

# TransLink Regional Transportation Model Phase 3 Userguide

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# 1 Introduction

TransLink's Regional Transportation Model (RTM) is a comprehensive travel demand forecasting tool for municipalities and/or districts in the GVRD and FVRD. The RTM estimates the 24-hour demand for various modes which include:

1. Auto
  - Single Occupancy Vehicle (SOV)
  - High Occupancy Vehicle (HOV)
2. Walk Access to Transit
  - Bus
  - Rail
  - West Coast Express (WCE)
3. Drive Access to Transit - Park and Ride
  - Bus
  - Rail
  - WCE
4. Active (not assigned to network)
  - Walk
  - Bike
5. Commercial Vehicles
  - Light Trucks (LGV)
  - Heavy Trucks (HGV)

The model has nine trip purposes:

1. Home-base Work
2. Home-base University
3. Home-base School
4. Home-base Shopping
5. Home-base Personal Business
6. Home-base Social-Recreational
7. Home-base Escorting (pick up and drop off)
8. Non-home-base Work
9. Non-home-base Other

The model assigns three main peak hour demands onto the network:

1. AM: 0730 - 0830
2. MD: 1200 - 1300
3. PM: 1630 - 1730

Peak hour active mode trips are calculated in the model, however, they are not assigned onto the network.

This User Guide provides details to the user regarding the various components of the model files delivered by TransLink. It is intended to provide a step - by - step guide on how to setup a model run and details to take into consideration before running the model. This User Guide does not provide technical details about the sub-models in the RTM3. These details, such as descriptions of the econometric models, will be provided in a comprehensive Model Documentation later in the year.

# 2 Model Format

The model is now delivered as a collection of plain text files with an initial script to build the emmebank in which the model is run. An EMME project file (.emp) is provided to reference all required folders and to link in an empty, minimally sized databank in the Template/ folder. This is only provided to allow EMME modeller tools to run before an RTM phase 3 databank has been initialized.

## RTM Phase 3 Folder Structure

RTM.emp  
BaseNetworks/  
BaseNetworks/Inputs/  
Documentation/  
Logbook/  
Media/  
Scripts/  
Template/  
Views/  
Worksheets/

### 2.1 RTM.emp

This file contains all of the project information for the EMME model and allows the software to reference all of the distributed folders consistently.

### 2.2 BaseNetworks/

This folder contains all of the files required to build a databank and contains:

- Network batchin files for model years 2011, 2015, 2030 and 2045
- External demand matrices
- Definitions of ensembles, modes, transit vehicles
- Networks: Auto, Transit, Turns for 4 horizon years and 3 time periods
- Starter Skims
- External demand bike scores
- Calibration factors K-factors
- Ensembles

### 2.3 BaseNetworks/Inputs/

This folder contains the default model assumptions for each model year; a copy of this folder is placed with each databank initialized by the InitEmmebank tool. The folder includes the following:

- Demographics from metro Vancouver
- Dummies for town centres / other
- Geographics
- Park and Ride Assumptions such as parking price and capacity
- Batch input files used in truck model

It is important to note that all these TAZ-level attributes get stored in the Emmebank as origin-based matrices (mo). The previous release stored attributes such as employment as destination-based matrices (md).

### 2.4 Documentation/

A copy of the model userguide and other technical documentation.

## 2.5 Logbook/

This folder holds the logbook information generated by EMME Modeller tools.

## 2.6 Media/

Shapefiles used as background boundaries in EMME worksheets are provided here, layers for the following are provided:

- Zone Boundary for 1700 Zone System
- National Road Network Centerlines extracted for the modelled region
- Municipal Boundaries
- Zone Boundaries and Municipal Boundaries from the earlier 641 Zone System

## 2.7 Scripts/

This folder contains the python scripts used to run the model.

## 2.8 Template/

A minimally dimensioned EMME databank is distributed to allow Modeller tools to run before an RTM databank has been initialized. No information is held in this template databank, it is provided only to allow Modeller to initialize an RTM databank from the provided text files.

## 2.9 Views/

Definitions for some standard views are provided in the EMME environment. Standard views for the GVRD, FVRD, each GY aggregation and each municipality are provided.

## 2.10 Worksheets/

Definitions for standardized worksheets can be saved in this folder.

# 3 Receiving/Relocating a RTM Model

All file references have been updated to be relative to the provided EMME project file (RTM.emp). The only exception to this are references to modeller python files in the EMME toolboxes. A batch file has been provided in Scripts/relocate\_tools.bat to link the toolboxes to the appropriate file if the project is moved.

This batch file must be run whenever the model is initially unpacked from a zip file, or whenever the project is moved to a different folder on the hard disk. If this is not done, Modeller will not be able to run any of the RTM scripting.

If the following error is encountered when running this script:

```
Traceback (most recent call last):
  File "toolbox_modify.py", line 155, in <module>
    set_tools_to_current_root(toolbox_path, root_dir_name)
  File "toolbox_modify.py", line 129, in set_tools_to_current_root
    with ToolboxWrap(toolbox_path) as toolbox:
```

```
File "toolbox_modify.py", line 60, in __init__
    self.documents = self.connection.execute('select * from documents').fetchall()
sqlite3.DatabaseError: file is encrypted or is not a database
```

It is likely that a Modeller instance is running and has locked the toolbox file. Close all Modeller instances and run the script again.

### 3.1 CSV Text Files

The csv input files for zone-based data has been introduced to provide a more convenient data format than the EMME batch-transaction files. Zone based data intended for an mo or md matrix can now be entered using a format more usable with Excel and other external tools in a column-based format. The first four rows are headers providing the following information, examples given are from the demographics input file:

- The mo or md matrix to store the data in (mo10)
- The name for the EMME matrix (TotPop)
- The description for the EMME matrix (POP\_Total)
- The column name in the SQL database where a copy of the data is kept (POP\_Total)

The first column of data is the zone number the data values are intended for.

#### 3.1.1 Demographics Input File

The demographics input file contains the following data

Matrix ID	EMME Name	SQL NAME	Notes
mo10	TotPop	POP_Total	Total Population
mo11	Pop0t4	POP_0to4	Population Ages 0 to 4
mo12	Pop5t12	POP_5to12	Population Ages 5 to 12
mo13	Pop13t17	POP_13to17	Population Ages 13 to 17
mo14	Pop18t24	POP_18to24	Population Ages 18 to 24
mo15	Pop25t34	POP_25to34	Population Ages 25 to 34
mo16	Pop35t54	POP_35to54	Population Ages 35 to 54
mo17	Pop55t64	POP_55to64	Population Ages 55 to 64
mo18	Pop65Up	POP_65plus	Population Ages 65 plus
mo20	TotEmp	EMP_Total	Total Employment
mo21	EmpConMfg	EMP_Construct_Mfg	
mo22	EmpFire	EMP_FIRE	
mo23	EmpTcuWh	EMP_TCU_Wholesale	
mo24	EmpRet	EMP_Retail	
mo25	EmpBoS	EMP_Business_OtherServices	
mo26	EmpAcFoInCu	EMP_AccomFood_InfoCult	
mo27	EmpHeEdPuAd	EMP_Health_Educat_PubAdmin	
mo30	EnrolElem	Elementary_Enrolment	Elementary School Enrollment
mo31	EnrolSec	Secondary_Enrolment	Secondary School Enrollment
mo32	EnrolPsFte	PostSecFTE	Post Secondary Full Time Equivalent Enrollment
mo40	TotHh	HH_Total	Total Households
mo41	Hh1p	HH_1Person	1 Person Households
mo42	Hh2p	HH_2Person	2 Person Households
mo43	Hh3p	HH_3Person	3 Person Households
mo44	Hh4pUp	HH_4plusPerson	4-plus Person Households

### 3.1.2 Geographics Input File

The demographics input file contains the following data

Matrix ID	EMME Name	SQL NAME	Notes
mo50	areahc	Hectares	Zone Area in Hectares
mo60	prk2hr	parking_two_hr_rate	Two Hour Parking Rate
mo61	prk8hr	parking_eight_hr_rate	Eight Hours Parking Rate
mo69	railStn	rail_stn_dummy	Zone contains a rail station (0/1)
mo70	cs250	car_share_250m	Zone has car share access within 250m (0/1)
mo71	cs500	car_share_500m	Zone has car share access within 500m (0/1)
mo80	bikesc	bike_score_taz	Bike Score (0-5)

## 4 Databank Initialization

Once the text files have been unpacked and the scripts relocated, open the EMME modeller toolbox and run the InitEmmebank tool, this will allow an RTM Phase 3 Databank to be initialized and linked into the current project. The tool requires a folder name which will be created, and the name of the databank to be shown in the project.

The screenshot shows the 'INRO TransLink' logo at the top. Below it is the title 'Translink Utility Toolbox'. The main section is titled 'Initialize a new Emmebank'. It contains two input fields: 'Enter the Folder Name for the new emmebank' and 'Enter the Title for the new emmebank'. Below these fields is a 'Run' button. At the bottom, there is a 'Recent history' link and the INRO logo with the copyright notice '© 2016 INRO. All rights reserved.'

Figure 1: The Initialize Emmebank Tool

## 5 Running the RTM Phase 3 Model

## 6 Network Coding

### 6.1 Modes

Modes are represented in the same manner as the Phase 2 model, with the addition of a new primary auto mode (v). The primary auto mode must be coded on any link that is expected to be used by any of the other auto modes. This mode was added to allow the representation of limited access roadways such as bus or commercial vehicle only lanes. In previous models the HOV mode was required to be allowed as well.

Mode	Description
v	Vehicles (Primary Auto Mode)
c	High Occupancy Vehicles (HOV)
d	Single Occupancy Vehicles (SOV)
x	Light Trucks
t	Heavy Trucks
n	Discourage Heavy Vehicle Traffic
b	Bus
p	Pedestrian
a	Auxillary Transit Access
l	SkyTrain
r	Commuter Rail (West Coast Express)
s	SeaBus
h	Gondola

### 6.2 Link Types

Links have been classified by their basic role for data summary purposes. There is currently no functional differences represented by the link type, but there may be in the future.

Type	Description
1	Centroid Connector
2	Pedestrian Links
3	Bowen Island Ferry
100	SkyTrain
101	SeaBus
102	West Coast Express
103	Gondola
200	Bus Only
201	HOV Lane
202	Commercial Vehicle Access Only
300	Freeway
301	Highway
302	Arterial
303	Collector
304	Local
305	Ramp
306	Highway Directional Ramp
307	Highway Loop Ramp

Type	Description
310	Other Roads

### 6.3 Extra Attributes

During a model run, a single master scenario is copied into 3 time of day specific scenarios for assignment. The network parameters are coded in extra attributes in the master scenario and copied to the appropriate place when the copies are made. A correspondence of from the master scenario to the time of day attributes is presented below.

Note that the posted speed attribute is not coded for each time of day, a single speed is used for all time periods.

Master Scenario Attribute	Time of Day Attributes
@posted_speed	@posted_speed
lanes	@lanesam, @lanesmd, @lanespm
vdf	@vdfam, @vdfmd, @vdfpm
tpf	@tpfam, @tpfmd, @tpfpm
tolls	@tollam, @tollmd, @tollpm
hdwy	@hdwyam, @hdwynd, @hdwympm

### 6.4 Network Modification Issues

#### 6.4.1 Issue 1 - Adding new Links

When adding new links that connect to a node defined as an intersection, be sure to review the new turns created as EMME will only auto-populate the tpf attribute, and not the time of day extra attributes, this could cause illogical turns to be allowed as the default value of the extra attribute is 0, which would disable all turns from or to the new link. Also, make sure to populate the '@posted\_speed' attribute. The streamlined vdf functions (see Appendix A) now require the modeller to input the posted speed for the new link. When adding a new link, make sure to update the '@fareboundary' with a boolean value - 1 if the link crosses a fare zone and 0 if it doesn't.

#### 6.4.2 Issue 2 - Adding new Intersections

Similar to Issue 1, when newly defining an intersection, ensure the extra turn attributes are coded to match the automatically set tpf values, otherwise all turns will be disabled at that node (tpf=0)


#### 6.4.3 Issue 3 - Adding new Transit services

When adding new itineraries, make sure the extra headway attributes are populated as expected, or the effective headway of 0 will cause these services to be removed when constructing the time of day networks.

### 6.5 Export Network Tool

Network coding should be done in the master scenarios only, as the time of day specific networks are overwritten during each model run. The export network tool is responsible for exporting all required information from a





## Full Model Run

Performs a full model run

**Model horizon year:**

Should match network scenario

**Scenario containing network information:**

This scenario will be copied into individual time of day scenarios.

**Global model iterations:**

Use 6 iterations in normal operation

**Demographics File:**



File must be csv file.

**Geographics File:**



File must be csv file.

**Maximum iterations for the trip distribution sub-model:**

The matrix balancing procedure should reach a convergence level of at least  $10^{-4}$  relative error in the final global iteration in order for the model to be considered converged. If this is not the case run again with more iterations.

**Maximum relative error for the trip distribution sub-model:**

**Maximum iterations for the auto assignment sub-model:**

The auto assignment should reach a convergence level of at least  $10^{-3}$  best relative gap or  $10^{-5}$  relative gap in the final global iteration in order for the model to be considered converged. If this is not the case run again with more iterations.

**Transit Assignment Options**


☒ Run Congested Transit Assignment

☒ Run Capacited Transit Assignment

**Number of processors on machine running model:**

Should be less than or equal to processors on machine

▶ Recent history



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Figure 2: The RTM Phase 3 Model Run Tool

scenario for later import into the model run process. The dropdown area allows multiple scenarios to be exported at the same time.

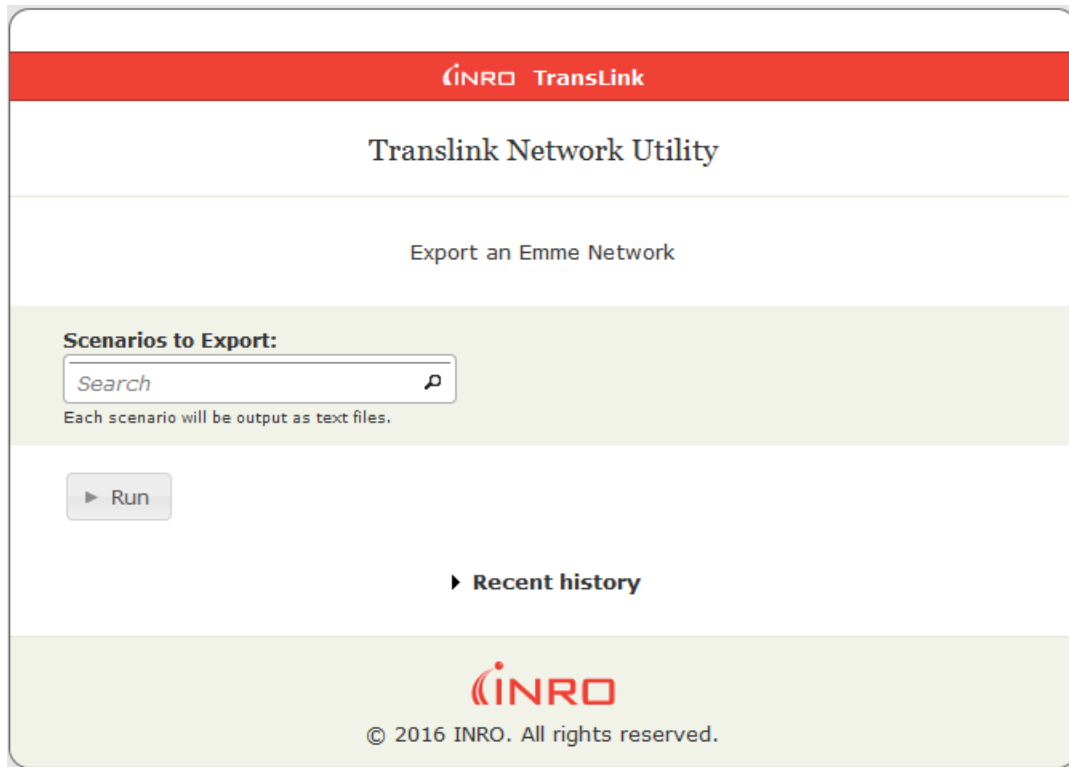


Figure 3: The Network Export Tool

## 6.6 Import Network Tool

Additional network scenarios can be imported to the emmebank using the Import Scenarios tool. This tool assumes all required files are in the BaseNetworks/ folder. The name of the scenario to be import is a user input.

## 7 Scripts Folder

The Scripts folder contains the main toolboxes and python codes used for running the model. Figure 5 shows the files inside the folder.

### 7.1 Util folder

The Util folder contains the Util toolbox and associated python script. The Util toolbox contains helper functions that get used repeatedly within a model run. These helper functions are usually called from other Python Scripts. The Util method is usually called using the command: `util = _m.Modeller().tool("translink.util")`

Examples of helper functions inside the Util method that get regularly called from the model's main scripts include:

- Matrix Calculator : `util.compute_matrix()`

**INRO TransLink**

## Translink Network Utility

Import an Emme Network

**Scenario number to Import:**

Scenario will be input from text files.

**Enter the Title for the new scenario**

[▶ Run](#)

[▶ Recent history](#)

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Figure 4: The Network Import Tool

model\_files\_p3 ▶ RTM ▶ Scripts ▶

Burn New folder

Name	Date modified	Type	Size
toolbox_modify	26/01/2017 10:10 ...	Python File	8 KB
relocate_tools	26/01/2017 10:10 ...	Shell Script	1 KB
relocate_tools	26/01/2017 10:10 ...	Windows Batch File	1 KB
util	17/03/2017 11:12 ...	File folder	
Phase3Scripts	17/03/2017 11:15 ...	File folder	

Figure 5: Contents of the Scripts/ Folder

- Extra Attribute Calculator: `util.emme_link_calc()`
- Importing Matrix Data in Numpy Array format : `util.get_matrix_numpy()`

These helper functions reduce the likelihood of making coding mistakes and make the overall code less repetitive and easier to read.

## 7.2 Phase3Scripts Folder

This folder contains the model's main python tool box and associated scripts. Figure 6 is a screenshot of the Phase3Scripts folder. The following is a brief description of each script in the order they appear in within the model run page. Each of the scripts in this folder has an object reference to the Util toolbox as mentioned in the previous section.

### 7.2.1 InitEmmebank.py

Creates a new databank which contains the building blocks of the model run:

1. Databank Size
2. Auto and Transit Networks for years 2011, 2015, 2030 and 2045
3. Ensembles
4. Functions
  - Volume-delay (vdf)
  - Turn penalty (tpf)
  - Transit time (ttf)

For more details, refer to Databank Initialization Section.

### 7.2.2 00\_RunModel.py

This the main model run wrapper and launches the subsequent model scripts. Figure 7 is a screenshot of the run page with required user inputs:

1. Model horizon year:
  - 2011
  - 2015
  - 2030
  - 2045
2. Base Year Network Scenario:
  - Scen 1000 - 2011 Base Network
  - Scen 2000 - 2015 Base Network
  - Scen 3000 - 2030 Base Network
  - Scen 4000 - 2045 Base Network
3. Global Model Cycles
  - Default: 4
4. Demographics File
  - households
  - population
  - employment
5. Geographics File
  - parking
  - car share
  - rail station availability
6. Trip Distribution Model





























model_files_p3 ▶ RTM ▶ Scripts ▶ Phase3Scripts				
New folder				
Name	Date modified	Type	Size	
 RTM_Phase3.mtbx	17/03/2017 11:12 ...	MTBX File	28 KB	
 00_RunModel	17/03/2017 12:45 ...	Python File	12 KB	
 01_CreateScenarios	17/03/2017 11:19 ...	Python File	9 KB	
 02_DataImport	15/03/2017 5:26 PM	Python File	47 KB	
 03_DataGeneration	16/03/2017 10:26 ...	Python File	31 KB	
 04_SocioEconomicSegmentation	04/03/2017 10:46 ...	Python File	21 KB	
 05_VehicleAvailability	04/03/2017 10:46 ...	Python File	8 KB	
 06_TripProductions	07/03/2017 5:52 PM	Python File	22 KB	
 07_TripAttractions	15/03/2017 5:04 PM	Python File	15 KB	
 08_Blended_Skims	04/03/2017 10:46 ...	Python File	94 KB	
 09_ModeChoice	05/03/2017 5:06 PM	Python File	8 KB	
 09-00_ModeChoiceUtilities	15/03/2017 5:04 PM	Python File	14 KB	
 09-01_HbWork	15/03/2017 5:04 PM	Python File	68 KB	
 09-02_HbUniv	15/03/2017 5:04 PM	Python File	23 KB	
 09-03_HbSchool	15/03/2017 5:04 PM	Python File	28 KB	
 09-04_HbShop	15/03/2017 5:04 PM	Python File	38 KB	
 09-05_HbPerBus	15/03/2017 5:04 PM	Python File	38 KB	
 09-06_HbSocial	15/03/2017 5:04 PM	Python File	38 KB	
 09-07_HbEscorting	15/03/2017 5:04 PM	Python File	31 KB	
 09-08_NhbWork	15/03/2017 5:04 PM	Python File	22 KB	
 09-09_NhbOther	15/03/2017 5:04 PM	Python File	21 KB	
 09-10_TruckModel	04/03/2017 10:46 ...	Python File	27 KB	
 10-01_AutoAssignment	17/03/2017 8:59 AM	Python File	32 KB	
 10-02_TransitAssignment	17/03/2017 9:48 AM	Python File	42 KB	
 12_DataExport	15/03/2017 5:04 PM	Python File	22 KB	
 ExportNetwork	17/03/2017 11:23 ...	Python File	6 KB	
 ImportNetwork	04/03/2017 8:54 PM	Python File	2 KB	
 InitEmmebank	17/03/2017 11:19 ...	Python File	23 KB	

Figure 6: Contents of the Phase3Scripts/ Folder

- Max Iterations Default: 60
- Max Relative Difference Default: 0.0001
- 7. Assignment Convergence Criteria
  - Max Iterations Default: 200
- 8. Toggles for Congested/Capacitated Transit Assignment
  - Default: Enable Congested Transit Assignment
  - Default: Enable Capacitated Transit Assignment
- 9. Number of Processors Specification
  - Default: number of CPUs in computer being used

### **7.2.3 01\_CreateScenarios.py**

Creates AM, MD and PM network scenarios from the main base year scenario. For example, if the user chose scenario 1000, this script will create AM, MD and PM scenarios - typically scenarios 21000, 22000 and 23000 - with the relevant network attributes (e.g. bus priority lanes and headways) by time of day.

### **7.2.4 02\_DataImport.py**

Imports/generates data used in a model run such as:

1. Values of Time
2. Transit perception Factors
3. External Demand and Trip Distribution K-Factors
4. Starter Skims

### **7.2.5 03\_DataGeneration.py**

Calculates attributes used in a model run such as:

1. Population and employment densities
2. Accessibility variables (e.g. number of jobs accessible from a zone within 30 minutes)

### **7.2.6 04\_SocioEconomicSegmentation.py and 05\_VehicleAvailability.py**

These two scripts split household data provided by Metro-Vancouver into segments by household size x number of workers x Income Category x Auto Ownership using a series of econometric logit models.


### **7.2.7 06\_TripProductions.py and 07\_TripAttractions.py**

This is the trip generation phase of the model. It includes multiplying econometrically estimated, purpose-specific, production/attraction trip rates by household/population and employment segments (depending on the trip purpose).

### **7.2.8 08\_Blended\_Skims**

Takes AM, MD and PM auto and transit skims and blends them by trip purpose to create ‘daily’ skims to be used in the trip distribution and mode choice models

**Model horizon year:**  
  
Should match network scenario

**Scenario containing network information:**  
   
This scenario will be copied into individual time of day scenarios.

**Global model iterations:**  
  
Use 6 iterations in normal operation

**Demographics File:**  
   
File must be csv file.

**Geographics File:**  
   
File must be csv file.

**Maximum iterations for the trip distribution sub-model:**  
  
The matrix balancing procedure should reach a convergence level of at least  $10^{-4}$  relative error in the final global iteration in order for the model to be considered converged. If this is not the case run again with more iterations.

**Maximum relative error for the trip distribution sub-model:**

**Maximum iterations for the auto assignment sub-model:**  
  
The auto assignment should reach a convergence level of at least  $10^{-3}$  best relative gap or  $10^{-5}$  relative gap in the final global iteration in order for the model to be considered converged. If this is not the case run again with more iterations.

**Transit Assignment Options**

☒ **Run Congested Transit Assignment**

☒ **Run Capacited Transit Assignment**

Figure 7: Screenshot of Model Run Page

### **7.2.9 09-01\_HbWork.py - 09-09\_NhbOther.py**

This series of nine scripts include the trip distribution, mode choice and time of day factoring models for each of the nine trip purposes.

### **7.2.10 09-00\_ModeChoiceUtilities.py**

Contains various helper functions that get used repeatedly in the trip distribution/mode choice models such as:

1. Trip distribution gravity model
2. Mode availability conditions

### **7.2.11 09-10\_TruckModel.py**

Runs the truck model and generates six origin - destination tables - 2 truck types (light and heavy) x three time periods

### **7.2.12 10-01\_AutoAssignment.py**

Runs the auto vehicle traffic assignment and generates time and cost skims for the three time periods

### **7.2.13 10-02\_TransitAssignment.py**

Runs the transit assignment (bus, rail and WCE) for the three time periods

Other scripts that are included in the Phase3Scripts but not part of a model run:

### **7.2.14 12\_DataExport.py**

Main model outputs are stored in a SQLite database inside the project folder as shown in Figure 8 (see rtm.db and trip\_summaries.db). This tool exports the data inside the SQLite database to .csv format inside the Outputs folder. The outputs include:

1. Trip summaries by mode, purpose and time of day at the aggregate and gy - gy level. Do note that daily trips at the gy - gy level are in Production - Attraction format whereas peak hour trips are in Origin - Destination format.
2. Network Summaries: Including VKT and travel times

### **7.2.15 ImportNetwork.py and ExportNetwork.py**

These two tools allow the import/export of current/future networks after they've been modified. More details are provided in the Step by Step Guide to running the model Chapter.

## **7.3 Notes on the Use of Numpy and Pandas Python Libraries**

Previous versions of the RTM relied largely on INRO's built in matrix calculator method throughout the full model run. In RTM3, most of these calculations are undertaken instead using Python's built in Numpy and Pandas Libraries. The latest versions of the EMME software allows easy exchange of data between numpy and the Emmebank. For example, if the number of households per zone is stored in Matrix 'mo1'(or 'md1'),



























 STRATS_s23041	16/03/2017 12:29 ...	File folder	
 STRATS_s23001	17/03/2017 11:08 ...	File folder	
 STRATS_s23000	17/03/2017 11:08 ...	File folder	
 STRATS_s22041	16/03/2017 12:25 ...	File folder	
 STRATS_s22001	17/03/2017 11:04 ...	File folder	
 STRATS_s22000	17/03/2017 11:04 ...	File folder	
 STRATS_s21041	16/03/2017 12:23 ...	File folder	
 STRATS_s21001	17/03/2017 11:02 ...	File folder	
 STRATS_s21000	17/03/2017 11:02 ...	File folder	
 Outputs	17/03/2017 12:38 ...	File folder	
 Inputs	16/03/2017 6:09 PM	File folder	
 emmemat	17/03/2017 10:00 ...	File folder	
 speed_macro.mac	17/03/2017 11:21 ...	MAC File	6 KB
 delmat.mac	07/09/2016 4:46 PM	MAC File	2 KB
 delattr.mac	07/09/2016 4:46 PM	MAC File	2 KB
 createattr.mac	05/01/2016 5:56 PM	MAC File	2 KB
 usemacro_116996	17/03/2017 9:43 AM	File	1 KB
 usemacro_95664	17/03/2017 11:08 ...	File	13 KB
 usemacro_14720	17/03/2017 11:11 ...	File	13 KB
 errors	17/03/2017 11:08 ...	File	29 KB
 emmebank	17/03/2017 11:27 ...	File	572,248 KB
 core_interface_log	17/03/2017 11:13 ...	File	2 KB
 trip_summaries	17/03/2017 10:00 ...	Data Base File	1,449 KB
 rtm	17/03/2017 9:54 AM	Data Base File	29,507 KB

Figure 8: SQLite Data Tables

the data can be stored in a vectorized Numpy array object of size 1741x1 (number of TAZs in the model) using the command: `X = emmebank.matrix("mo1").get_numpy_data()`, where X is the array object. Once a calculation is completed, the result can be directly stored back into the Emmebank using the command: `emmebank.matrix("mo2").set_numpy_data(X)`.

Similar operations can be undertaken on full matrices except the array object would be of size 1741x1741.

The example below demonstrates a mode choice utility expression constructed using the matrix calculator and Numpy.

Matrix Calculator:

```
# mf100 and mf101 are time and cost coefficients.  
Util_Transit = str(Bias) + "+" + str(Time_Coeff) + "*mf100" + "+" + str(Cost_Coeff) + "*mf101"
```

Numpy:

```
Time = emmebank.matrix("mf100").get_numpy_data()  
Cost = emmebank.matrix("mf101").get_numpy_data()  
  
Util_Transit = Bias + Time_Coeff * Time + Cost_Coeff * Cost
```

The Numpy expression is explicit and analogous to the Emme macro language - in other words, it does what the modeller is asking it to do.

To summarize, below are a few advantages of using Numpy:

- 1) Code is succinct and easier to read since it does not require string concatenation
- 2) Reduces the amount of coding errors
- 3) Numpy is flexible and significantly faster than Matrix Calculator. This is especially important for complex models with many TAZs
- 4) Direct integration with Python's Pandas library which allows relational database/SQL type operations such as Join and Relate. This capability makes the management of complicated RTM submodels, such as Park and Ride, much easier.

Both the 'get' and 'set' Numpy methods are available in the 'Util' toolbox as helper functions. The two examples below show how these are invoked in the RTM:

Get Method: `Array = util.get_matrix_numpy()` Set Method: `Array = util.set_matrix_numpy()`

For more information on Python Coding Guidelines, refer to Appendix XX of this User Guide.

## 8 Step by Step Guide for Running the Model

This chapter provides a step by step guide for running the model. Two examples will be used:

- 1) Run a base year 2011 run
- 2) Run a future scenario run which includes demographic, auto and transit network changes.

Example 1 starts from the point the user receives the model files from TransLink. Example 2 focuses more on data inputs that need to be updated for running a future scenario. Both examples provide screenshots to help guide the discussion.

### 8.1 2011 Model Run

This section provides a step by step guide to launching a base year, 2011, model run assuming no changes to model input data.

1. Unzip folder received from TransLink. The folder contents will look similar to Figure 9

2. Run the `relocate_tools` batch script found inside the Scripts folder. This script locates the python tools associated with the model run.
3. Run `RTM.emp` to launch EMME. The Explorer will look similar to Figure 10 with one dummy scenario (Scenario 1)
4. Launch EMME Modeller and go to ‘Translink RTM Phase 3 Model’ tool. The model utilities toolbox, ‘Translink Utilities’ can also be seen at the bottom in Figure 11
5. Launch the Initialize Emmebank tool. Enter a name for the title and folder name of the Emmebank you wish to create and click on the Run button (see Figure 12).
6. Close Modeller, the Explorer will now point to the newly created Emmebank which will include four scenarios, one for each horizon year, and associated networks as shown in Figure 13. The newly created Emmebank folder, `2011_Base` in this example, will look similar to Figure 14. You will notice a copy of the Inputs folder that also exists in the ‘RTM/BaseNetworks’ directory.
7. Launch Modeller and run the ‘Run RTM3’ tool inside the ‘Translink RTM Phase 3 Model’ toolbox.
8. Fill out the user inputs as shown in Figure 7. The user can change the inputs depending on the type of run being undertaken, however since this is a 2011 base year run the inputs will look largely similar to the ones shown in the previous figure.
9. Click the Run Button
10. Once a run is completed, run the Data Export tool under the Stage 4 subfolder and check the Export to CSVs toggle as shown in Figure 15. The csv outputs are stored in the ‘Outputs’ folder inside the Emmebank folder as shown in Figure 16.












Name	Date modified	Type	Size
 <b>data_tables</b>	16/03/2017 2:31 PM	Data Base File	4,863 KB
 <b>RTM</b>	16/03/2017 2:31 PM	Emme Project	52 KB
 <b>project.mtbx</b>	26/01/2017 4:43 PM	MTBX File	12 KB
 <b>BaseNetworks</b>	15/03/2017 5:21 PM	File folder	
 <b>Documentation</b>	26/01/2017 10:10 PM	File folder	
 <b>Logbook</b>	16/03/2017 12:48 PM	File folder	
 <b>Media</b>	26/01/2017 10:10 PM	File folder	
 <b>Scripts</b>	15/03/2017 5:08 PM	File folder	
 <b>Template</b>	15/03/2017 11:07 PM	File folder	
 <b>Views</b>	26/01/2017 10:10 PM	File folder	
 <b>Worksheets</b>	14/03/2017 3:10 PM	File folder	

Figure 9: RTM Zip File Contents

Warnings:

1. In the Model horizon years, make sure you only enter 2011, 2030 and 2045 as certain model components such as the truck model, external demand and bike scores were only setup for these years
2. Make sure the number of processors entered is less than or equal to what the machine supports

## 8.2 2030 Model Run

This section provides a step by step guide to setting up a horizon year, 2030, model run which includes the following input assumptions as part of the scenario:

- Revised land-use data
- New tolled facility
- New Rail Line
- New Park and Ride lot

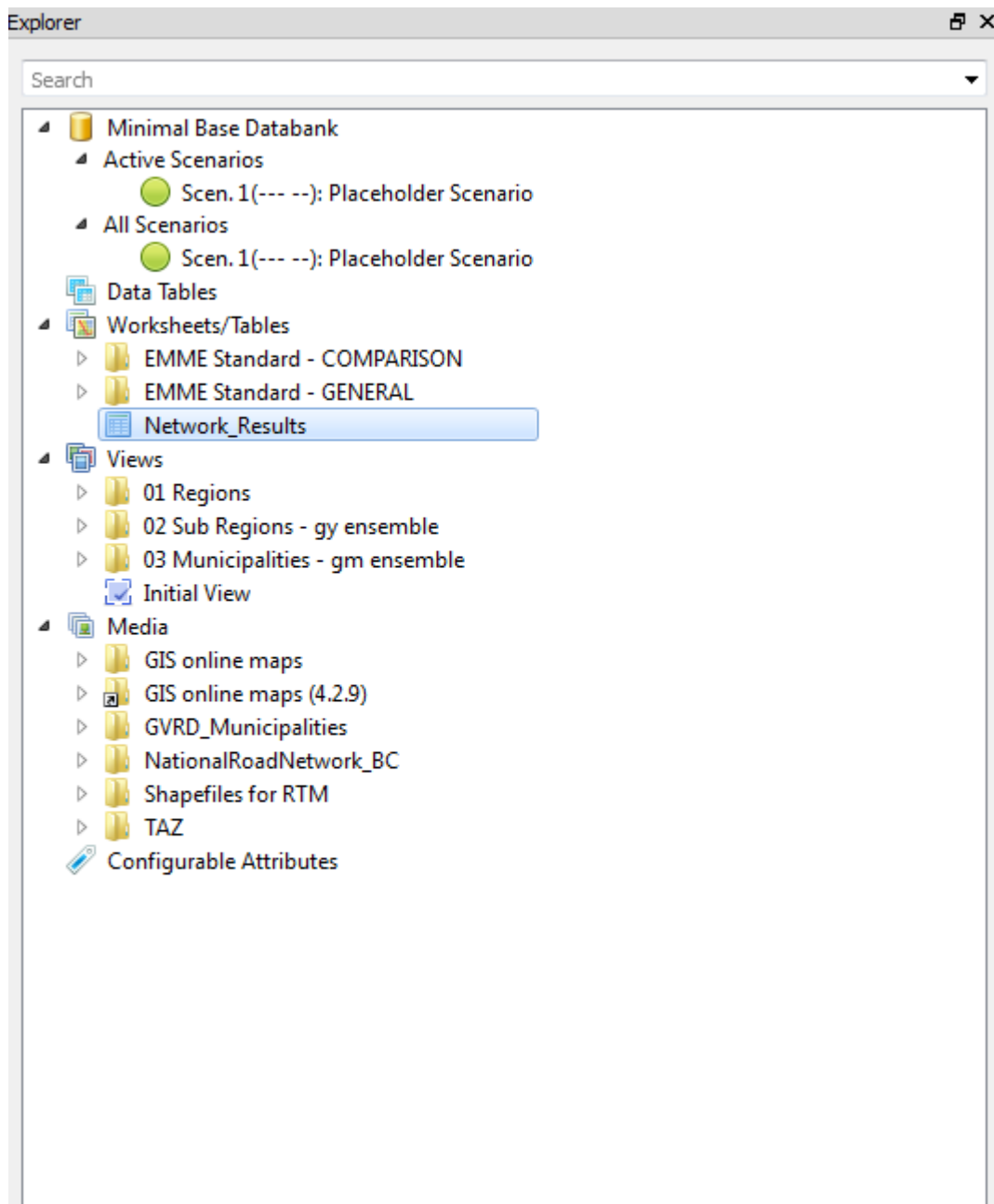


Figure 10: Initial RTM Databank

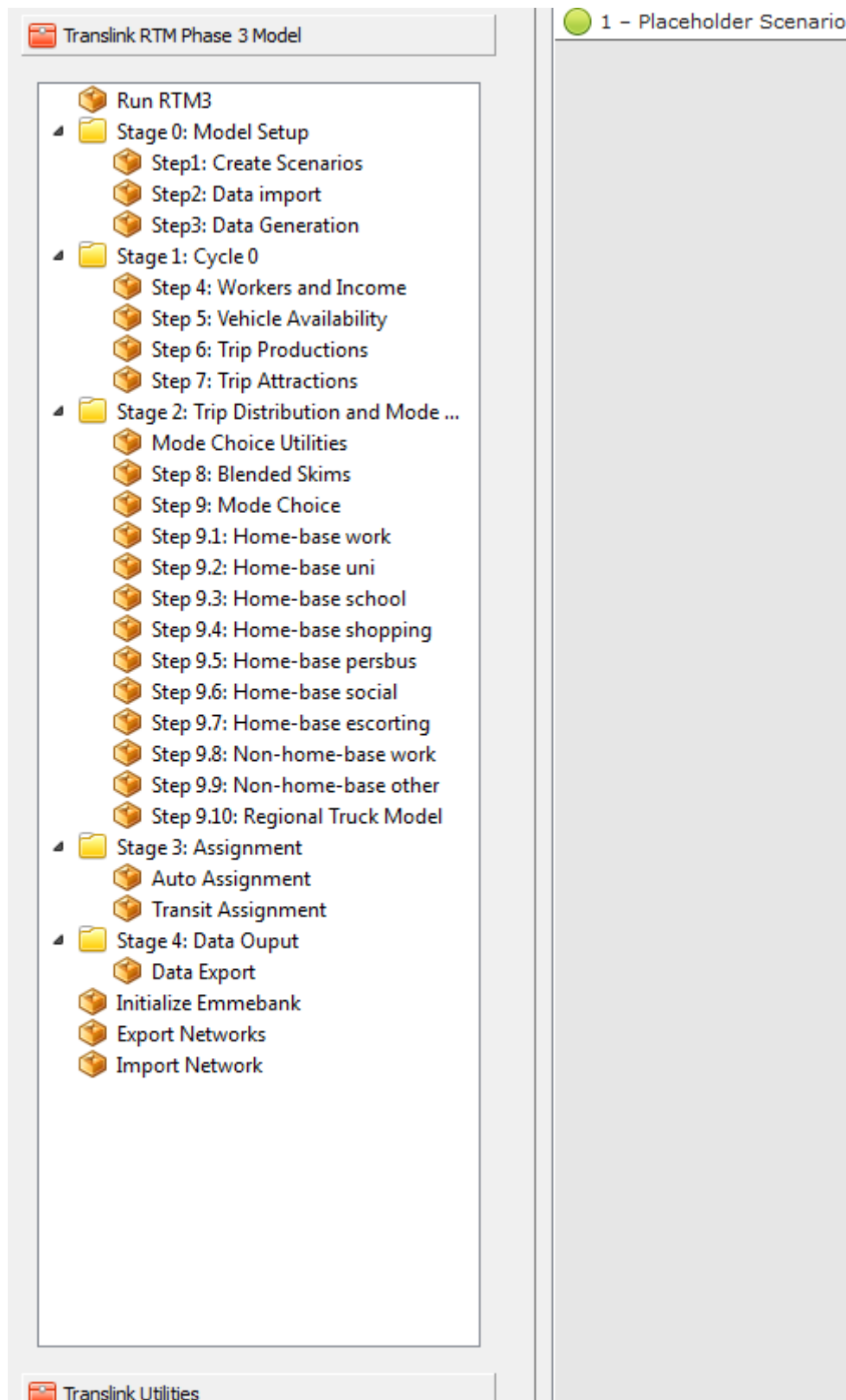


Figure 11: RTM Model Toolbox

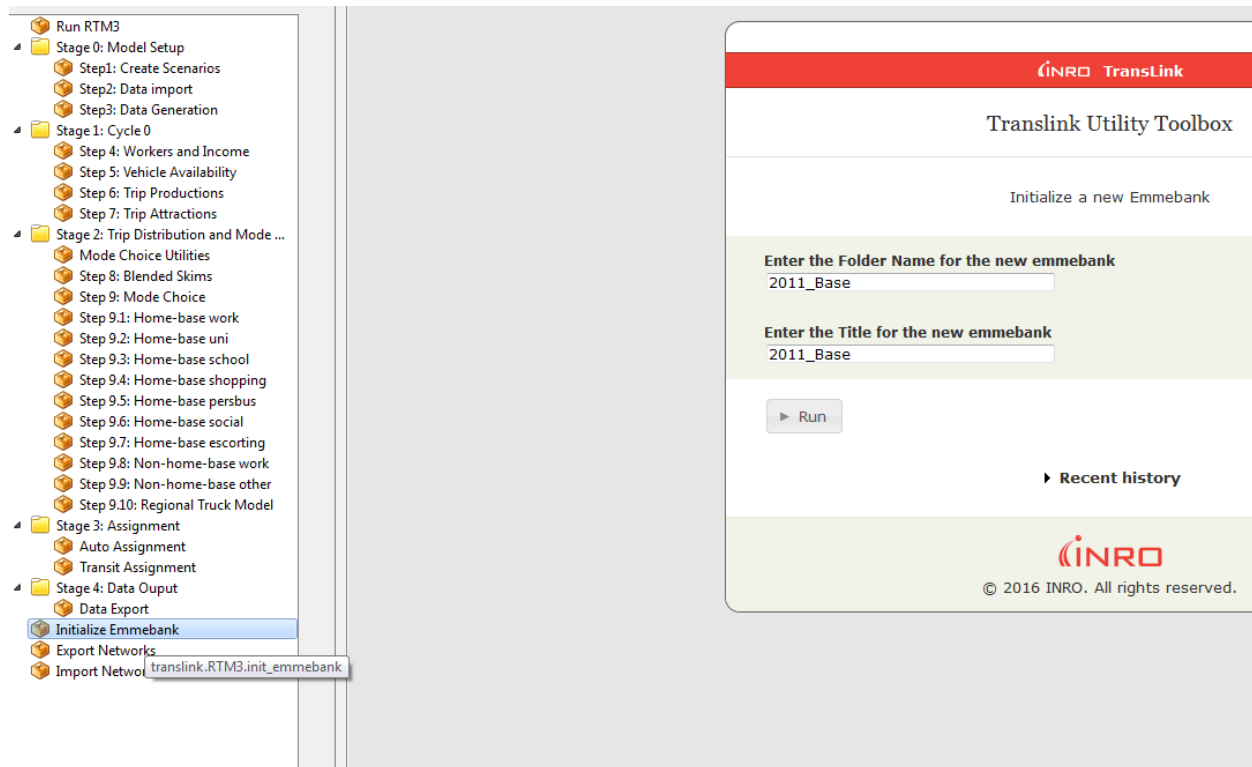


Figure 12: RTM Model Initialization

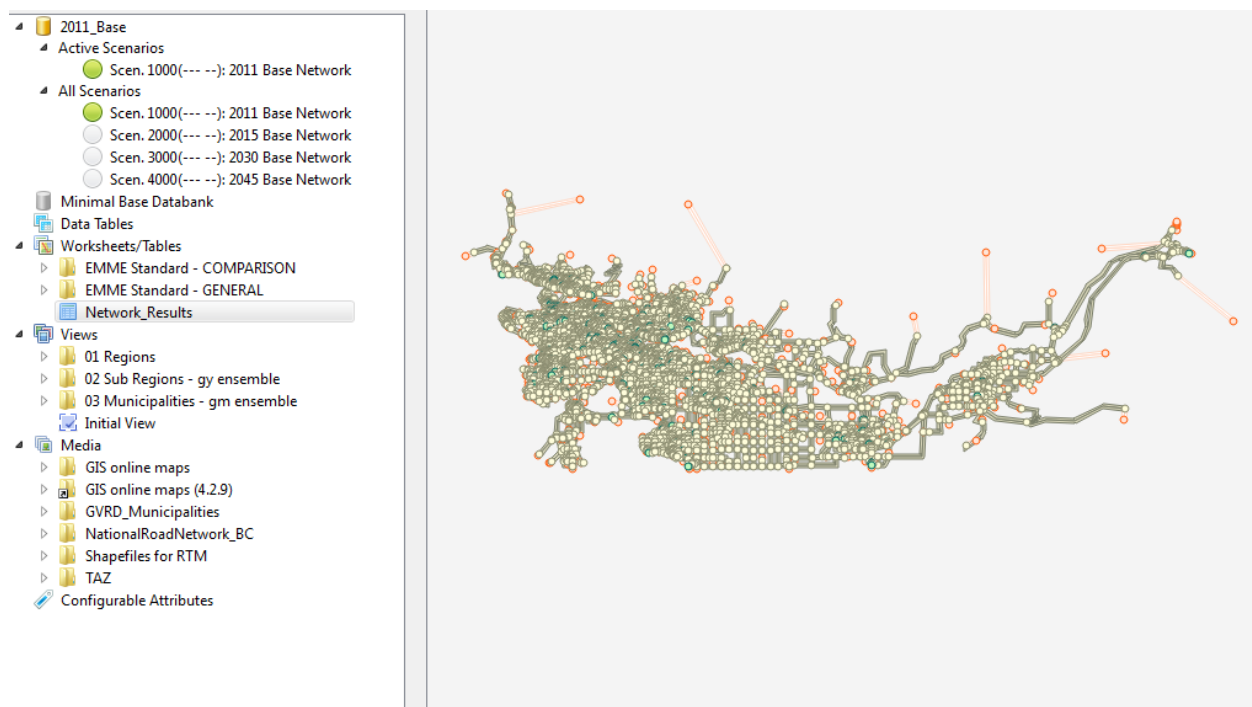


Figure 13: RTM Model After Initialization

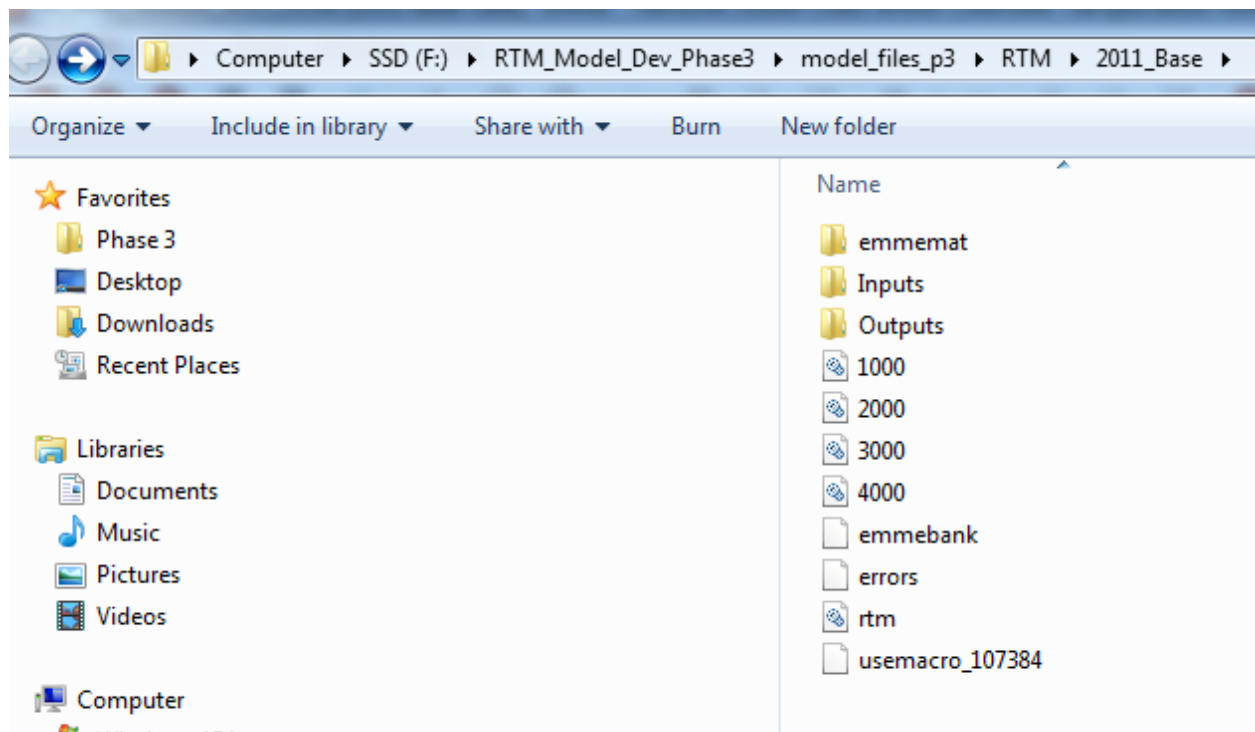


Figure 14: RTM Emmebank Folder Contents

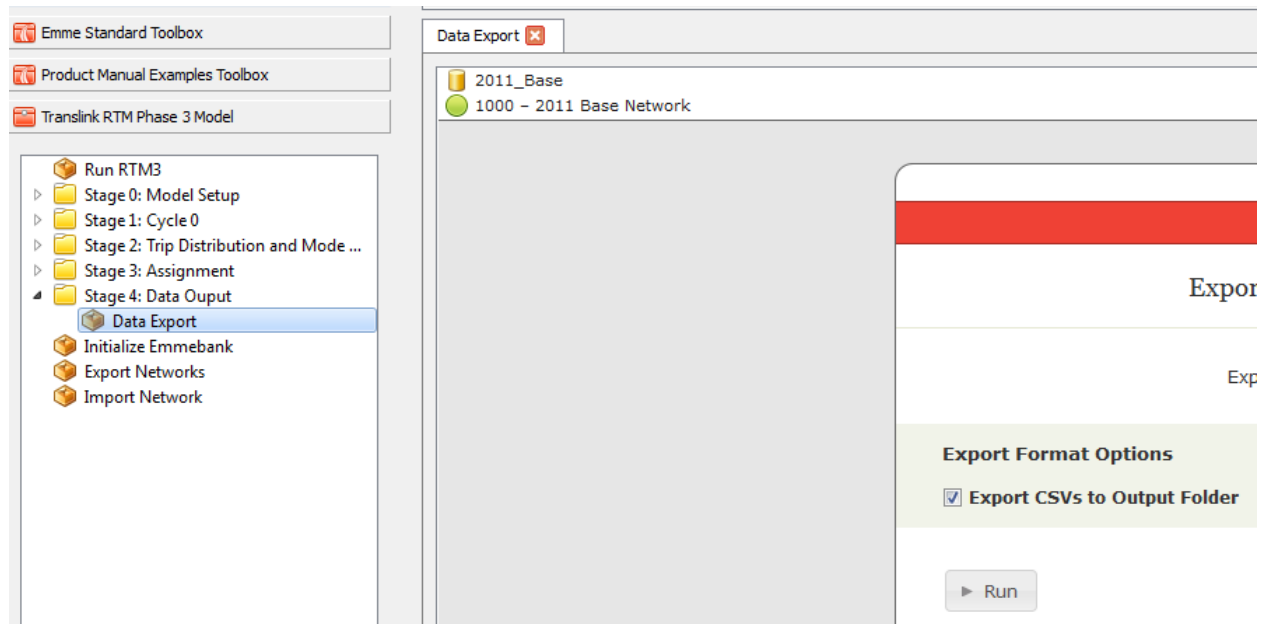


Figure 15: RTM Data Export








model_files_p3 ▶ RTM ▶ P3_2017_03_17 ▶ Outputs			
New folder			
Name	Date modified	Type	Size
 aggregateNetResults	17/03/2017 11:52 ...	Microsoft Excel C...	1 KB
 avgTravelTimes	17/03/2017 11:52 ...	Microsoft Excel C...	1 KB
 daily_gy	17/03/2017 11:52 ...	Microsoft Excel C...	384 KB
 phr_gy	17/03/2017 11:52 ...	Microsoft Excel C...	1,050 KB
 tripGeneration	17/03/2017 11:52 ...	Microsoft Excel C...	10 KB
 vModeShareDaily	17/03/2017 11:52 ...	Microsoft Excel C...	1 KB
 vModeShareDailyPurpose	17/03/2017 11:52 ...	Microsoft Excel C...	2 KB

Figure 16: RTM Output Folder

Only steps requiring changes to the input data are included in this section. The user can refer to the previous section on how to launch a model run.

1. Revised Land-use data:
  - Generate a demographics file similar in format to the ones located inside the 'BaseNetworks/Inputs' directory (for example the taz1700\_demographics\_2030.csv file).
  - Very Important: Since this model is largely driven by household trip rates, make sure all appropriate demographic attributes are updated. For example, if the scenario modelled assumes a 20% population increase in Coquitlam, the number of households in that municipality should also be updated accordingly
2. New Tolled Facility
  - Make a copy of one of the four main scenarios (in this case we assume scenario 3000 is copied to scenario 3001).
  - Code the new tolled facility. Make sure to follow the Network Coding Guidelines described in Chapter 6.
  - Ensure all ramp sections are coded with the correct volume-delay functions and speeds (refer to Network Coding Guidelines described in Chapter 6)
  - Add the appropriate tolls for each time period
  - Make sure turn penalty functions are coded properly for each time period and accounting for any turn restrictions
3. New Rail Line
  - Code the new rail line facility in scenario 3001. Make sure to follow the Network Coding Guidelines described in Chapter 6.
  - As this is a rail line, we strongly recommend coding it on separate, rail specific, links with pedestrian links connecting it to the main network.
  - Make sure to code AM, MD and PM headways
  - Make sure to allow boardings and alightings at rail station locations



- If the service crosses a fare boundary, be sure to discuss with TransLink modelling staff the proposed fare increment amount.
4. New Park and Ride Lot
    - Code the new park and ride in scenario 3001. Make sure to follow the Network Coding Guidelines described in Chapter 6.
    - Make sure the lot number chosen ranges between 100 - 130 and is not one of the existing lots used in the model in the future. Unused lots are usually stored in the North-easternmost portion of the EMME network as shown in Figure <13\_PnR.png>
    - Update the 'gn' ensemble in the 'taz1700\_ensembles.csv' file inside the 'BaseNetworks/Inputs' directory - the proposed lot, say 129, gets a value of 3, which indicates this is a lot that only exists in the future
    - Update attributes associated with the lot, such as capacity, cost and terminal time (auxiliary time spent walking inside the parking lot to a bus/rail stop/station). The file is located at 'BaseNetworks/Inputs/taz1700\_pnr.csv'
  5. Export the Network
    - If Scenario 3001 becomes a main future year scenario that needs to be run repeatedly, the user can export the Scenario using the 'Export Networks' tool. The outputs will be stored inside the BaseNetworks folder as shown in Figure <14\_BaseNetworks.png> The text files will be numbered with 3001. Afterwards, the InitEmmebank.py script can be updated to include scenario 3001 as part of the main horizon year networks as shown in Figure <15\_InitEmmebank2.png>.
  6. Final Checks before launching the run:
    - Make sure to add new transit vehicles if required
    - Make sure the correct seating and total capacities are provided in the transit vehicles table
    - Make sure to update the Geography (or create a new) file located at './RTM/BaseNetworks/Inputs' if needed. For example, in the New Rail Line scenario, the user will need to update the rail station dummy with a value of 1 for TAZs containing those stations.
  7. Launch the model run following the steps described in the previous section.
  8. To summarize Park and Ride results, the user will need to check SOV/HOV and transit peak hour trips that travel from/to zones 100 - 130. These trips are stored in the mf300 series (see Appendix XX for details on matrices stored in the databank).

## 9 Appendix A: Volume Delay Function Definitions

el1 is set to the extra attribute @posted\_speed

### 9.1 Special Functions

$$fd01 = length * 60 / 40$$

$$fd02 = 40 + ((volau + volad) - 100) * 60 / (volau + volad) * ((volau + volad).ge.100)$$

### 9.2 Merge Functions

$$fd03 = length * 60 / el1 + 0.85 * ((volau + volad) / (600 * lanes))^5$$

$$fd04 = length * 60 / el1 + 0.85 * ((volau + volad) / (800 * lanes))^5$$

$$fd05 = length * 60 / el1 + 0.85 * ((volau + volad) / (1000 * lanes))^5$$

$$fd06 = length * 60 / el1 + 0.85 * ((volau + volad) / (1200 * lanes))^5$$

$$fd07 = length * 60 / el1 + 0.85 * ((volau + volad) / (1400 * lanes))^5$$

### 9.3 Controlled Intersection Functions

$$fd25 = 0.25 + length * 60/el1 + .85 * ((volau + volad)/(400 * lanes))^4$$

$$fd35 = 0.25 + length * 60/el1 + .85 * ((volau + volad)/(600 * lanes))^4$$

$$fd45 = 0.25 + length * 60/el1 + .85 * ((volau + volad)/(800 * lanes))^4$$

$$fd55 = 0.25 + length * 60/el1 + .85 * ((volau + volad)/(1000 * lanes))^4$$

$$fd65 = 0.25 + length * 60/el1 + .85 * ((volau + volad)/(1200 * lanes))^4$$

$$fd75 = 0.25 + length * 60/el1 + .85 * ((volau + volad)/(1400 * lanes))^4$$

### 9.4 Free Flow Links

$$fd85 = length * 60/el1 * (1 + .6 * .85 * ((volau + volad)/(1600 * lanes^{1.05}))^5)$$

$$fd88 = length * 60/(el1 * 1.1) * (1 + .6 * .43 * ((volau + volad)/(1600 * lanes^{1.05}))^{5.25})$$

## 10 Appendix B: Matrix Ranges

Type	Matrix Type	Matrix Series	Description
ms	Scalar	1 - 99	Model Inputs
ms	Scalar	100 - 150	HOV Occupancy and Passenger Car Equivalents
ms	Scalar	160	Transit One Zone Fare
ms	Scalar	200 - 299	Values of Time
ms	Scalar	300 - 399	Transit Perception Factors
ms	Scalar	400 - 499	Blended Skims Factors
ms	Scalar	500 - 599	Transit Fare Blended Skims Factor
ms	Scalar	8000 - 8099	Truck Model Scalars
mo	Origin	1 - 99	Model Inputs
mo	Origin	100 - 199	Geographic and Ensemble Dummies
mo	Origin	200 - 299	Urban Form Variables such as densities and accessibilities
mo	Origin	2000 - 2099	Trip Productions
mo	Origin	8000 - 8099	Truck Model Productions
md	Destination	2000 - 2099	Trip Attractions
md	Destination	8000 - 8099	Truck Model Attractions
mf	Full	1 - 99	Model Inputs
mf	Full	200 - 299	Person - trips by time of day
mf	Full	300 - 399	Assigned trips by time of day (auto driver and transit)
mf	Full	3000 - 3999	Trip Distribution and Mode Choice Daily Trips by Trip Purpose
mf	Full	5000 - 5099	Auto Assignment Skims by time of day
mf	Full	5100 - 5299	Auto Assignment Blended Skims by Trip Purpose
mf	Full	5300 - 5399	Bus Assignment Skims by time of day
mf	Full	5400 - 5499	Bus Assignment Blended Skims by Trip Purpose
mf	Full	5500 - 5599	Rail Assignment Skims by time of day
mf	Full	5600 - 5699	Rail Assignment Blended Skims by Trip Purpose
mf	Full	5700 - 5799	WCE Assignment Skims by time of day
mf	Full	5800 - 5899	WCE Assignment Blended Skims by Trip Purpose
mf	Full	6000 - 6999	Park and Ride Model chosen lot and skims
mf	Full	8000 - 8099	Truck Model trips by market sector (daily and by time of day)

Type	Matrix Type	Matrix Series	Description
mf	Full	9000 - 9099	Mode Choice Logsums by trip purpose
mf	Full	9100 - 9199	Trip Distribution Friction Factors scratch matrices
mf	Full	9200 - 9299	Trip Distribution K-Factors
mf	Full	9900 - 9999	Temporary time of day skims storage