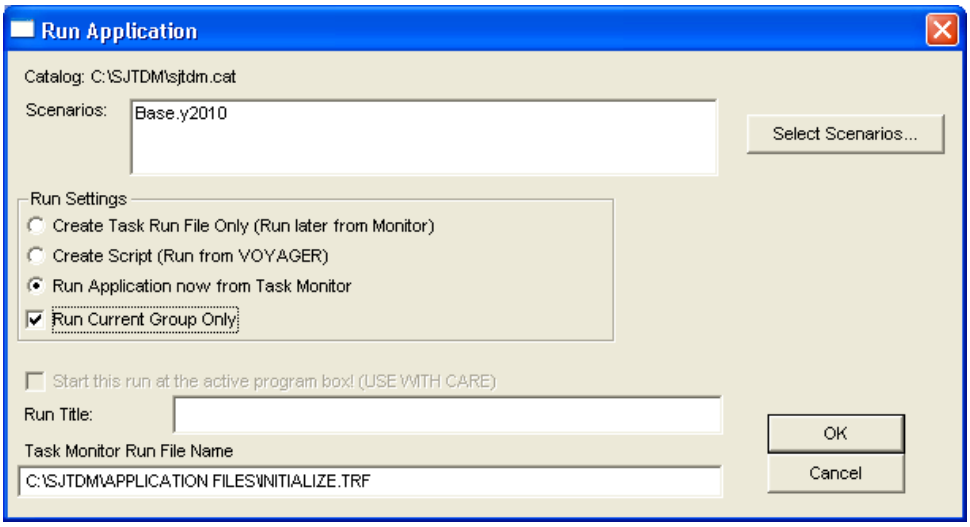
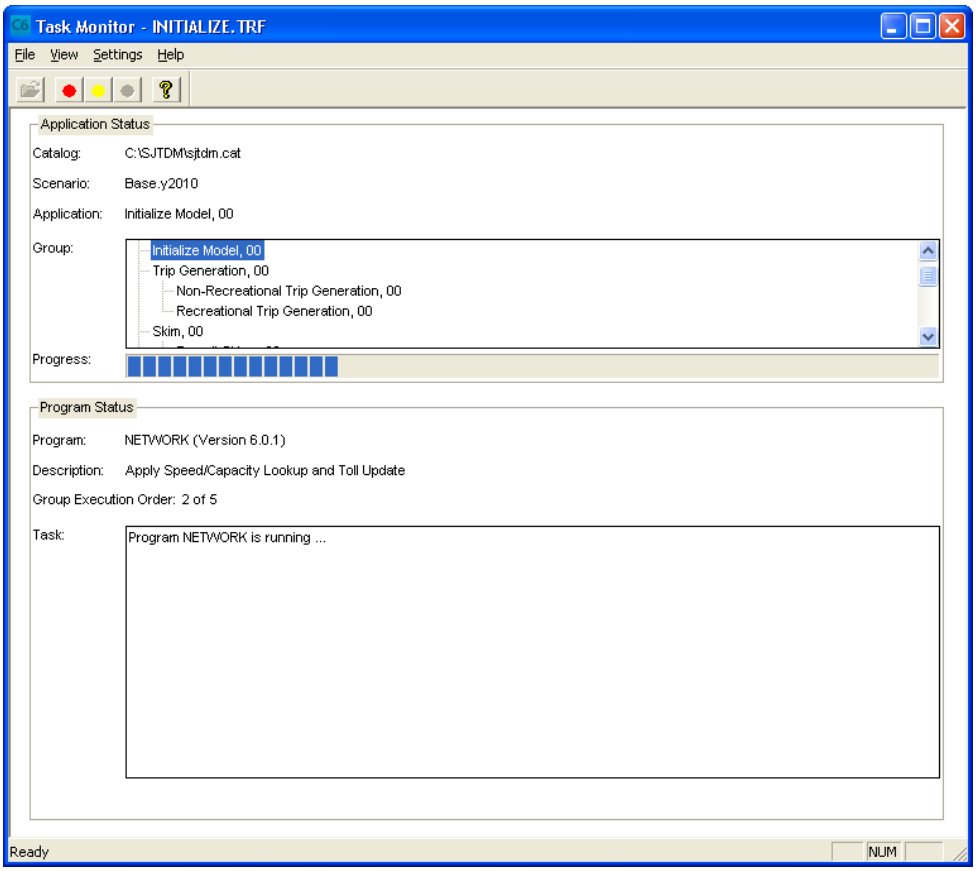


Figure 5-3: Task Monitor during a single application group run



6.0 Model Summaries/Reports

Once the model execution is complete, the outputs from the various steps of the modeling chain can be summarized in an Excel spreadsheet or can be viewed via Cube Reports. This section provides guidance on how to perform the summaries.

6.1 Model Output Files for Spreadsheet Summaries

The output files generated from a model run that are relevant for performing spreadsheet summaries are shown in Table 6-1. Some of these are automatically generated by the model run whereas a few are generated after running Voyager scripts. These scripts are only relevant to the base year 2010 (such as 'Attach traffic counts.s') and thus have not been incorporated into the model chain.

Table 6-1: Model Output Files for Spreadsheet summaries

Filename	Spreadsheet Used	Source
PANDA.DBF	Trip Generation -2010.xlsx	Non-recreational Trip Generation Step
SJRECTGSHORE.DBF		Recreational Trip Generation Step
SJRECTGACCESS.DBF		
SJRECTGCAS.DBF		
SJRECTGEVT.DBF		
trip distribution output.prn	Trip Distribution -2010.xlsx	Print trip distribution matrices.s
avg_triplen.dbf		Trip Length.s
ModalTrips.prn	Mode Choice - 2010.xlsx	Mode Choice step
RMSE.PRN	Highway Assignment-2010.xlsx	RMSE.s
Tppl*.prn		crosstab.s
TASSN_WBUS_PK.dbf	Transit Assignment - 2010.xlsx	Transit Assignment Step
TASSN_WRAIL_PK.dbf		
TASSN_WBUS_OP.dbf		
TASSN_WRAIL_OP.dbf		
TASSN_DBUS_PK.dbf		
TASSN_DRAIL_PK.dbf		
TASSN_DBUS_OP.dbf		
TASSN_DRAIL_OP.dbf		

6.2 Cube Reports

Citilabs has incorporated a reporting package known as Cube Reports into the standard Cube-Base installation (this used to be a separate stand-alone package in addition to Cube-Base in earlier versions of Cube). Cube Reports provide the ability to view table, graphs and charts of summarizing model outputs within the Cube environment. The reports require the development of input files that should be of a specific format. Each report can have only one data source.

As part of the SJTDM enhancements, several Cube Reports have been developed and incorporated into the model application. Table 6-2 provides a summary of the reports and their

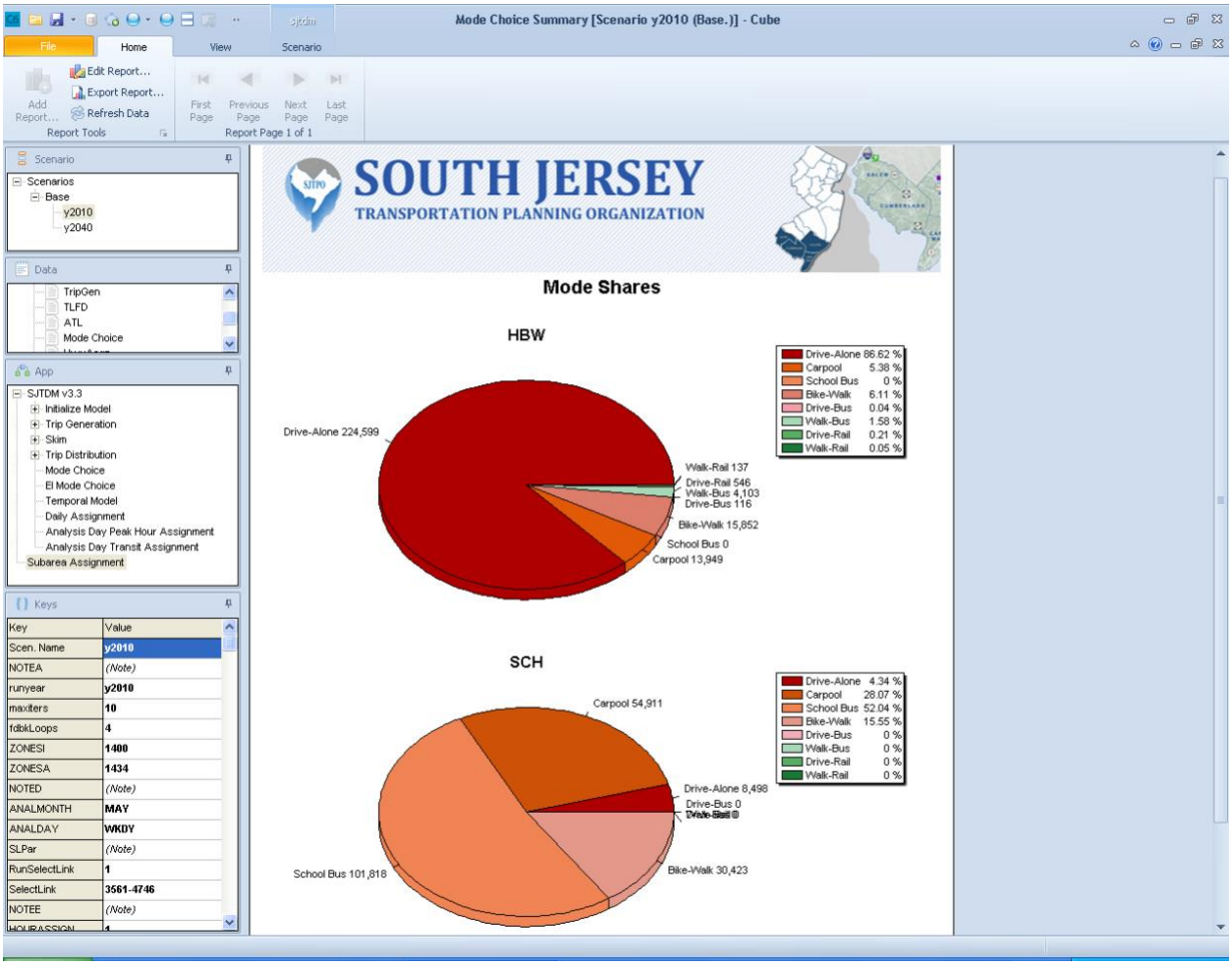
description. The inputs for each of the reports are automatically generated via Voyager scripts during the execution of the model chain. In order to view the reports, simply double-click the report name under Data->Reports in the SJTDM application.

Table 6-2: Cube Report descriptions

Report Name	Description
TripGen	Pie chart and table of trip productions and attractions
TLFD	Graph of model-estimated trip length frequency distribution
ATL	Table of average trip lengths
Mode Choice	Pie chart of mode shares
HwyAsgn	Cross tabulations of volume, count, VMT and VHT by FT and AT
VMT by LOS	Table showing VMT by LOS and FT for AM and PM peak period
Lane Miles by LOS	Table showing Lane Miles by LOS and FT for AM and PM peak period

The Cube Report depicting a summary of the Mode Choice Step in the SJTDM is shown in Figure 6-1.

Figure 6-1: Cube Report for SJTDM Mode Choice Step



7.0 Common Analysis Tasks

This section provides instructions on performing some common analysis tasks using the SJTDM Cube Model. It is assumed that the user has some basic knowledge of Cube-Base and the Voyager scripting language. The Cube/Voyager Help or the documentation can be referred to for additional reference.

7.1 Socioeconomic Data Update

One of the common tasks in travel demand modeling is to update the socioeconomic data input for a particular scenario. This could be applicable to a few zones within a corridor or for all the zones in the entire modeling area. If only a few zones need to be edited, it can be done directly within the SJTDM Cube modeling environment. For instance, if the population in TAZ 1 needs to be updated, the SJMZPOP.DBF file located in the application as an input to the trip generation step (see Figure 7-1) can be opened in Cube by simply double-clicking it. Once it is opened (Figure 7-2), simply click the cell corresponding to the POP field and TAZ 1 and enter the revised population. This is a convenient method to update data for a few TAZs.

Figure 7-1: Socioeconomic Input Data file location in SJTDM application

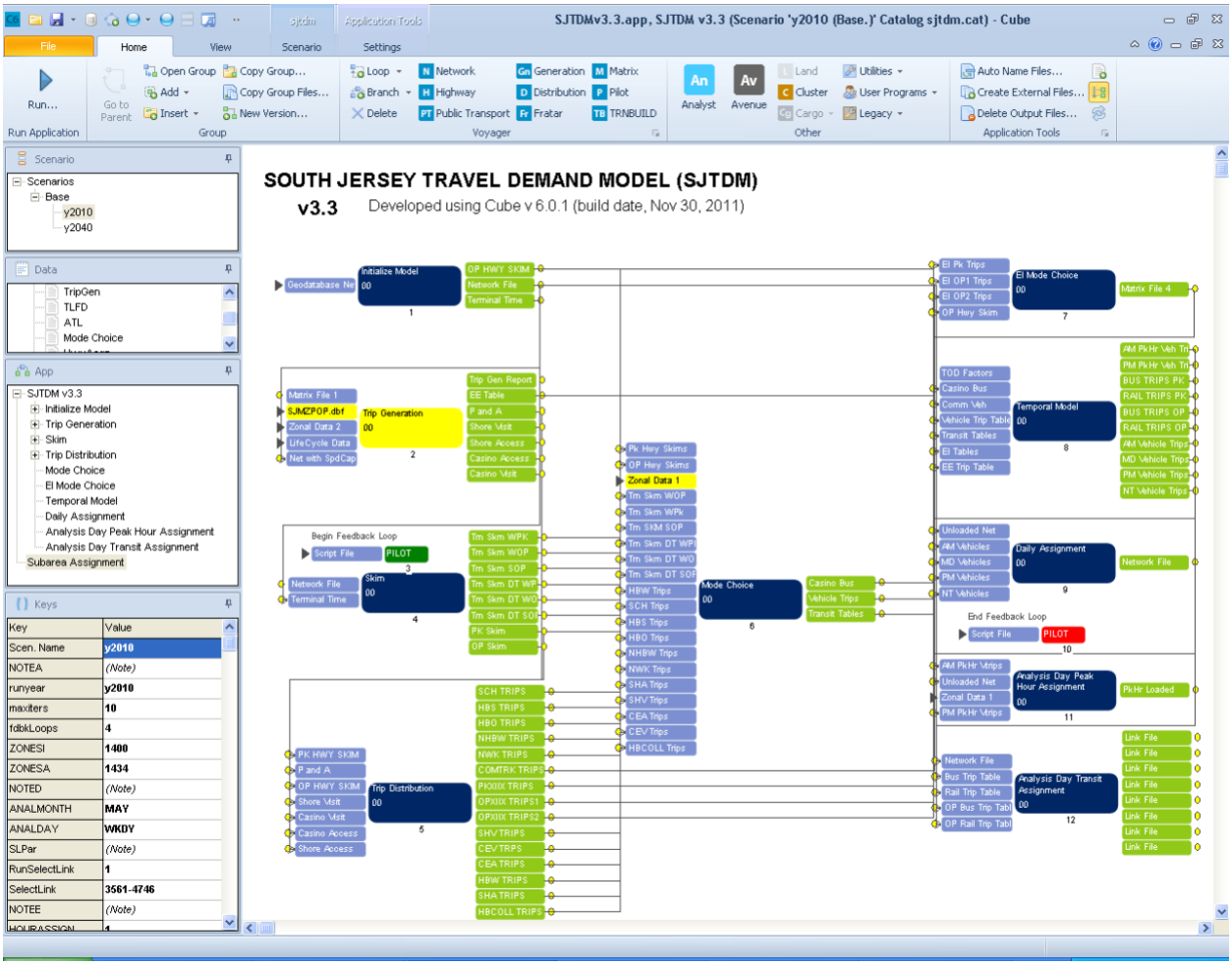
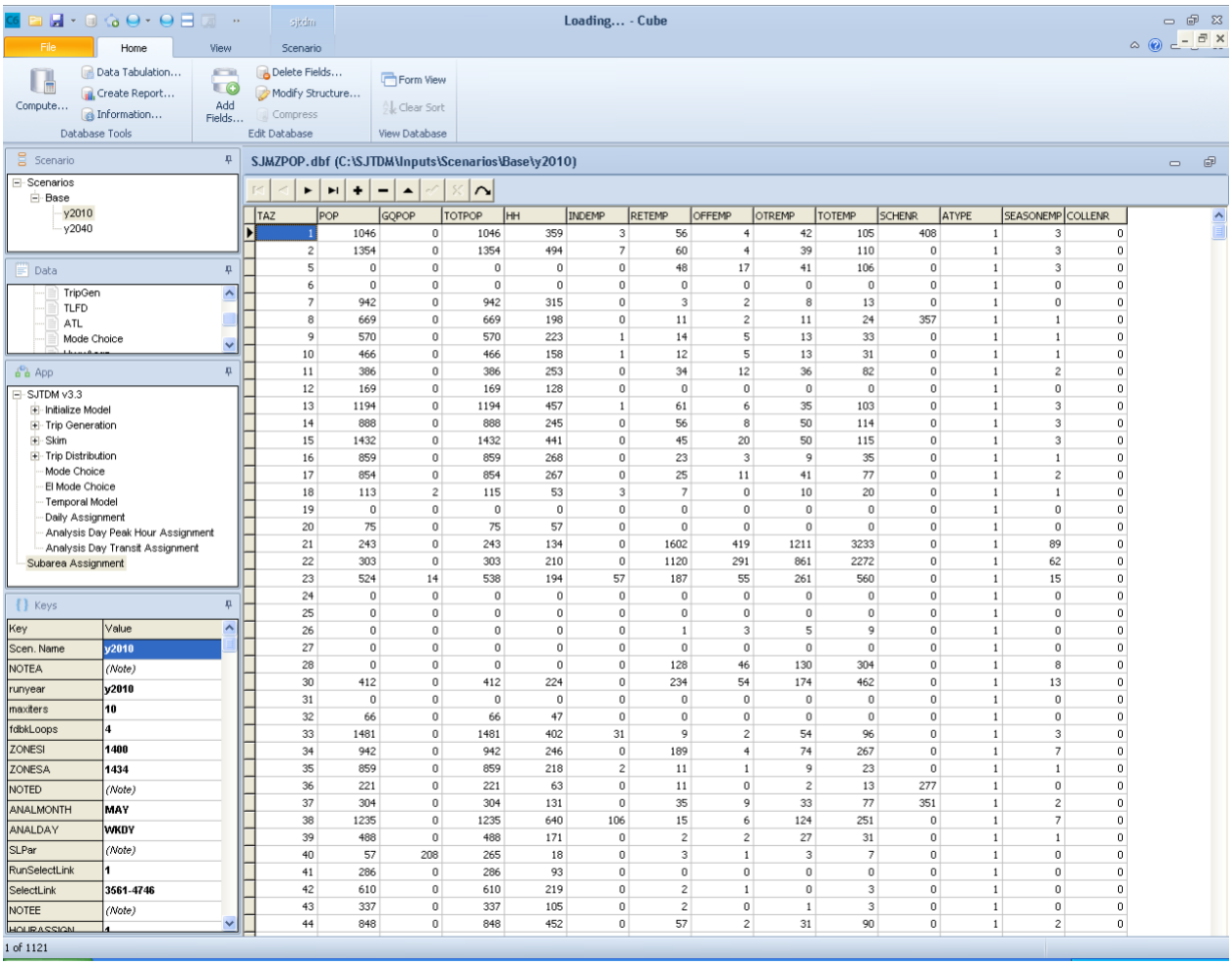


Figure 7-2: Socioeconomic Input Data file opened in Cube



If the socioeconomic data attributes of the entire model area need to be updated, it is best done by opening the SJMZPOP.DBF file (located under \sjtdm\Inputs\Scenarios\Base\y2010 if the 2010 data is to be updated) as an Excel spreadsheet, saving it as an Excel spreadsheet, performing the calculations or updates in Excel and then converting it back to DBF format via Microsoft Access.

7.2 Highway Network Update

Another common modeling task is to update the input highway network either to correct a previously overlooked coding error or to edit it based on revised assumptions. The input highway network can be opened in Cube by double-clicking the 'Network' geodatabase file which is an input to the 'Initialize Model' step (See Figure 7-3). This would open the network in the 'GIS Window' in Cube (Figure 7-4). If desired, a shapefile of the street layer can be opened in Cube to aid in the network editing task, by clicking on the 'Add Data' icon (a plus sign) and adding a shapefile by browsing to the directory containing the shapefile of the streets.

Figure 7-3: Input highway network location in SJTDM application

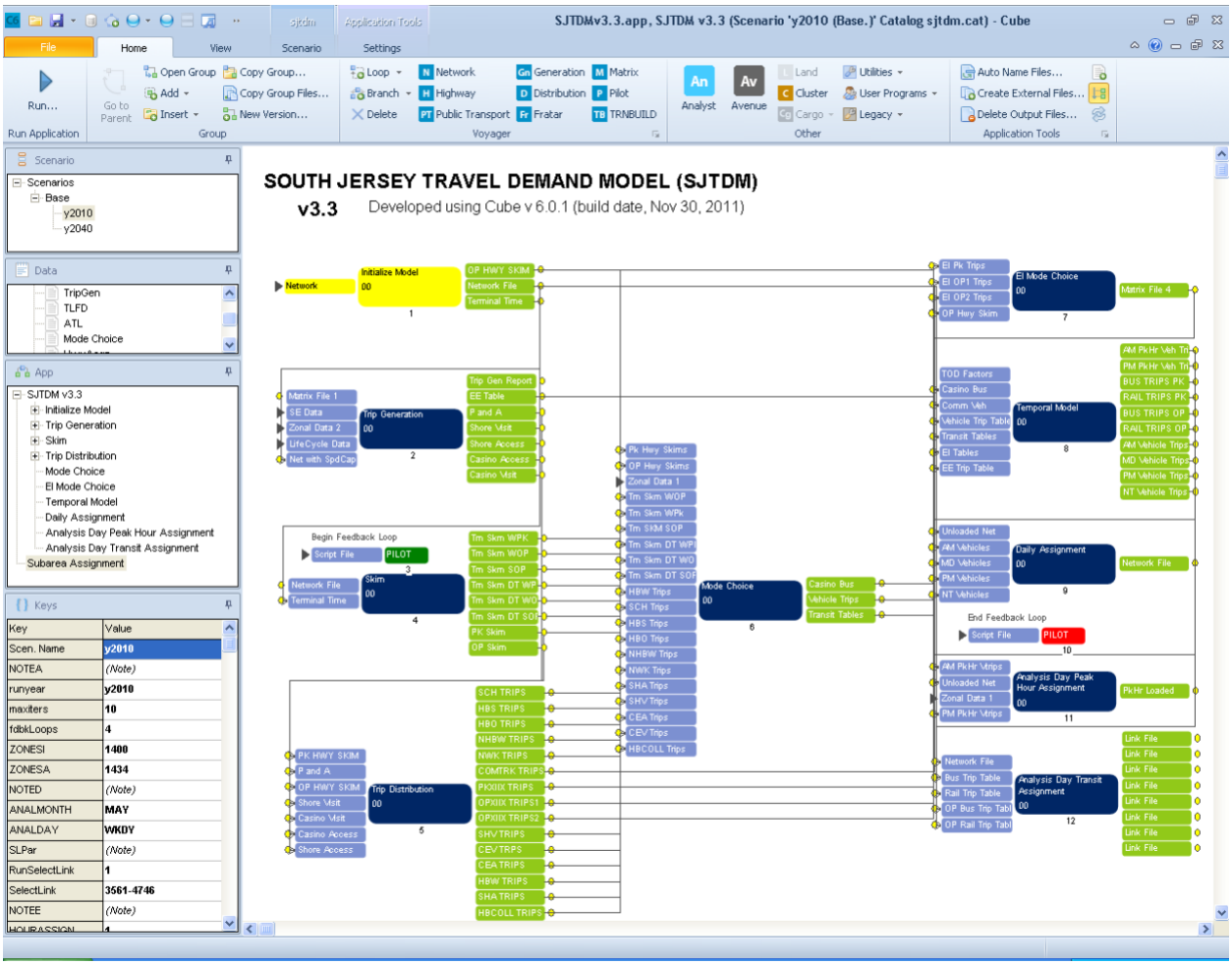
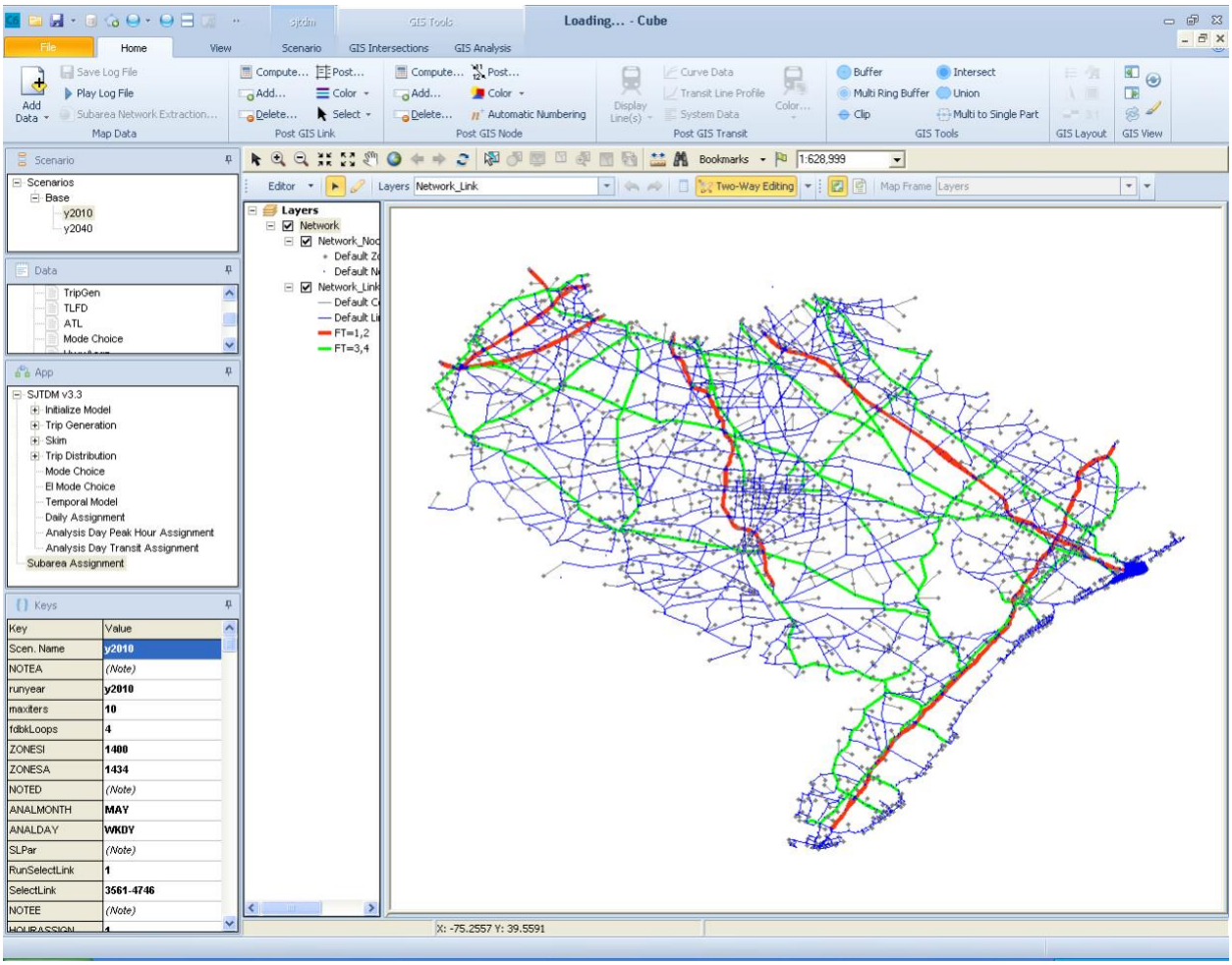
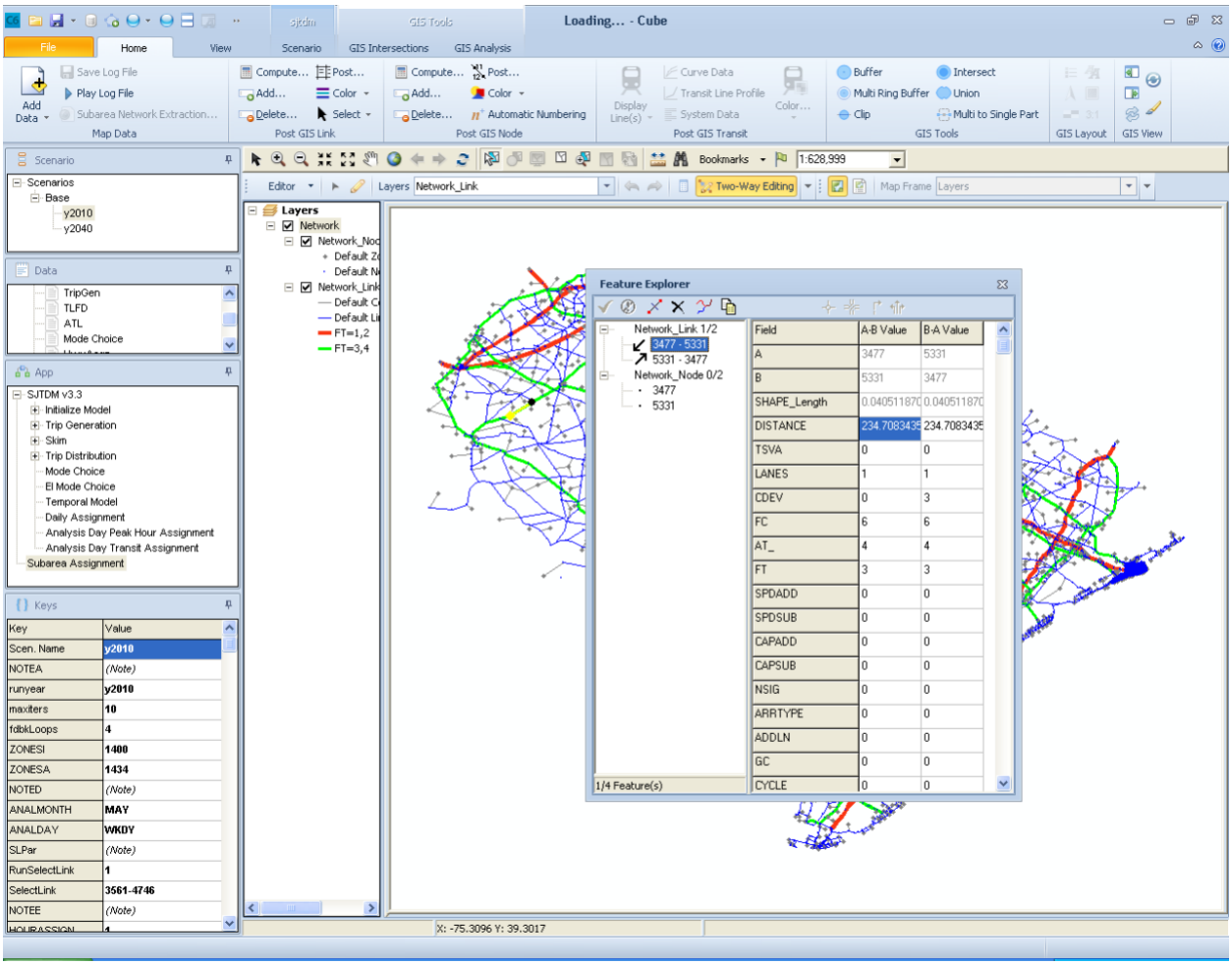


Figure 7-4: Input highway network opened in Cube



The network can be modified by first clicking Editor->Start Editing, click 'Select Features' and then click the desired link to bring up the 'Feature Explorer' dialog box (Figure 7-5). The link attributes can be edited by simply typing in the updated values. The link can also be split by clicking the 'Split Link' button in the Feature Explorer and specifying an intermediate node number at the prompt.

Figure 7-5: Feature Explorer in Cube



To add a new link, first ensure that the link layer is selected from the 'layers' drop-down menu, click the 'Create Feature' button (pencil icon) which would cause the cursor to appear like a pencil, click the anode and then the bnode to create a link between an existing anode and bnode. If the link is to be created from an anode to a bnode that does not exist, the bnode should be specified while terminating the link creation task.

In order to add shapes to the links, click 'Edit Vertex' under the 'Editor' button and then click the desired location on the link to add the vertex.

Once all the edits are complete, click on 'Save Edits' under the 'Editor' button.

The user can save a 'log file' of the network changes if the same changes need to be applied to another highway network automatically. A log file is a text file (see Figure 7-6 for an example) that 'records' the link and node edits. This is a useful feature wherein the changes need not be manually repeated in another network thus avoiding errors and inconsistencies. The log file can be saved by clicking the 'save log file' button. The log file can be applied to another network by first opening that network in Cube, clicking on 'Play log file' button, navigating to the directory location where the log file was saved and then double-clicking the log file to apply the network edits.

The above is not an exhaustive list of network editing tasks in Cube, but the most frequently encountered in typical modeling applications. For a complete and comprehensive description of all the highway network editing tasks possible in Cube, please refer to the Cube Base Help or Documentation.

Figure 7-6: Example Log File created using Cube

```
HighwayLayerLogX,"C:\sjtpo\Inputs\SJTPO-Scenarios\y2002-
Validation\LRTP2035\y2010-Base\SJM_2010_Updated Highway
Network.net",6,46,1/25/2012 2:28:34 PM

Node,N,X,Y,SUB_TYPE,OLD_NODE,TAG

Link,A,B,DISTANCE,TSVA,SPDCLASS,CAPCLASS,LANES,CDEV,FC,AT,FT,SPDADD,SPD
SUB,CAPADD,CAPSUB,NSIG,ARRTYPE,ADDLN,GC,CYCLE,ZONE,REGION,TOLL,HOVFLAG,
DROP,FREELINK,SPDLIM,RTCODE,NAME[24],CURVE,EXTERNAL,TAG,AADT,AADT1WAY,C
OUNT_SOURCE,DVRPC_CNT,NEWLINK,LOC_NUM,DIRECTION[2],AM_CNT,PM_CNT,MD_CNT
,AC_AADT,AC_AADTSTR[5],SCNCODE,SJCNT[11]

N,A,0,60506,-74.58786,39.27512,0,0,0

N,A,1,60577,-74.8186,38.98573,0,0,0

N,A,2,60761,-75.03767,39.47068,0,0,0

N,A,0,60409,-74.65003,39.53338,0,0,0

N,A,1,61445,-74.8143,39.63304,0,0,0

N,D,2,60409,-74.65003,39.53338,0,0,0

N,A,0,61409,-74.64967,39.53323,0,0,0

N,A,1,62255,-74.51098,39.46339,0,0,0

N,A,2,62526,-74.65947,39.25046,0,0,0
```

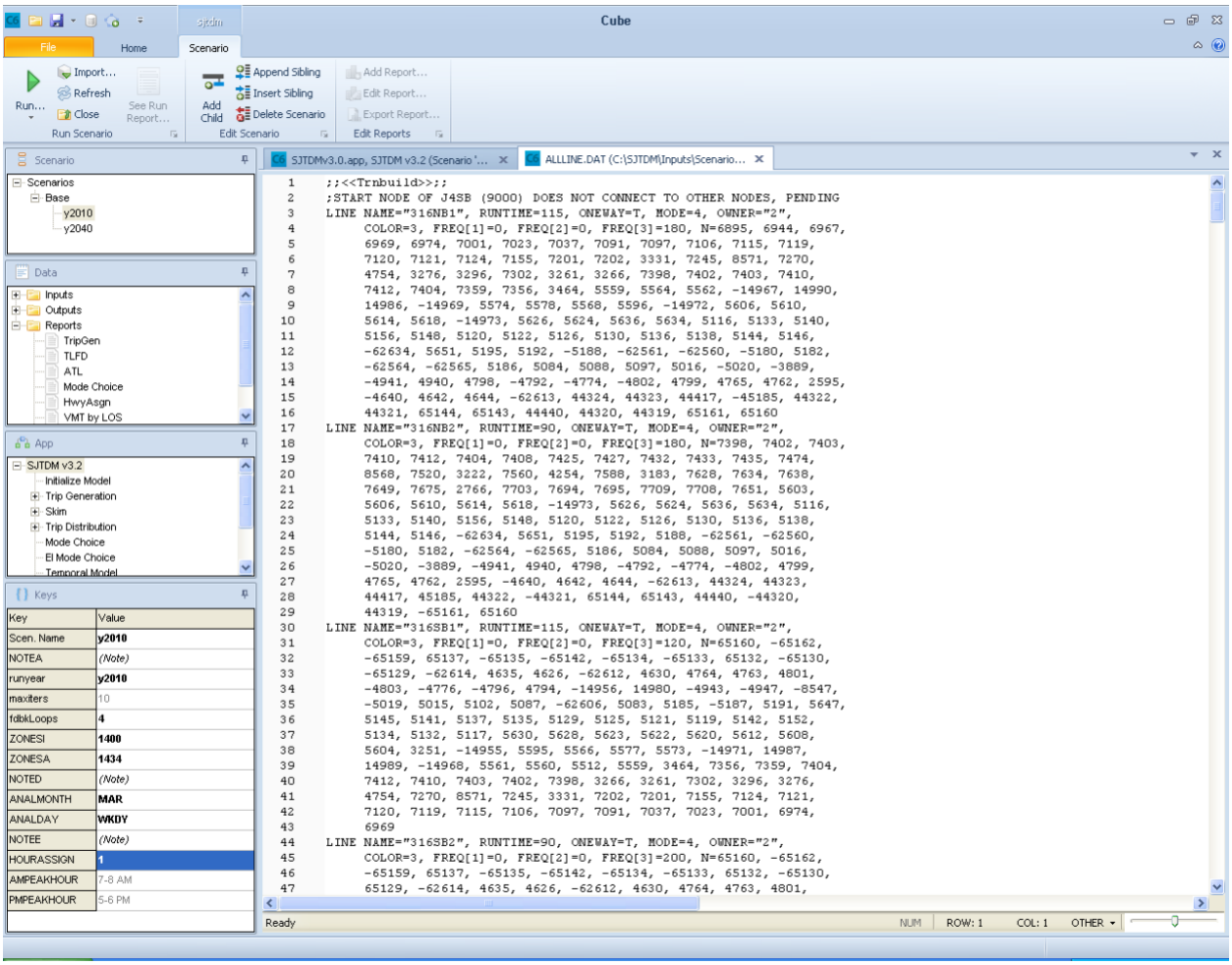
7.3 Transit Network Update

Since the SJTPO model includes transit routes that are either entirely within the model area or partially within the model area, the transit network editing process is described separately for these two scenarios.

7.3.1 Internal Transit Network Coding

The SJTDM transit network comprises primarily of the 'alline.dat' route file, located under 'C:\sjtdm\Inputs\Scenarios\Base\y2010' for 2010 as an example, and is a text file that can be opened in Cube or any text editor such as notepad. One of the basic changes that sometimes need to be made to the transit network is editing the frequency of selected buses based on updated information from schedules. This can be done by opening the allline.dat file (see figure 7-7 of this file opened in Cube), clicking 'Search->Find' and entering the route name of the bus/train that is needed to be modified, and typing the revised frequency (in the FREQ[1], FREQ[2] or FREQ[3] fields as applicable) corresponding to the LINE NAME that is found via the search. Other attributes such as RUNTIME can also be updated via the same procedure.

Figure 7-7: SJTDM transit route file opened in Cube



If a particular transit route needs to be re-aligned, it is best done graphically in Cube rather than the text file approach described above. First the highway network in *.NET format (NetwithSpdcap.NET) should be opened in Cube. The transit route file can be opened as another layer by clicking on 'Layer Control', double-clicking Transit layer, browsing to the allline.dat file located in the SJTDM\Inputs\Scenarios\Base directory for the particular model run and double-clicking it. The entire transit network would appear as shown in Figure 7-8. To display only the route that the user is interested in editing, click on 'Display Transit Line' to select the route name from the list on the left (figure 7-9).

Figure 7-8: SJTDM Transit Network in Cube

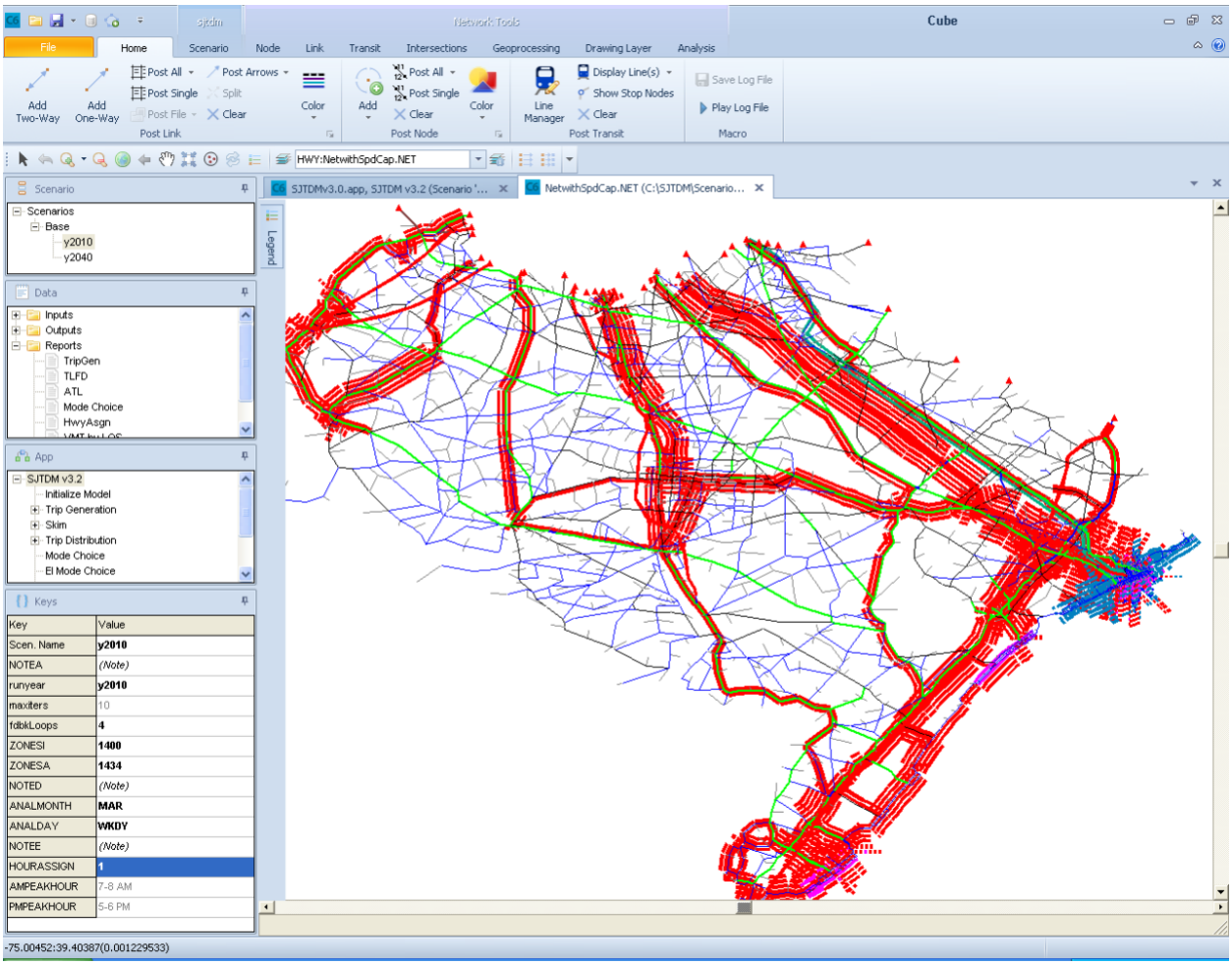
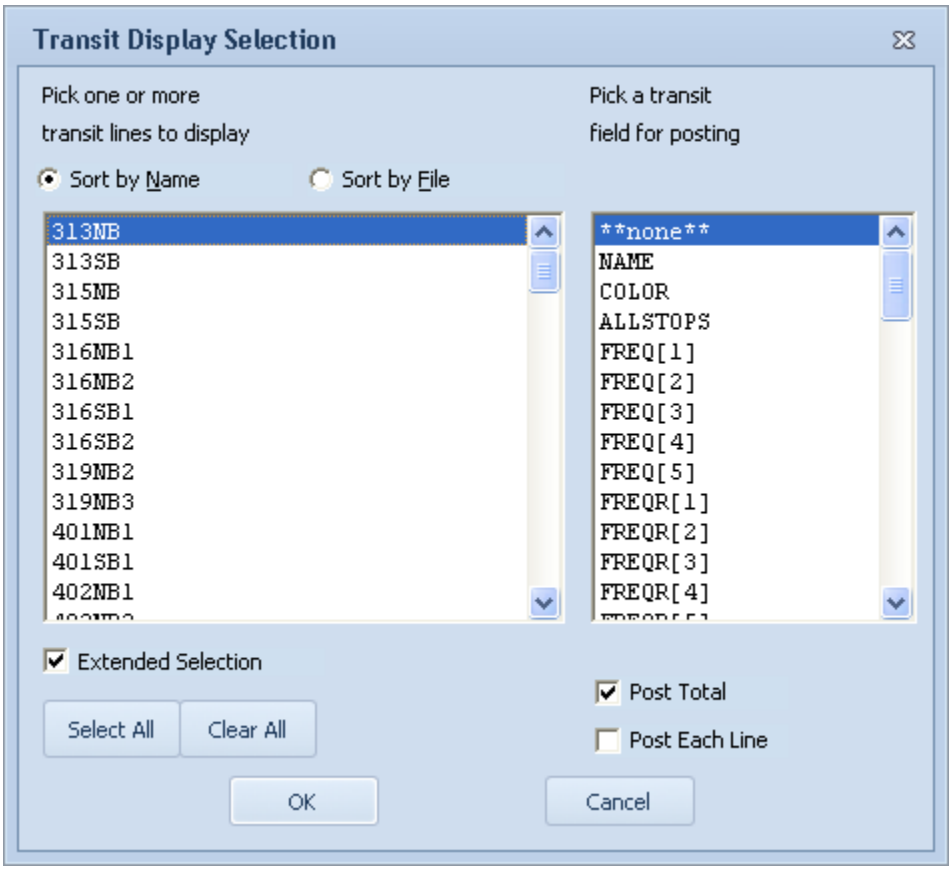
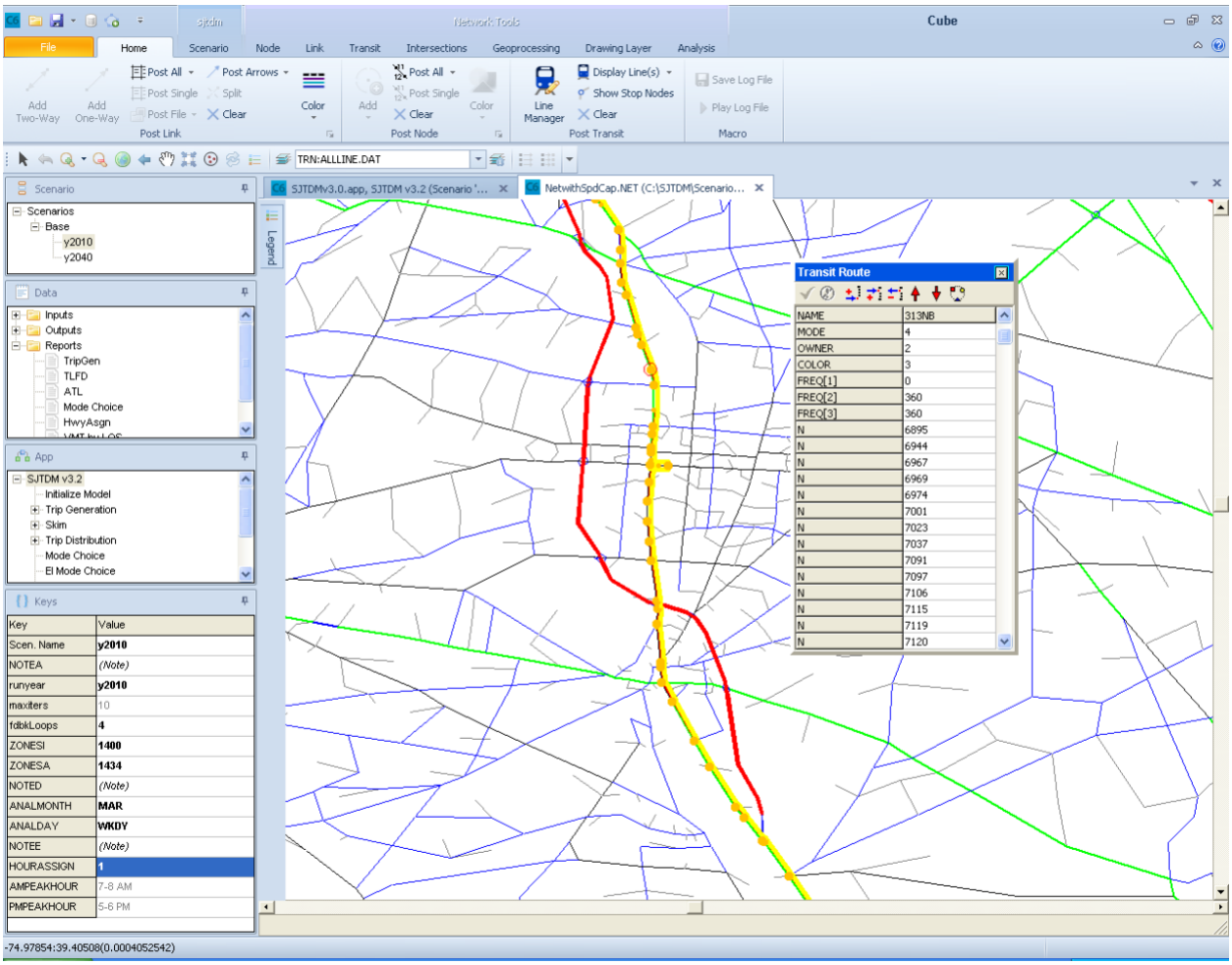


Figure 7-9: Display selected transit route



Next, the user should ensure that the transit layer is on top of the highway layer under the Layer drop down box. The selected route can be double-clicked and edited graphically by clicking on the Route Edit button in the Transit Route dialog box (Figure 7-10). The cursor will turn into a crosshair, and the user can click on highway nodes to add stations along the route. IF a station is to be a non-stop, the user should click 'Alt' before clicking the node to add a '-' preceding the node to indicate a non-stop.

Figure 7-10: Transit Route Editing dialog box



The Cube Manual can be referenced for additional transit network edits.

7.3.2 External-Internal Transit Network Coding

Certain transit routes in the SJTDM extend beyond the modeled area in reality. For instance, the Atlantic City Rail Line is coded in the model as terminating at the Atco station which is located at the model boundary whereas in reality it continues beyond that station and terminates in Philadelphia. This section describes how to code a new transit project that is located partially within the model area and extends beyond the model boundary, such as the proposed Camden Gloucester Rail project. Firstly, the internal portion of the line route should be coded in the *'Allline.dat'* file and the physical links in the *'Raillinks.dat'* file. Catchment zones for any proposed park-n-ride lots should be coded in the PNR_Rail.dat file. In order to represent the portion of the project outside the model boundary, the rail time and cost (fare) fields (these represent the runtime and fare from the external station to the final destination) should be entered for the appropriate external station in the Level-of-Service data files (*EI_LOS_PhillyCtr.csv* for Philly Center area, *EI_LOS_PhillyOther.csv* for Other Philadelphia County areas and *EI_LOS_Camden.csv* for Camden City areas), located under the EI Mode

Choice application step (see Figure 7-11). This file, which is a proxy for the external portion of the transit network, is in csv format so that calculations can be performed if needed; steps 3-5 convert this to a dbf file. Figure 7-12 shows this file in dbf format. Please refer to the Model development report to obtain an understanding of how the EI Mode Choice process works.

Figure 7-11: Level of Service file location in SJTDM application

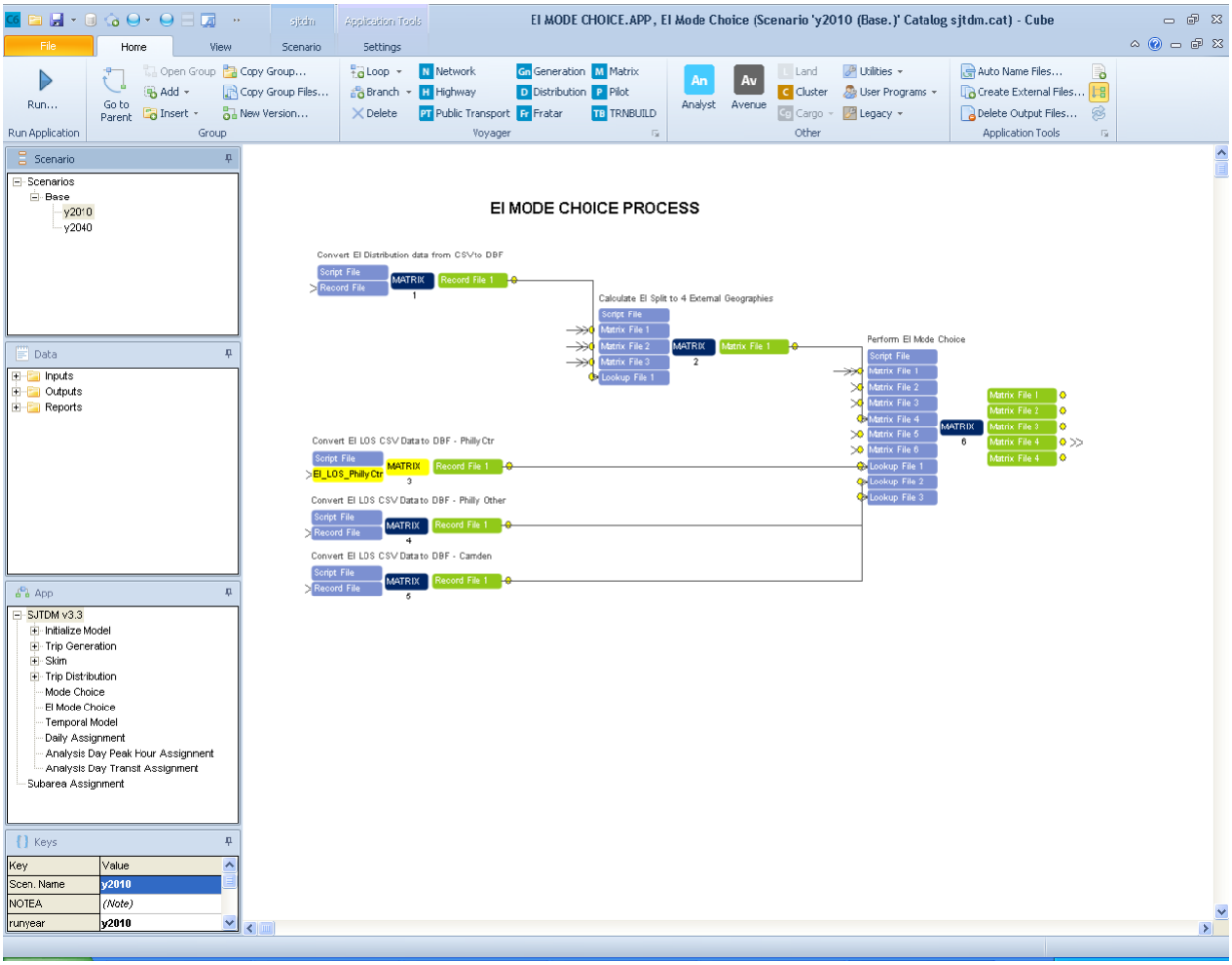
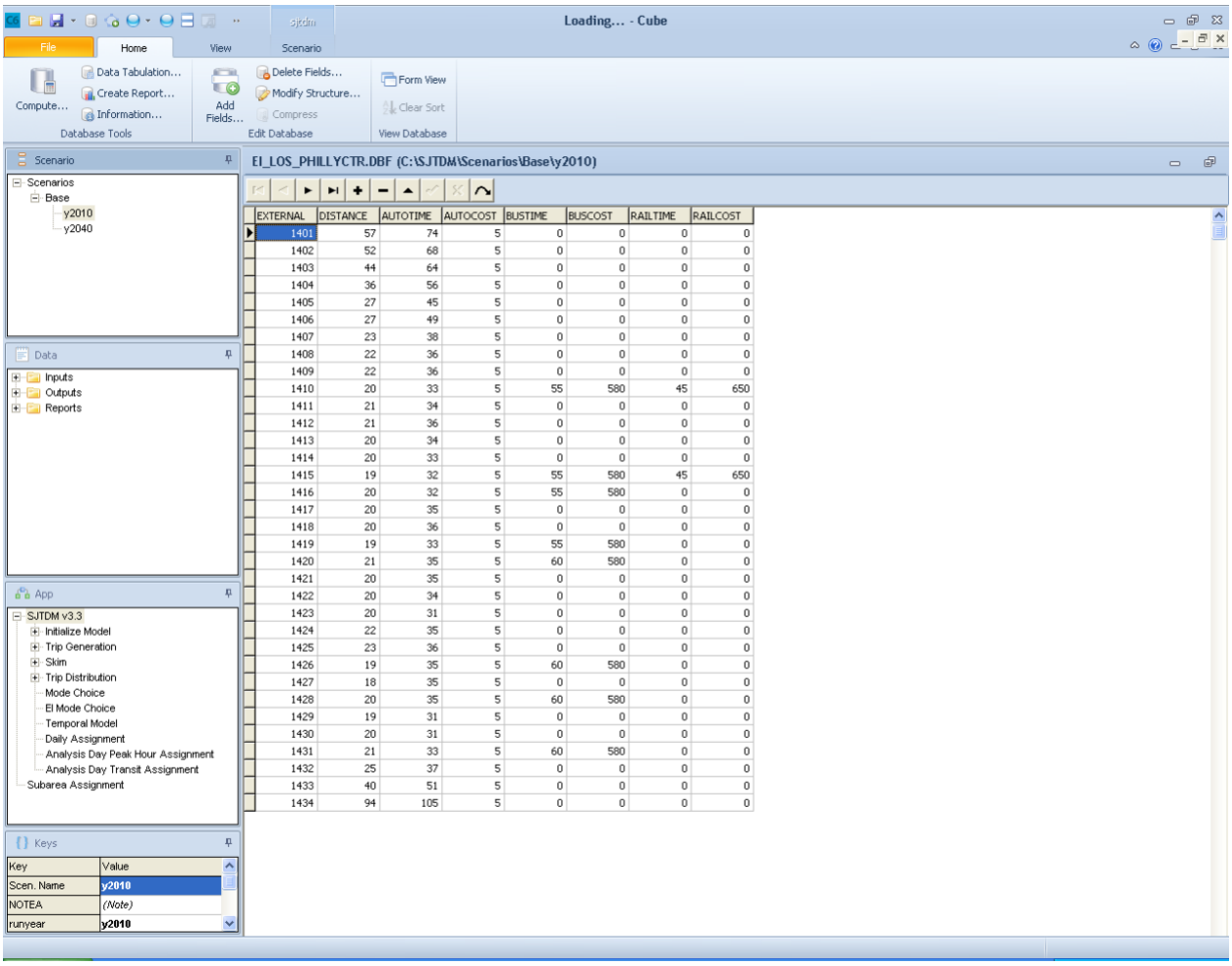


Figure 7-12: LOS input file in dbf format



7.4 Select Link Analysis

Select-link analysis is used to identify the origins and destinations of traffic that traverse a particular highway network link. This can be accomplished in Cube/Voyager by adding special syntax in the highway assignment Voyager script's PATHLOAD statement to accommodate the additional select link volume fields. An example of what this statement would look like is shown below.

```
path = cost, peni = 1, VOL[1]=mw[XX],excludegrp=1,
                       mw[5]=mw[XX],selectlink=(L=anode-bnode),
                       vol[9]=mw[5]
```

In the above example, VOL[1] stores the regular volume and VOL[9] stores the select link volume. The SJTDM assignment script has already been setup to perform select link analysis for one link. The user may modify this link as needed by entering the required link's A-node and B-node on the model run screen as shown in Figure 5.1. The select link volumes can be visualized via the SLVOL24 field in the daily loaded network HWYLOADS_TD.NET.

It is important to remember to add a statement in the ADJUST phase of the assignment step to exclude the select link volume fields from the total volumes used to compute V/C ratio in successive assignment iterations. This statement (already added in the SJTDM) would be as follows (the select link volumes would be beyond the 8 volume sets shown here):

```
FUNCTION  {
      v     = vol[1] + vol[2] + vol[3] + vol[4] + vol[5] + vol[6]
+ vol[7] + vol[8]
}
```

If more information is needed about this process, the select link processing section of the VOYAGER reference guide should be consulted.

7.5 Turning Movement Volume Display

Cube has the ability to display modeled turning movement volumes at intersections, provided that those were saved during the highway assignment step. In order to save the turns, open the highway assignment script (see Figure 7-13 for location of the script) for the desired time period (or all time periods, if needed) and add a statement below the listing of input/output files as follows:

turns n=4727,4746,5396

where the numbers represent the node numbers where the turns are needed.

After running the highway assignment with the above change, the loaded network (AMLOADED.NET for example) can be opened in Cube, and then click Intersections-> Output File and navigate to amturns.trn located under the model scenario run directory and double-click it. Zoom into the node (such as 4727), click it and then click on the 'Show Output Intersection Data' button (Figure 7-14) to display the turning movement volumes (Figure 7-15). The various volume sets (1 to 8) represent the loaded volumes for the various modes in the assignment model which are free-SOV, toll-SOV, free-HOV, toll-HOV, free-commveh, toll-commveh, free-truck and toll-truck. Additional volume sets will be present when performing select link assignment, in which case it should be ensured that the those volume sets are not pressed in the top left portion of the turning movement volume display.

Figure 7-13: Location of highway assignment script in SJTDM application

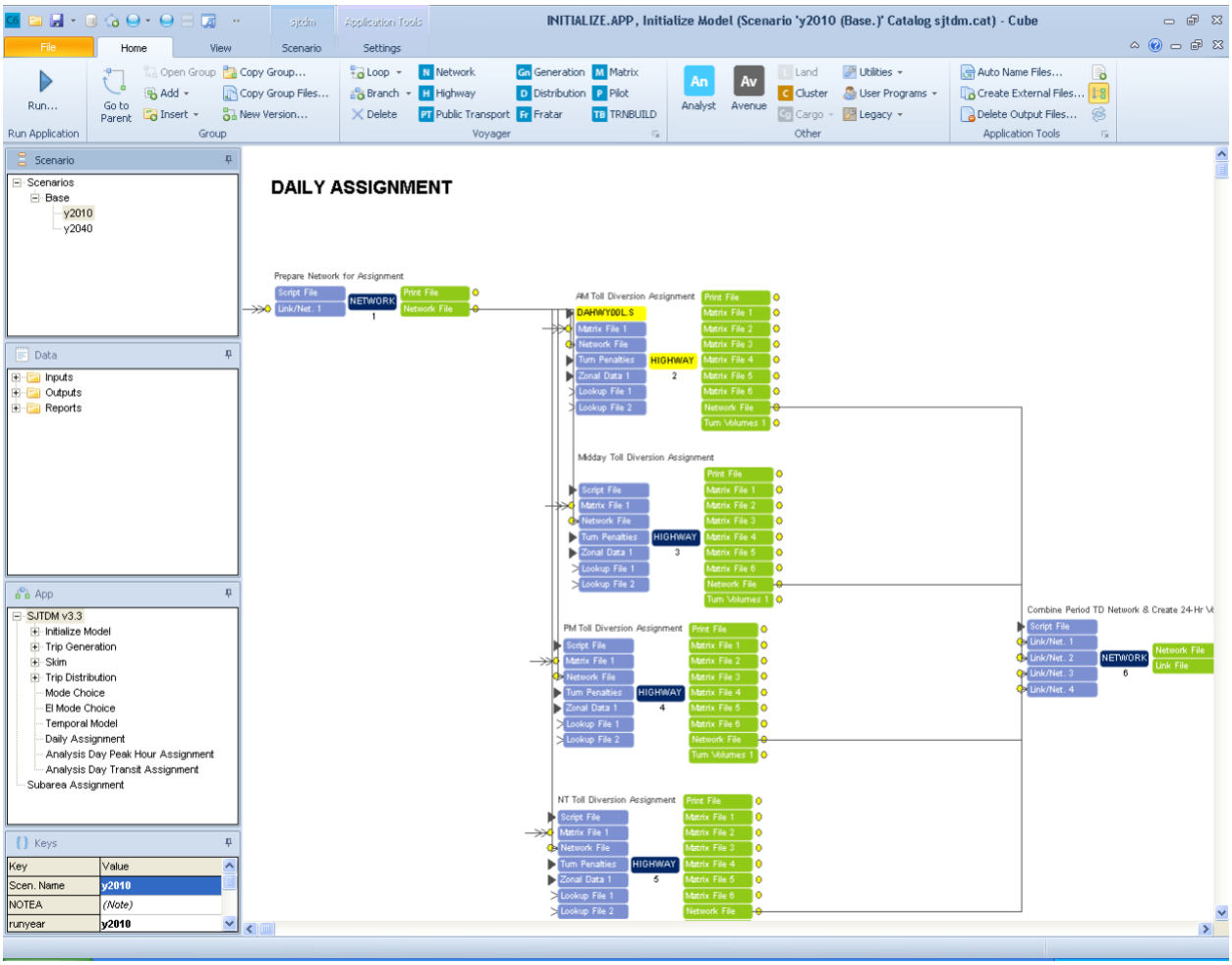


Figure 7-14: Show Output Intersection Data button

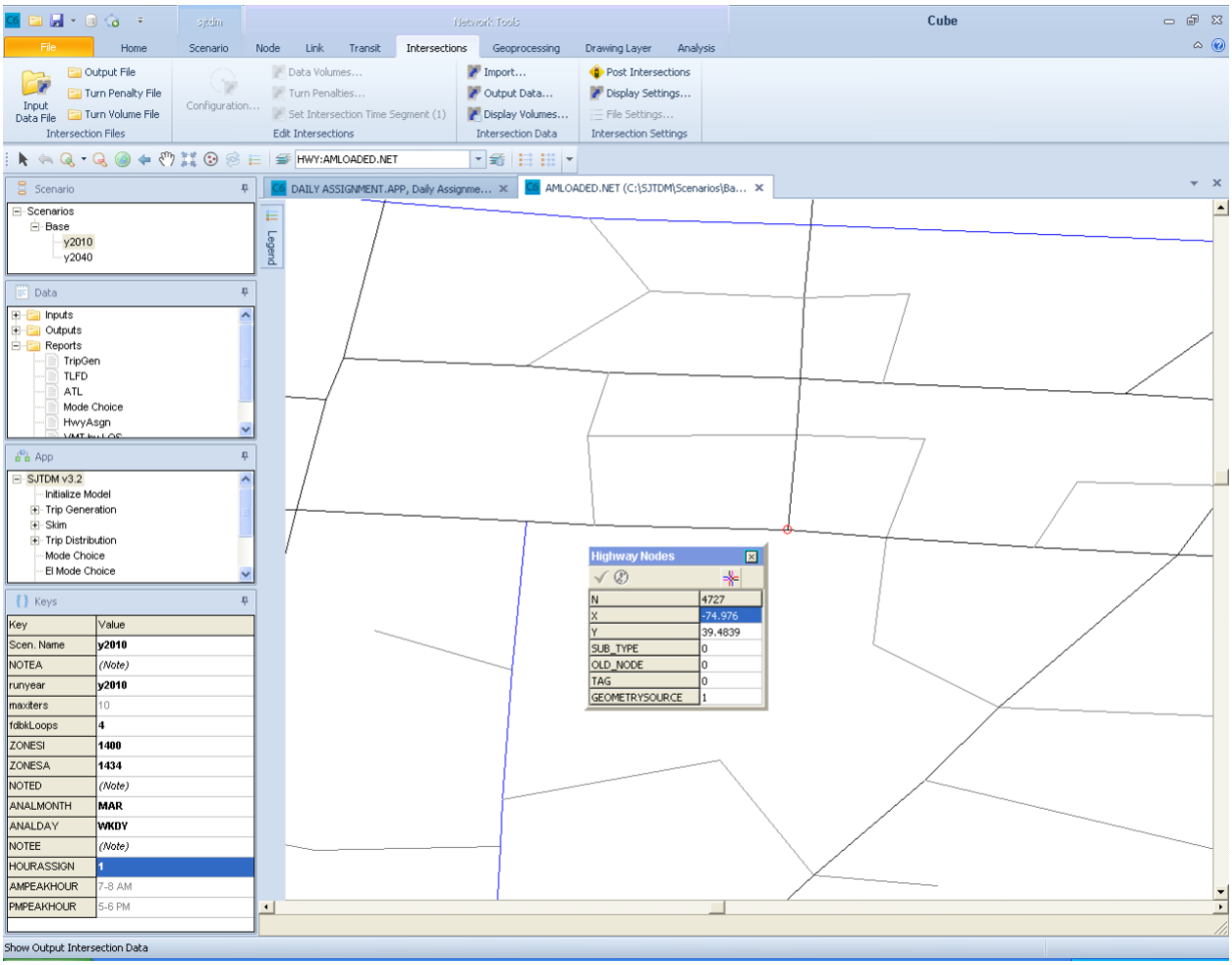
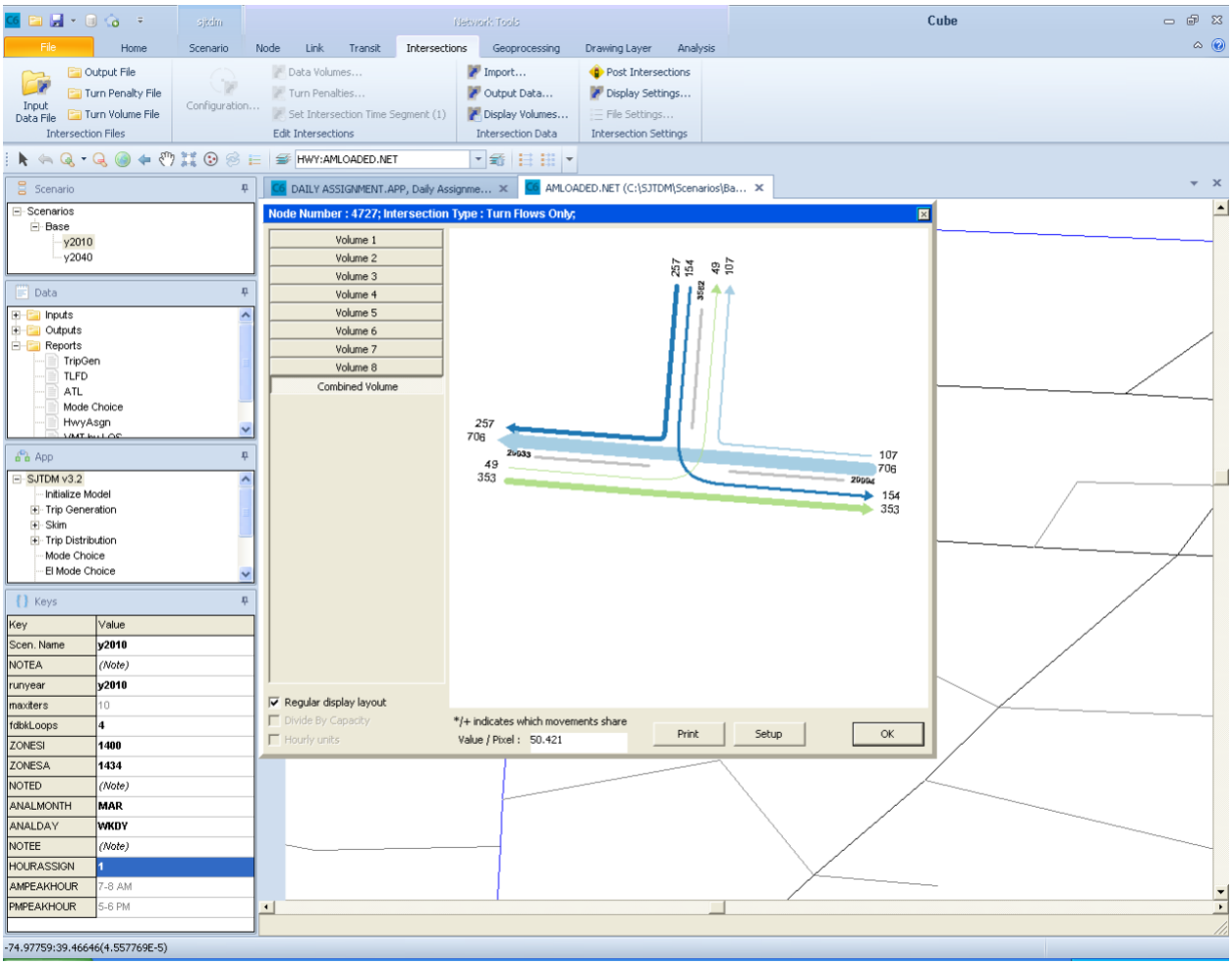


Figure 7-15: Turning movement volume display in Cube

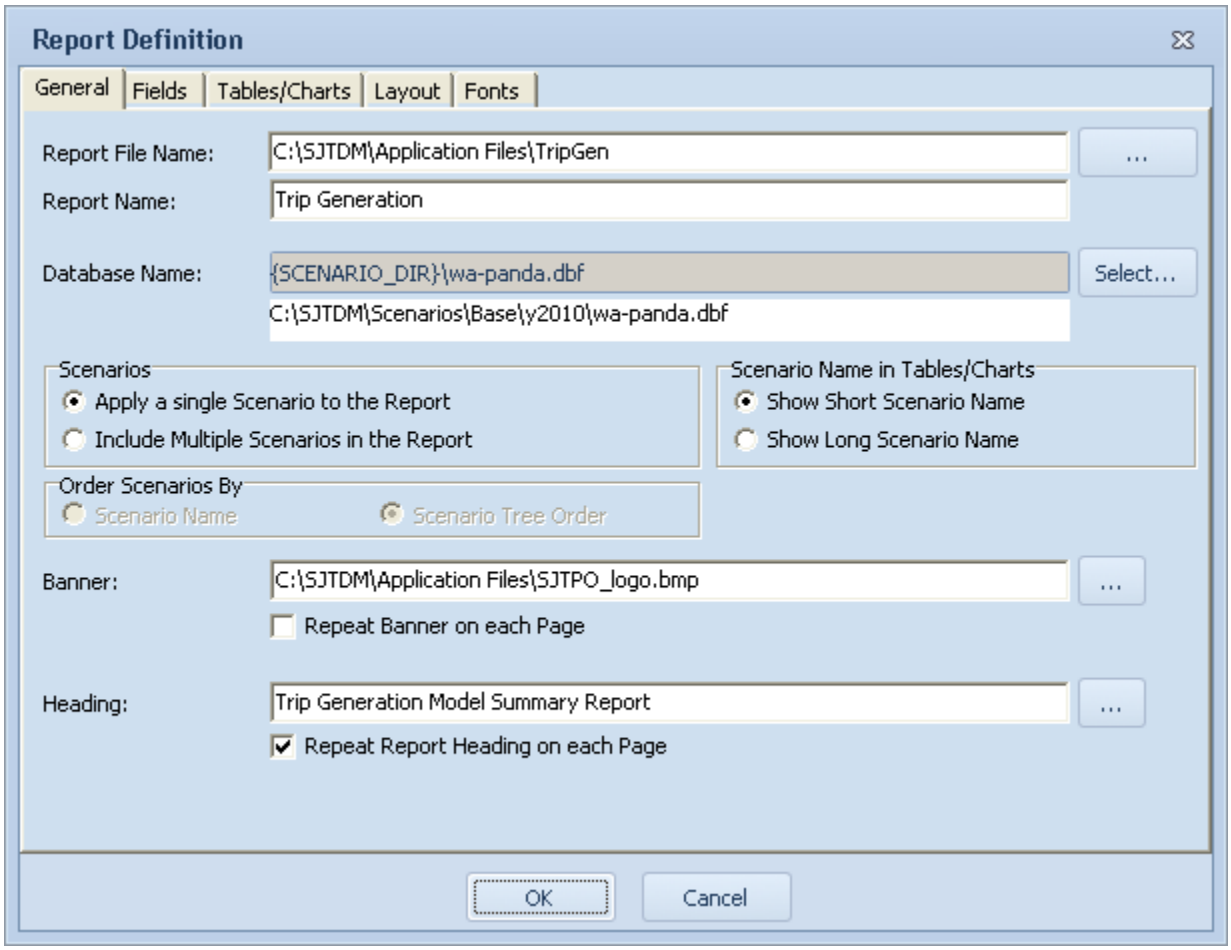


7.6 Development of new Cube Reports

The SJDTM application includes several Cube Reports that aid in viewing summaries of various modeling steps. This section provides guidelines on how the reports were developed so that a user can create new ones. The first step is designing the report – identifying what fields go in the report, what is the measure or statistic that the user desires to display, whether the report should present the data in tabular format, as a pie chart or as a chart, and whether the model automatically generates that data in the format that a Cube Report can read. These formats include database files (*.dbf), matrix files (*.mtx), highway network files (*.net) or tables in geodatabase files (*.mdb). If the required data is not readily available from the model, it could be generated via custom Voyager scripting.

The SJDTM includes a report for generating a pie-chart for trip productions by purpose. The development of this report is shown here as an example. In the SJTDM Scenario manager under Data->Reports, right click on TripGen->Edit and view the information that has been entered (input data, fields needed, format of report, etc – see Figure 7-16). All the other tabs can be viewed to understand how the report was created. Please refer to the Cube Base documentation for further details on Cube Reports.

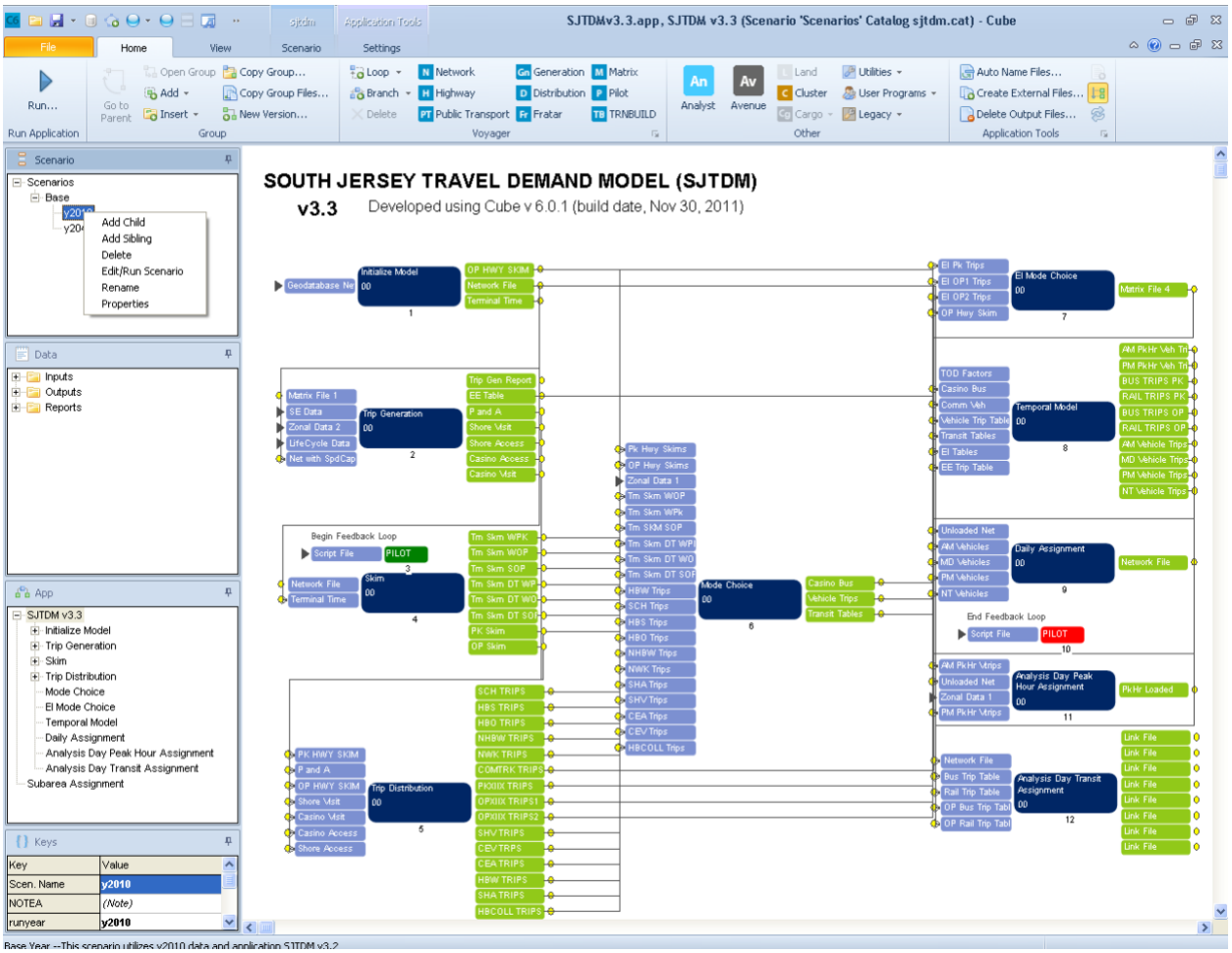
Figure 7-16: Cube Reports Definition



7.7 Development of new scenario/run year

The SJTDM currently includes the base year 2010 and future year 2040 runs. It may be desired to add additional scenarios for the same model run year (such as 2040) or create an entirely new model run year (such as 2030). In the SJTDM application, a new scenario can be created by adding one as a *sibling* or as a *child* in the Scenario Manager. If a scenario is added parallel to an existing scenario, it is called the *sibling* scenario. If the scenario is added underneath an existing scenario, it is called the *child* scenario. If a scenario is added as *sibling*, it is very important to make sure all the model inputs and parameters within the scenario (also known as *catalog keys*) are updated as needed. See Section 3.2 for more information on *catalog keys*. If a new scenario needs to be added for an alternatives analysis, it is recommended to add it as a *child* to the ***Base*** scenario. Adding scenarios as *child* permits automatic copying of the catalog keys of the *parent* scenario to the *child* scenarios. This reduces the burden on the user to update all catalog keys; however, care should be exercised in verifying the *catalog keys* to make sure they represent the scenario. Figure 7-17 shows the creation of new Scenario in the SJTDM Scenario Manager.

Figure 7-17: Creation of new Scenario in SJTDM Scenario Manager



To set up a new scenario for use within the SJTPO v3.3 model a total of 22 input files need to be prepared. The key input files for a model run were discussed in section 4.1. Sometimes it may not be required to prepare all of these files from scratch; it can be copied from an existing scenario if the underlying assumptions for data in that file are the same. All required input files for a new scenario should be placed in a directory under the SJTDM INPUTS sub-directory in a hierarchical manner that complies with the scenario structure.

7.8 Subarea extraction/assignment

Subarea extraction/assignment is used to develop a subset of the highway network and trip table and perform a highway assignment to generate loaded highway volumes on the subarea network. This section provides guidance on accomplishing this in the SJTDM Cube model.

First, a subarea network needs to be created from the entire model highway network. This can be done by opening the highway network (NetwithSpdcap.NET), click Drawing Layer->New to draw an imaginary boundary of the subarea (Figure 7-18), click Drawing Layer->SubArea Extraction, provide a name for the subarea network, accept or modify the default zone/node numbering system proposed for the subarea network (Figure 7-19) and save the subarea in the model run directory as 'Subarea.net'. The turn penalty file should also be renumbered

accordingly after removing records that are irrelevant for the subarea and saved in the scenario input folder as 'Tcards_subarea.dat'.

Once a subarea network has been extracted, a sub-area matrix extraction and sub-area assignment can be performed via the Subarea Assignment application in the SJTDM by double-clicking that application (see Figure 7-18) and then clicking Run->run Current Group only.

Figure 7-18: Polygon definition for subarea network

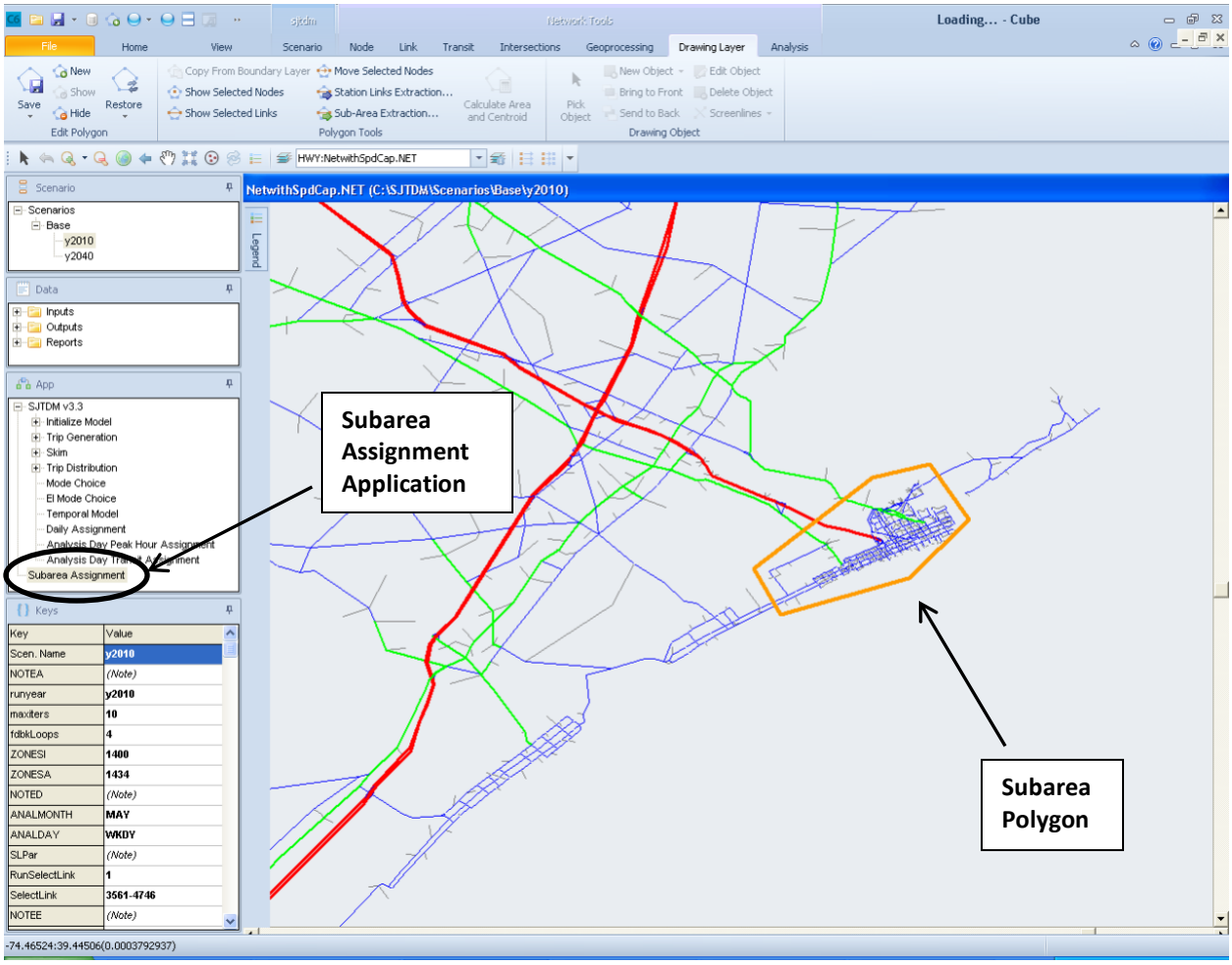
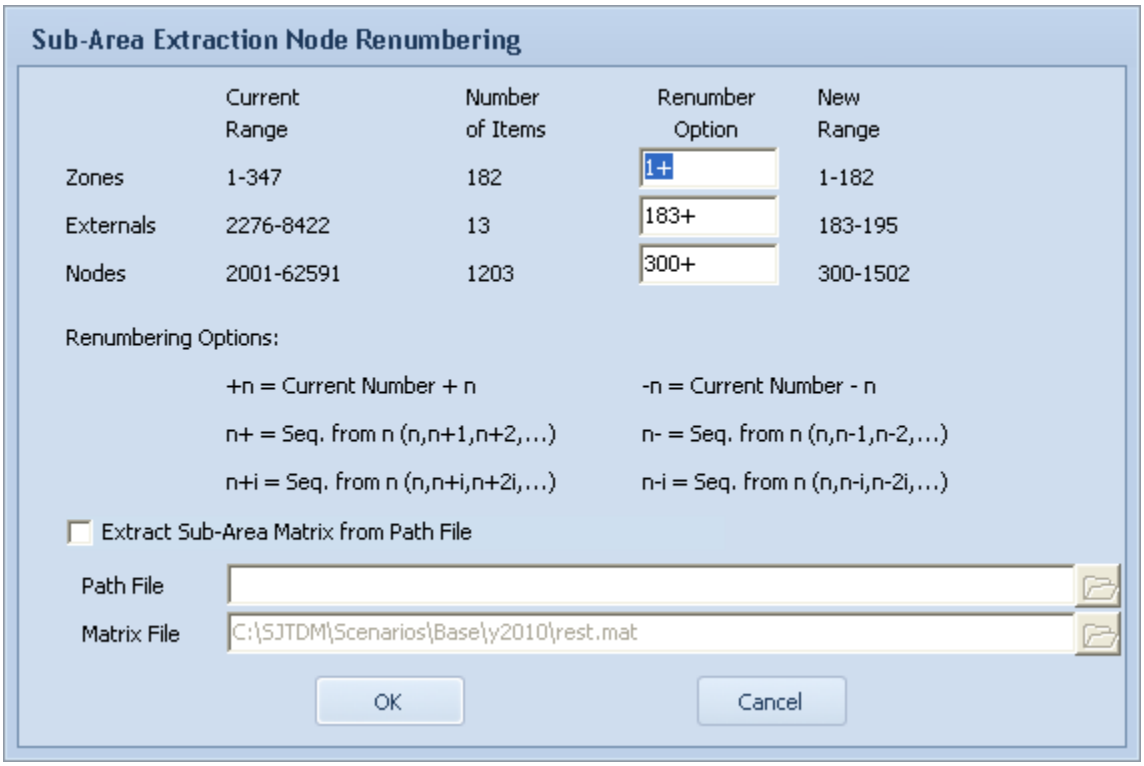


Figure 7-19: Zone/Node renumbering for subarea network



7.9 TAZ Splits

The TAZ system in the latest version of the SJTDM has been modified considerably in comparison to the previous version of the model. Table 7-1 shows the revised TAZ system. As can be seen from the table, several gaps were left in each county as reserve zones that can be used when TAZs need to be split.

Table 7-1: TAZ System in SJTDM

Region	# Zones	Zone Range
Atlantic City	155	1-155
Atlantic City spare zones	20	156-175
Atlantic County Recreational Zones	27	176-202
Atlantic County Recreational spare zones	18	203-220
Rest of Atlantic County	257	221-477
Atlantic County spare zones	23	478-500
Cape May County Recreational Zones	132	501-632
Cape May County Recreational spare zone	18	633-650
Rest of Cape May County	71	651-721
Cape May County spare zones	29	722-750
Cumberland County	253	751-1003
Cumberland County spare zones	22	1004-1025
Salem County	130	1026-1155
Salem County spare zones	20	1156-1175
Gloucester County	97	1176-1272
Gloucester County spare zones	28	1273-1300
Camden County	38	1301-1338
Camden County spare zones	12	1338-1350
Additional reserve for all counties zones	50	1351-1400
SJ External	34	1401-1434
Total spare zones	240	

An example application of TAZ split would be to add a TAZ for a new casino in Atlantic City. The new TAZ should be in the range 156-175 to comply with the above TAZ system. The socioeconomic data files such as SJMZPOP.DBF, SJMREC.DBF, SJMLIFE.DBF and SJMZDAT.DBF should be updated to reflect the additional TAZ number that is introduced as a result of this split. If the number of split TAZs exceeds the available total spare TAZs (240), a major restructuring of the zonal system would be needed.

7.10 Sensitivity Tests

7.10.1 Network Tests

One of the common sensitivity tests performed using travel demand models is by modifying certain aspects of the highway network such as number of lanes or increasing the speed or capacity of links. The number of lanes or any highway link attribute can be modified following the steps mentioned in section 7.2. The speed or capacity can be modified either for the entire facility type/area type/lane combinations or for selected links. If the former, it can be done via the speed-capacity table, located as shown in Figure 7-20 under the Initialize Model Step. Upon double-clicking it, the table opens up as shown in Figure 7-21. The free flow or initial congested speeds and/or capacities can be modified as needed.

If the speeds or capacities of only a selected links need to be modified without altering the speeds and capacities of other links in the network that belong to the same facility type, area type and number of lane categories, it can be done by modifying the spdadd, spdsub, capadd and capsub link attributes directly in the highway network. These represent % additions or

subtractions from those obtained via the speed-capacity table. For instance, if a 10% increase is desired for the capacity for a few links, capadd=10 for those links.

After making the required changes, the model can be run and the results evaluated to quantify the impact of the change. The highway assignment loaded volumes are a good indicator of the effect of network changes.

Figure 7-20: Speed-capacity table location in SJTDM application

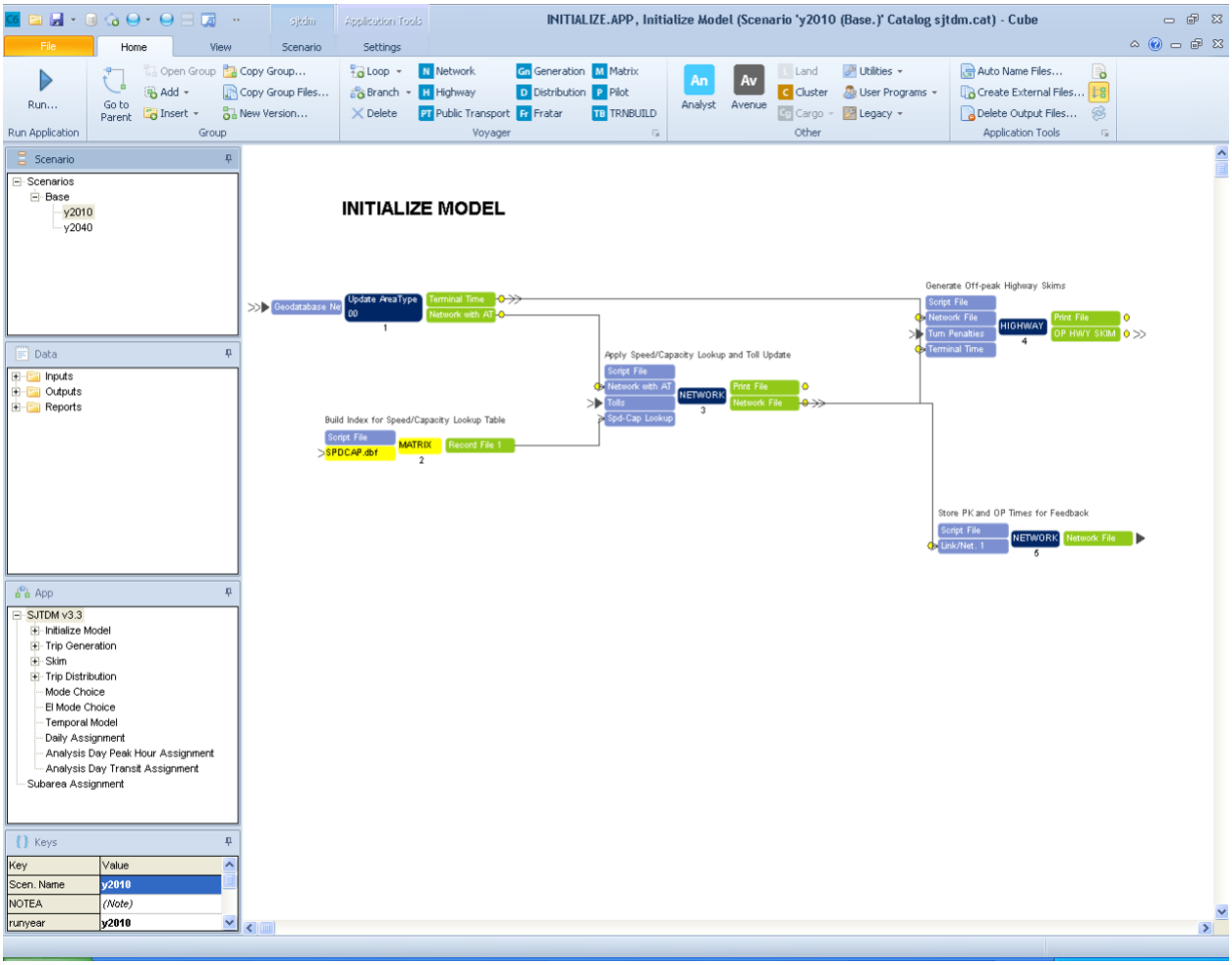
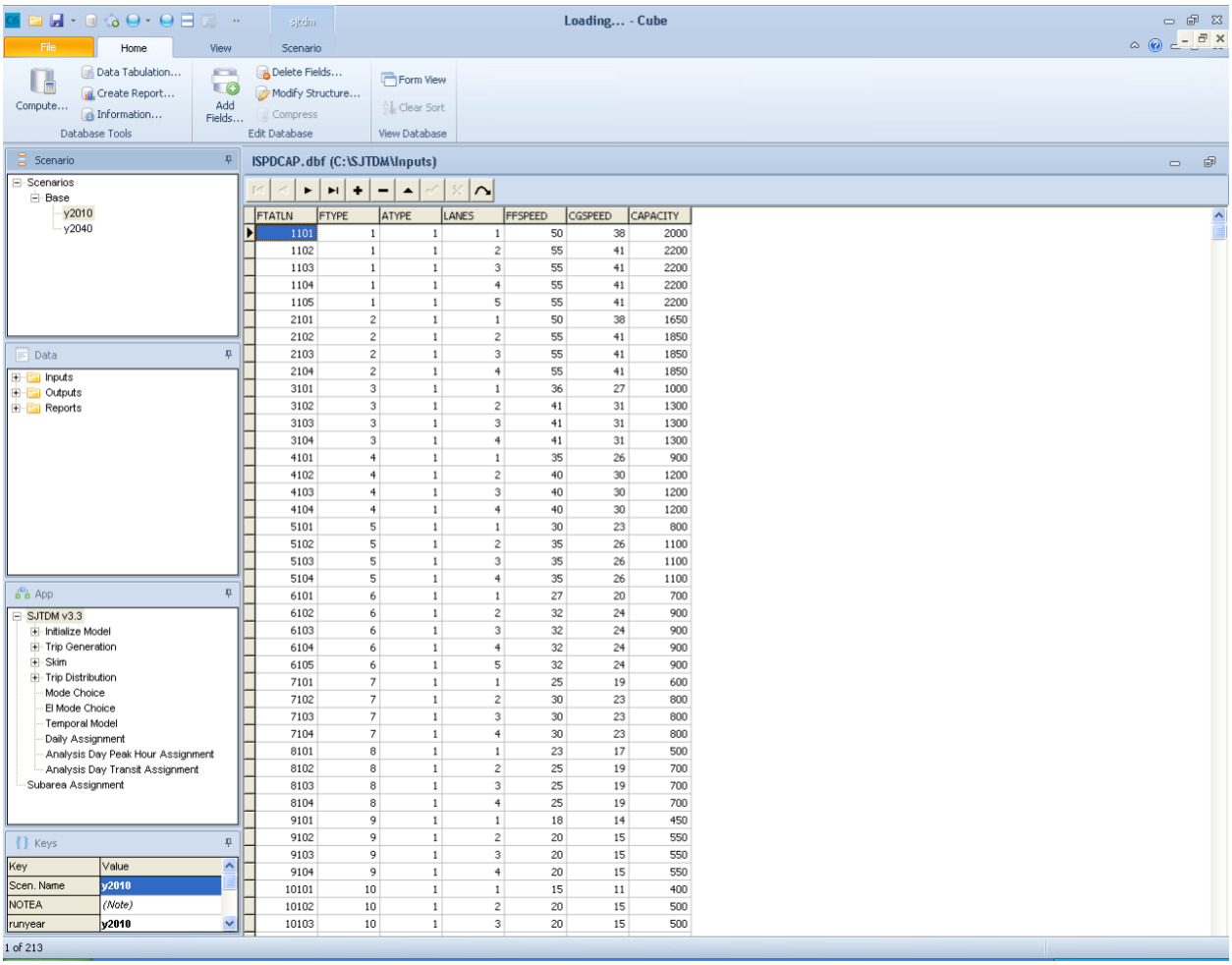


Figure 7-21: Speed-Capacity Table in SJTDM



FTATLN	FTYPE	ATYPE	LANES	FFSPEED	CGSPEED	CAPACITY
1101	1	1	1	50	38	2000
1102	1	1	2	55	41	2200
1103	1	1	3	55	41	2200
1104	1	1	4	55	41	2200
1105	1	1	5	55	41	2200
2101	2	1	1	50	38	1650
2102	2	1	2	55	41	1850
2103	2	1	3	55	41	1850
2104	2	1	4	55	41	1850
3101	3	1	1	36	27	1000
3102	3	1	2	41	31	1300
3103	3	1	3	41	31	1300
3104	3	1	4	41	31	1300
4101	4	1	1	35	26	900
4102	4	1	2	40	30	1200
4103	4	1	3	40	30	1200
4104	4	1	4	40	30	1200
5101	5	1	1	30	23	800
5102	5	1	2	35	26	1100
5103	5	1	3	35	26	1100
5104	5	1	4	35	26	1100
6101	6	1	1	27	20	700
6102	6	1	2	32	24	900
6103	6	1	3	32	24	900
6104	6	1	4	32	24	900
6105	6	1	5	32	24	900
7101	7	1	1	25	19	600
7102	7	1	2	30	23	800
7103	7	1	3	30	23	800
7104	7	1	4	30	23	800
8101	8	1	1	23	17	500
8102	8	1	2	25	19	700
8103	8	1	3	25	19	700
8104	8	1	4	25	19	700
9101	9	1	1	18	14	450
9102	9	1	2	20	15	550
9103	9	1	3	20	15	550
9104	9	1	4	20	15	550
10101	10	1	1	15	11	400
10102	10	1	2	20	15	500
10103	10	1	3	20	15	500

7.10.2 Socioeconomic Growth Tests

The SJTDM includes the base year 2010 and a future year 2040 scenario model runs. The 2040 scenario, specifically the socioeconomic data, was developed based on the latest assumptions on the growth that is expected to occur between 2010 and 2040. It may be desired to test a more aggressive growth rate compared to what was assumed or to test a policy such as smart growth. For such a sensitivity test, the 2040 socioeconomic data file (SJMZPOP.DBF) should be prepared via calculations in Excel and saved back as a DBF file, as described in section 7.1. The effect of this test can be evaluated via a review of the loaded network volumes or VMT (via Cube Reports) after running the model.

7.10.3 Trip Rate Tests

The trip generation rates in the SJTDM were developed based on data obtained from surveys conducted in the region. It may be desired to test the effect of higher or lower trip rates on the model results. The non-recreational trip production rates are specified in the PRATES.CSV and ARATES.CSV files located in the Non-Recreational Trip Generation step in the SJTDM application (See Figure 7-22). Note that there are steps for converting these files to DBF Format; Figures 7-23 and 7-24 show these files opened in DBF format.

Figure 7-22: Location of Production and Attraction rate files in SJTDM application

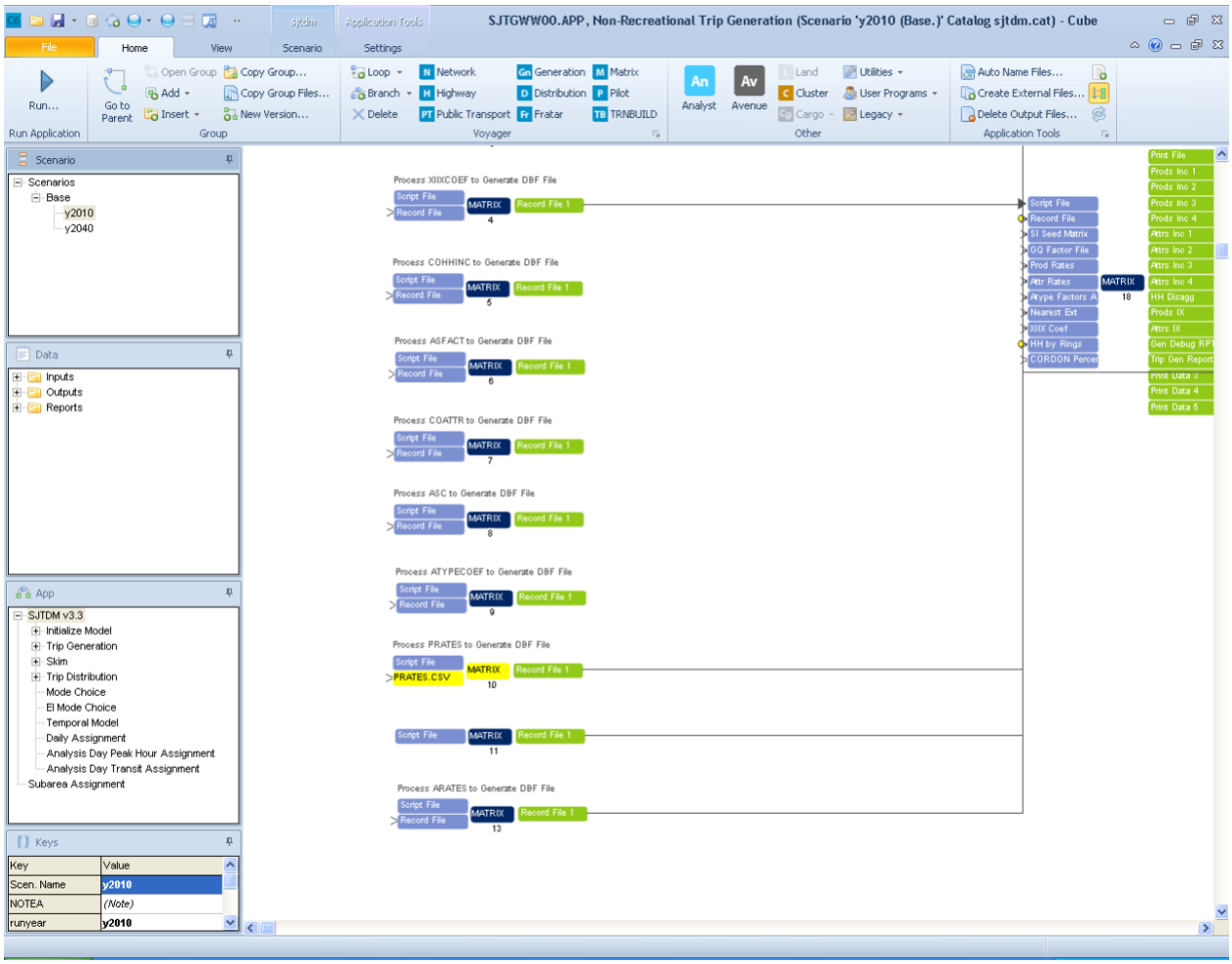
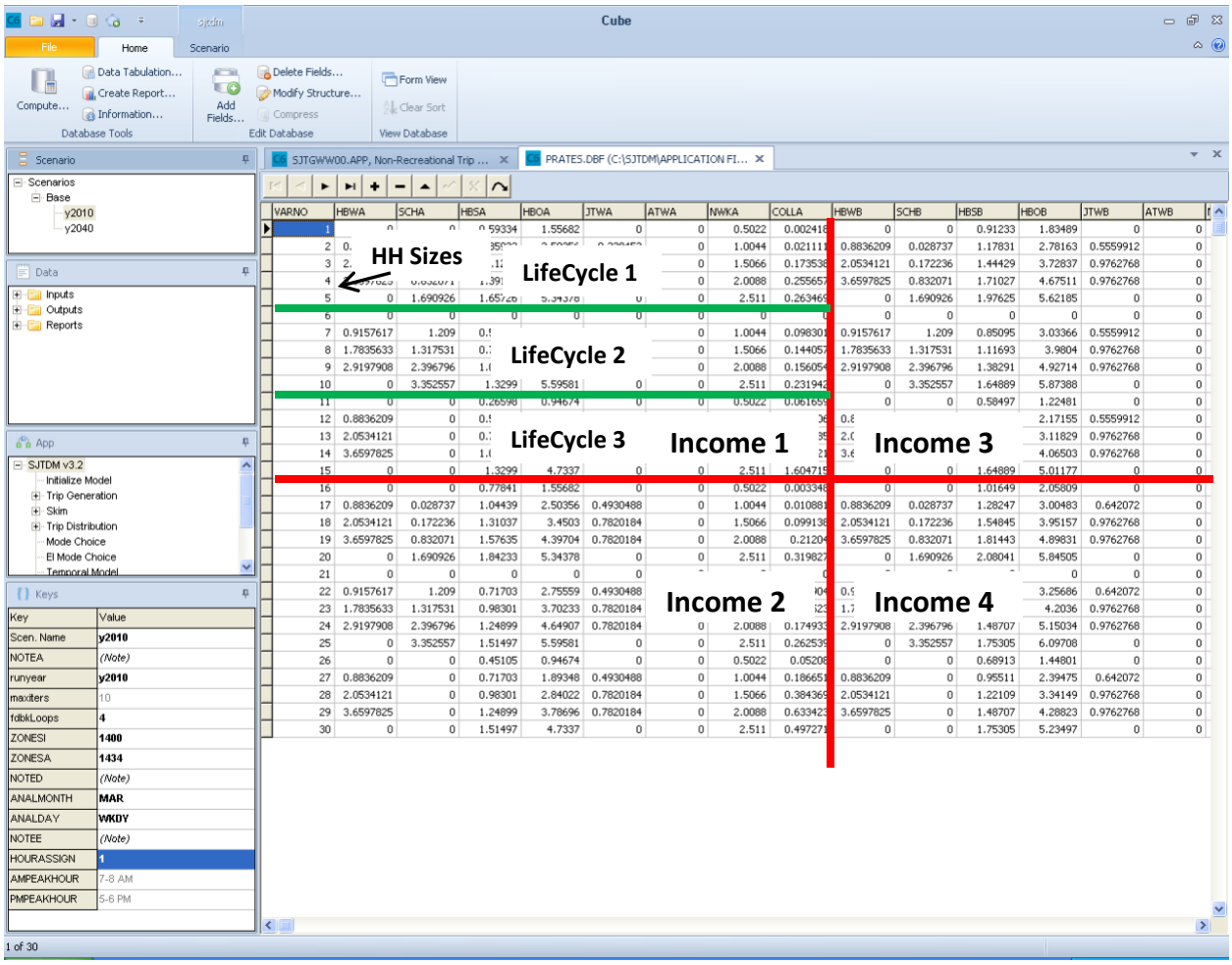
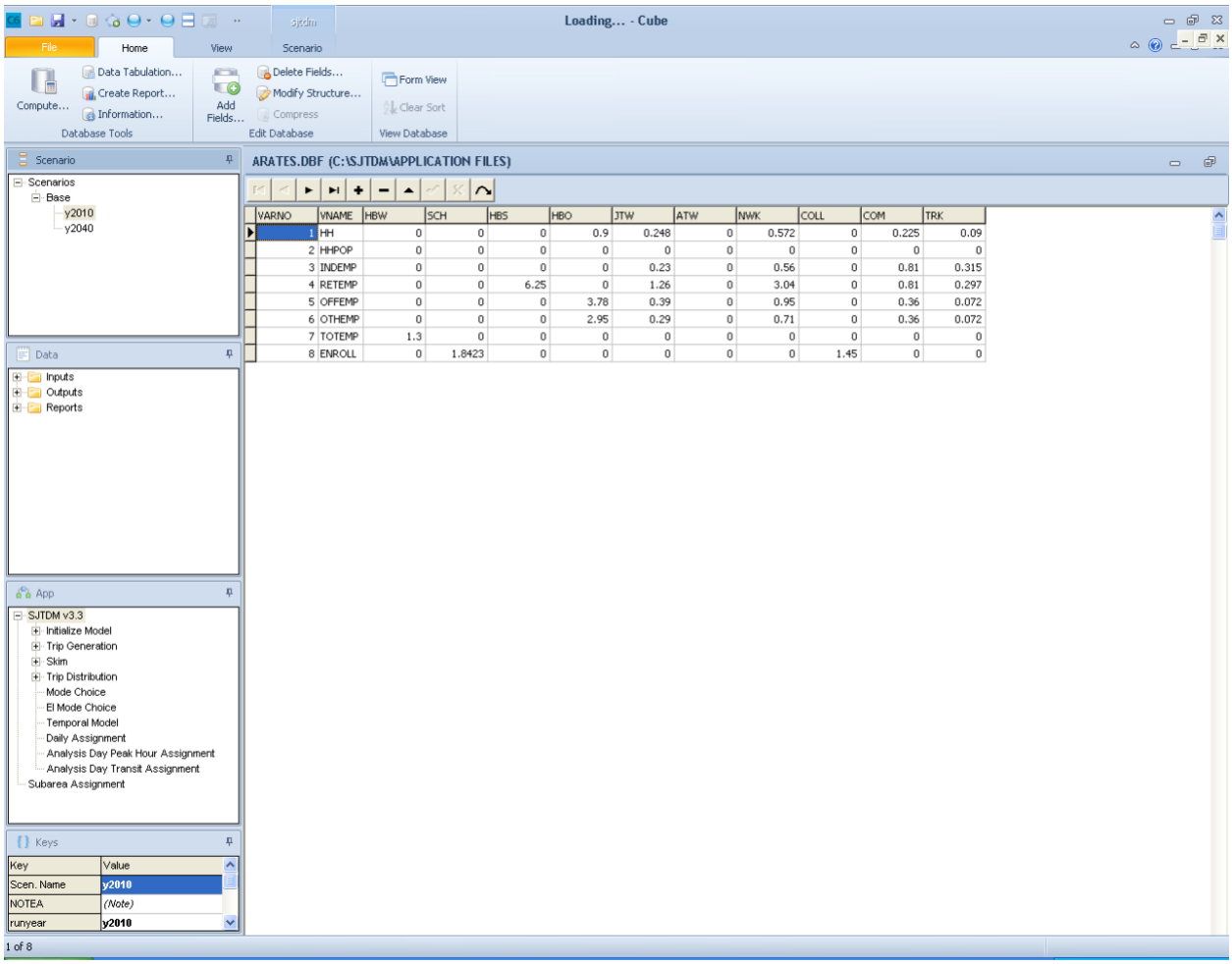


Figure 7-23: Non-recreational Trip Production File



The 30 rows of data in the production rates file comprise of 3 life-cycles, 4 income categories and 5 Household size categories. The above figure describes the order in which the rates should be read.

Figure 7-24: Non-recreational Trip Attraction File



VARNO	VNAME	HBW	SCH	HBS	HBO	JTW	ATW	NWK	COLL	COM	TRK
1	HH	0	0	0	0.9	0.248	0	0.572	0	0.225	0.09
2	HHPOP	0	0	0	0	0	0	0	0	0	0
3	INDEMP	0	0	0	0	0.23	0	0.56	0	0.81	0.315
4	RETEMP	0	0	6.25	0	1.26	0	3.04	0	0.81	0.297
5	OFFEMP	0	0	0	3.78	0.39	0	0.95	0	0.36	0.072
6	OTHEMP	0	0	0	2.95	0.29	0	0.71	0	0.36	0.072
7	TOTEMP	1.3	0	0	0	0	0	0	0	0	0
8	ENROLL	0	1.8423	0	0	0	0	0	1.45	0	0

The effect of this test can be evaluated via a review of the loaded network volumes or VMT (via Cube Reports) after running the model.

7.10.4 Toll Rate Tests

The tolls on the toll roads in the SJTDM 2010 scenario were updated to reflect the latest available information from the toll agencies. It may be desired to test the effect of a toll increase for the entire system or selected toll roads. The tolls in the SJTDM are specified in the TOLLS.DBF file located in the Initialize Model step (See Figure 7-25). This file, which contains the highway network anode, bnode, toll in cents and location, is shown in Figure 7-26.

Figure 7-25: Location of Toll File in SJTDM application

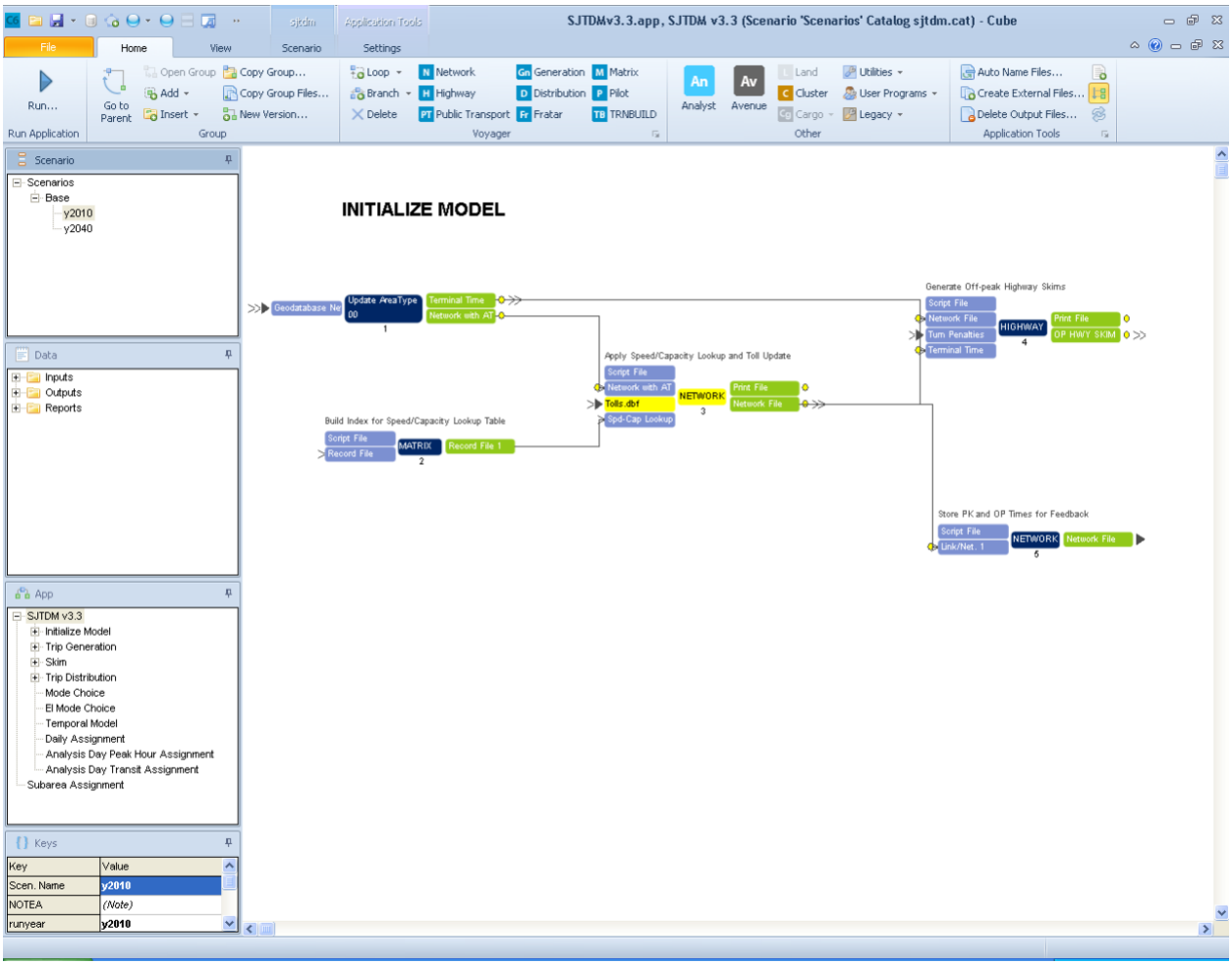
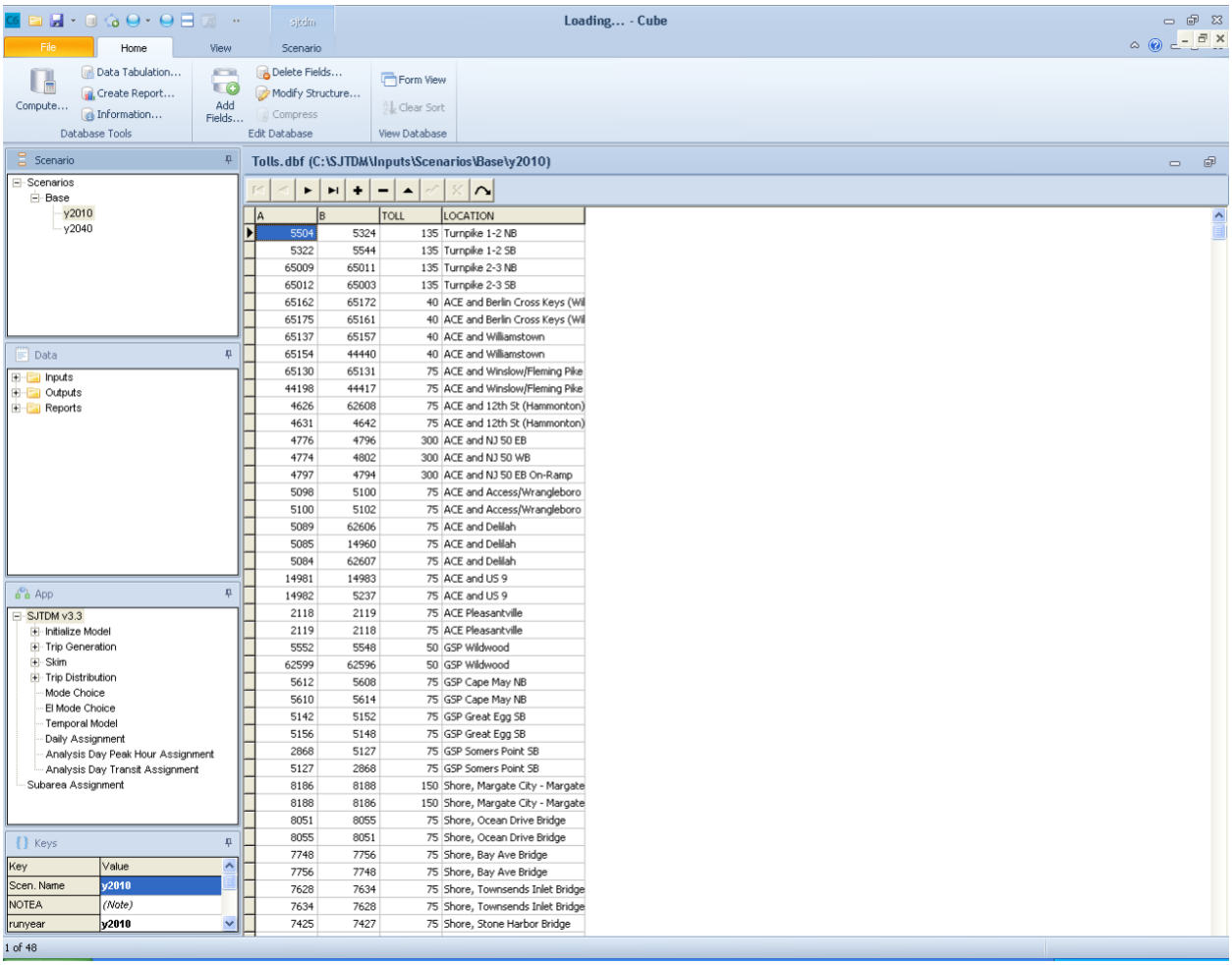


Figure 7-26: Toll File



If the toll changes are only at a few locations, they can be performed directly in the DBF file, otherwise they can be performed in Excel (especially if it involves calculations) and saved back as a DBF.

SJTPO

URS

335 COMMERCE DRIVE, SUITE 300
FORT WASHINGTON, PA 19034