Dynamic Traffic Assignment modelling for a Sydney Traffic Model

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Introduction

Transport Systems are a fundamental aspect of our everyday lives and the decisions we make about our transport systems have wide impacts on our economy, our environment and our society. Transport models are representations of these complex real-world transport systems. Models inform planners about three important factors; current performance of transport systems, forecasting future scenarios in response to changes in demographics, land use etc., and comparing the merits of different traffic management strategies.

The goal with trip or traffic assignment is to solve for user equilibrium on the network, where every traveller succeeds in finding a route that minimizes their travel time between origin and destination, and for each OD pair, every used route has the same travel time. Traffic assignment has conventionally been applied statically for a given time period. However there is a growing interest in the development of dynamic, rather than static models. Static assignment inherently cannot capture time dependent phenomena such as bottlenecks and congestion. Dynamic traffic assignment (DTA) is more realistic and consistent in representing traffic dynamics. It can be used for short term and long term analysis, capacity improvement studies and even understanding the impact of traveller information systems.

This document outlines the steps taken to apply Dynamic Traffic Assignment (DTA) to a mesoscopic model for a peak morning period from 7-9am using the software Aimsun. Aimsun was chosen for its flexibility, speed and ability to produce models of any scale and complexity. This work represents a continuation of previous studies which are mixing the traffic simulation modelling together with data-driven aproaches, via various simulation environments, traffic signal control, or multi-agent approaches (see previous works in [1]-[2]..[18]). The current approach will be focusing more on microscopic traffic simulation modelling, powered by data driven streams.

Objectives

The following were the main objectives over the summer period:

1. Apply the DTA process to a study area within Sydney to produce a dynamic simulation model
2. Exploring the capabilities of the modelling software, Aimsun for DTA purposes
3. Documentation of the whole process

Existing Model

The model used for this DTA project was the 2012 Sydney Strategic Travel Model (STM3) provided by RMS. TSS's Sydney Project Model was also considered, however it was found that the former model had the most up to date and detailed representation of the study region in terms of road geometry and characteristics. This model contains 2729 origins and destinations. Although the most recent data at the time was the 2011 ABS Census, it may not have been inputted into the model and thus may actually contain the 2006 census data. In this case, this model uses a forecasted, or planning demand. Therefore, the V/C ratio may be greater than 1 if it is serving more vehicles than it was originally intended for. For an up to date model, it is expected that the demand is calibrated and is adequately fulfilled by current capacity of infrastructure.

Study Area Selection

The Pyrmont Region was selected for its relatively stable road geometry and minimal entrances and exits from the network. This is to reduce the size of the extracted traversal matrix. The CBD area was also considered, however due to the construction of the Sydney Light Rail Project and lack of current data for a constantly changing network, it was ultimately not chosen.

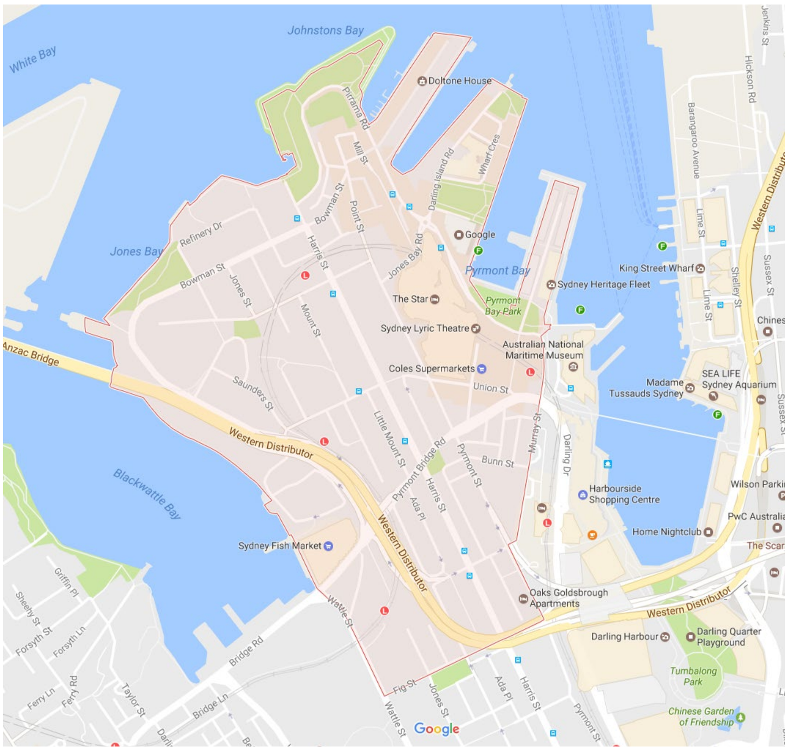


Figure 1: Bounds of the Pyrmont study area

Road Network Characteristics

The network geometry for the study region was updated using Open Street Maps and aerial and street-level photography from Google Maps. The street-level photographs date from late 2014 to late 2015. The curvature and alignment of the roads were adjusted, in particular the Western Distributor was moved substantially to represent the actual location and shape. The small arterials were deemed insignificant and not included in the model. Lane usage and turn bays were also checked since reduced capacity will affect delay times and routing decisions. After consulting the online City of Sydney parking meter map, it was found that during the given study period, all parking lanes are likely to be occupied and so those lanes were removed from the model to represent the actual reduced capacity. The location of bus stops was also reviewed. Road characteristics such as capacity, maximum speed and road type were already included in the existing model.

For sections with a capacity of 0 vehicles per hour, a Python script was written to set the capacity to 900 vehicles per lane. The original reason for these zero capacity sections needs to be clarified. The capacity was changed for this project since the experiments required a non-zero value.

Data Inputs

Initially, the SCATS data for Pyrmont was obtained using Excel sheets for each link containing the intersection ID's, turning ratio, distance, number of lanes and speed limit. For each lane, it was assumed that if there were 2 possible movements (e.g. turning and going straight), the turning ratio would be evenly split, 0.5. These files can be found in the "SCATS_Region_Graphics" folder. The data obtained for each of these links contained mean travel time, throughput, speed limit, inflow and outflow at 15 minute intervals for a 24 hour period. However, for importation into Aimsun we thought that vehicle counts would be required for each detector at each intersection.

SCATS data for vehicles counts were provided for a 4-month period from 1 March to 27 June 2015. The vehicle counts were an average over the whole period. It should be noted that although most sections had data for every consecutive day within the given dates, some days were missing. In future work, it would be more realistic to choose a single day that represents normal operation on the network, or at least to separate the weekdays from the weekend.

When importing the detector counts, the dates must be set to the same as the running date for scenarios and time periods must be exactly matching.

For public transport data, timetables and bus stop information were provided for the Sydney Bus routes 389 and 501, which run through the Pyrmont area. A Python script was written to import the information into the model. The relevant files for this process can be found in the folder "PT_Import". Aimsun currently does not support easy importation of General Transit Feed Specification (GTFS) data, however this is something in development and will be released in future versions of the software. Although there is a light rail system in Pyrmont, it is an underground network and does not affect the behaviour of the road network, so it was not considered for this project. In the future, there is the possibility of using Opal card data to model public transport user behaviour in more detail.

Signal control data is essential for modelling traffic flow realistically. Due to issues with using the SCATS interface, this data was not available.

Importation of Public Transport Lines

Although future versions of Aimsun will be compatible with the GTFS format, Python scripting is currently the only way to import public transit data into a model. One such method, using the code "IMPORT_PT_LINE_501" (in the model "stm_17jan.ang") has been detailed below. All files can be found in the "PT_Import" folder. It should be noted that more efficient methodologies may exist.

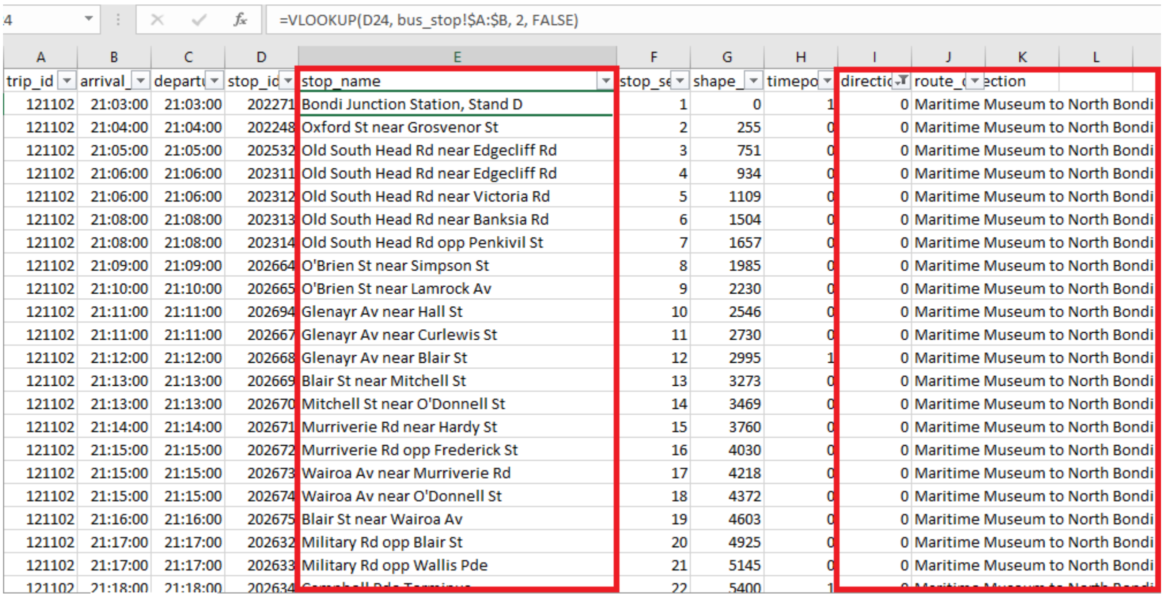
The offset time is a value indicating the number of seconds from the departure time of the public transport vehicle from the first stop to the arrival time at this stop. It will keep the bus in the stop until the departure time for this stop is reached.

It has been assumed that every bus will stop at every bus stop. While in reality certain buses may not stop if there are no passengers to pick-up or set-down, it is a reasonable assumption to make without conducting an extensive on-site survey.

The mean and deviation of stop time has been set to 10 ± 2 seconds for all stops. A site visit would be needed to approximate conditions in the study area.

Data Preparation

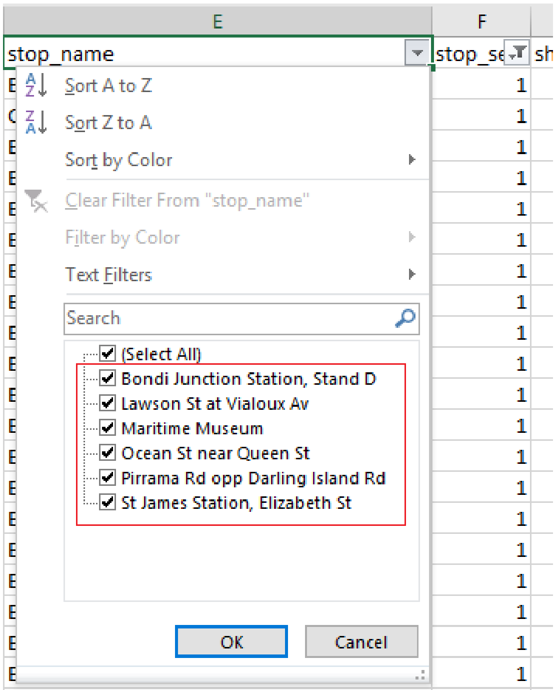
1. Create a new Public Transport Line in the Aimsun model (PROJECT > PUBLIC TRANSPORT > New Public Transport Line) and create the new route by manually selecting sections and bus stops.
    - Sydney bus routes, 389 and 501 had several variations of a main route – if this is the case, the import process will be faster by first creating the route with the most amount of stops, duplicating that route and then removing necessary stops to create the shorter routes.
2. Given the raw files 'bus_stop', 'bus_stop_time' and 'bus_trip', use VLOOKUP function in Excel to add the corresponding stop names (from 'bus_stop'), direction ID and route direction (both from 'bus_trip') into the 'bus_stop_time' table. This is to help visualise the different bus routes.



=VLOOKUP(D24, bus_stop!$A:$B, 2, FALSE)

trip_id	arrival_	departu	stop_id	stop_name	stop_se	shape_	timepo	directio	route_direction
121102	21:03:00	21:03:00	202271	Bondi Junction Station, Stand D	1	0	1	0	Maritime Museum to North Bondi
121102	21:04:00	21:04:00	202248	Oxford St near Grosvenor St	2	255	0	0	Maritime Museum to North Bondi
121102	21:05:00	21:05:00	202532	Old South Head Rd near Edgecliff Rd	3	751	0	0	Maritime Museum to North Bondi
121102	21:06:00	21:06:00	202311	Old South Head Rd near Edgecliff Rd	4	934	0	0	Maritime Museum to North Bondi
121102	21:06:00	21:06:00	202312	Old South Head Rd near Victoria Rd	5	1109	0	0	Maritime Museum to North Bondi
121102	21:08:00	21:08:00	202313	Old South Head Rd near Banksia Rd	6	1504	0	0	Maritime Museum to North Bondi
121102	21:08:00	21:08:00	202314	Old South Head Rd opp Penkivil St	7	1657	0	0	Maritime Museum to North Bondi
121102	21:09:00	21:09:00	202664	O'Brien St near Simpson St	8	1985	0	0	Maritime Museum to North Bondi
121102	21:10:00	21:10:00	202665	O'Brien St near Lamrock Av	9	2230	0	0	Maritime Museum to North Bondi
121102	21:11:00	21:11:00	202694	Glenayr Av near Hall St	10	2546	0	0	Maritime Museum to North Bondi
121102	21:11:00	21:11:00	202667	Glenayr Av near Curlewis St	11	2730	0	0	Maritime Museum to North Bondi
121102	21:12:00	21:12:00	202668	Glenayr Av near Blair St	12	2995	1	0	Maritime Museum to North Bondi
121102	21:13:00	21:13:00	202669	Blair St near Mitchell St	13	3273	0	0	Maritime Museum to North Bondi
121102	21:13:00	21:13:00	202670	Mitchell St near O'Donnell St	14	3469	0	0	Maritime Museum to North Bondi
121102	21:14:00	21:14:00	202671	Murriverie Rd near Hardy St	15	3760	0	0	Maritime Museum to North Bondi
121102	21:15:00	21:15:00	202672	Murriverie Rd opp Frederick St	16	4030	0	0	Maritime Museum to North Bondi
121102	21:15:00	21:15:00	202673	Wairoa Av near Murriverie Rd	17	4218	0	0	Maritime Museum to North Bondi
121102	21:15:00	21:15:00	202674	Wairoa Av near O'Donnell St	18	4372	0	0	Maritime Museum to North Bondi
121102	21:16:00	21:16:00	202675	Blair St near Wairoa Av	19	4603	0	0	Maritime Museum to North Bondi
121102	21:17:00	21:17:00	202632	Military Rd opp Blair St	20	4925	0	0	Maritime Museum to North Bondi
121102	21:17:00	21:17:00	202633	Military Rd opp Wallis Pde	21	5145	0	0	Maritime Museum to North Bondi
121102	21:18:00	21:18:00	202634	[illegible]	22	5400	1	0	[illegible]

3. Filter the inbound and outbound data and save as two files. In this example, the files are named, '389 _inbound.xlsx'. (The inbound and outbound data have been split into two separate files purely for the purpose of reducing the number of sheets per Excel book). The inbound and outbound directions are defined below.
   - Outbound: direction = 0, bus heading out of the CBD
   - Inbound: direction = 1, bus heading towards the CBD
4. Use the 'stop_sequence' column to determine the variations of routes (e.g. the bus may start or finish at different stops)
   - For example, after filtering the 'stop_sequence' column to stop number 1 and selecting the 'stop_name' filter, you will see the different stops that the route begins at.



The four tables below summarize the variations in the 501 and 389 lines.

Outbound 389, direction = 0, CBD to Eastern Suburbs

First stop	Last stop	Number of stops
Maritime Museum (200015)	Campbell Pde Terminus (202634)	53
Pirrama Rd opp Darling Island Rd	Campbell Pde Terminus (202634)	51
St James Station, Elizabeth St	Campbell Pde Terminus (202634)	43
Ocean St near Queen St (202528)	Campbell Pde Terminus (202634)	27
Bondi Junction Station, Stand D (202271)	Campbell Pde Terminus (202634)	22
Lawson St at Vialoux Av (202192)	Bondi Junction Station, Stand G (202267)	11

Inbound 389, direction = 1, Eastern Suburbs to CBD

First stop	Last stop	Number of stops
Campbell Pde Terminus (202627)	Maritime Museum (200015)	52
Bondi Junction Station, Grafton St, Stand R	Town Hall Station, Park St, Stand J (2000425)	22
Ocean St near Queen St (202522)	Town Hall Station, Park St, Stand J (2000425)	18
Glenayr Av near Warners Av (202692)	Bondi Junction Station, Grafton St, Stand Q (202268)	11
Town Hall Stationk, Park St, Stand J (2000425)	Maritime Museum (200015)	10

Outbound 501, direction = 0, CBD to Western Suburbs

First stop	Last stop	Number of stops
Pitt St opp Barlow St (200083)	West Ryde Interchange (Set Down) (211421)	48
Pitt St opp Barlow St (200083)	Blaxland Rd near Church St (211230)	37

Inbound 501, direction = 1, Western Suburbs to CBD

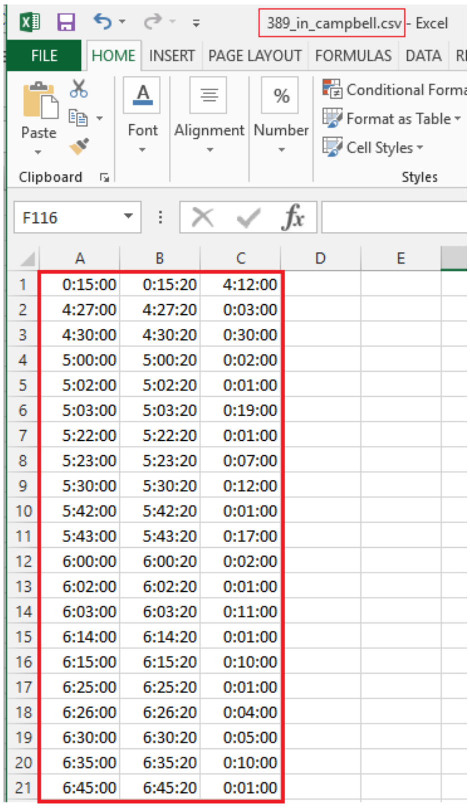
First stop	Last stop	Number of stops
West Ryde Interchange - Stand B (211426)	Pitt St at Barlow St (2000428)	51
Blaxland Rd near Devlin St (211220)	Pitt St at Barlow St (2000428)	40
Cambrige St near Harvard St (211111)	Pitt St at Barlow St (2000428)	33
Victoria Rd near Terry St (203911)	Pitt St at Barlow St (2000428)	16

5. Filter the data for each route variation (with the filter on stop_sequence = 1) and copy the information into a new sheet
    - Sort the arrival times from smallest to largest (ensuring that the range is from 0:00:00 to 23:59:59)
    - Assume that buses leave 20 seconds after the arrival time - add 20 seconds to the departure time column
    - Calculate the duration time (time between the one trip and the next)
        - A schedule duration of 0:00:00 is not permitted in Aimsun. A duration of 0 seconds can be interpreted as two buses leaving that stop at the same time, the phenomena of bus bunching. To make the values compatible with Aimsun, modify the arrival time of the 2nd bus to one minute later, so that the duration becomes 1 min.
        - Note that all times given in the raw data have been rounded to the nearest minute.

trip_id	arrival_time	departure_time	calculate_duration	stop_id	stop_name
258917	0:15:00	0:15:20	4:12:00	202627	Campbell Pde
252889	4:27:00	4:27:20	0:03:00	202627	Campbell Pde
259861	4:30:00	4:30:20	0:30:00	202627	Campbell Pde
257060	5:00:00	5:00:20	0:02:00	202627	Campbell Pde
254067	5:02:00	5:02:20	0:01:00	202627	Campbell Pde
373659	5:03:00	5:03:20	0:19:00	202627	Campbell Pde
254068	5:22:00	5:22:20	0:01:00	202627	Campbell Pde
373660	5:23:00	5:23:20	0:07:00	202627	Campbell Pde
257061	5:30:00	5:30:20	0:12:00	202627	Campbell Pde
254069	5:42:00	5:42:20	0:01:00	202627	Campbell Pde
373661	5:43:00	5:43:20	0:17:00	202627	Campbell Pde
257062	6:00:00	6:00:20	0:02:00	202627	Campbell Pde
254070	6:02:00	6:02:20	0:01:00	202627	Campbell Pde
373662	6:03:00	6:03:20	0:11:00	202627	Campbell Pde

- Save the values from the arrival time, departure time and duration columns in a separate file as "XXX_inbound/outbound_ first/laststop.csv”

trip_id	arrival_time	departure_time	calculate_duration	stop_id	stop_name
258917	0:15:00	0:15:20	4:12:00	202627	Campbell Pde
252889	4:27:00	4:27:20	0:03:00	202627	Campbell Pde
259861	4:30:00	4:30:20	0:30:00	202627	Campbell Pde
257060	5:00:00	5:00:20	0:02:00	202627	Campbell Pde
254067	5:02:00	5:02:20	0:01:00	202627	Campbell Pde
373659	5:03:00	5:03:20	0:19:00	202627	Campbell Pde
254068	5:22:00	5:22:20	0:01:00	202627	Campbell Pde
373660	5:23:00	5:23:20	0:07:00	202627	Campbell Pde
257061	5:30:00	5:30:20	0:12:00	202627	Campbe[illegible]de
254069	5:42:00	5:42:20	0:01:00	[illegible]	[illegible]
373661	5:43:00	5:43:20	0:17:00	[illegible]	[illegible]
257062	6:00:00	6:00:20	0:02:00	[illegible]	[illegible]
254070	6:02:00	6:02:20	0:01:00	202627	Campbe[illegible]
373662	6:03:00	6:03:20	0:11:00	202627	Campbe[illegible] Pde
254071	6:14:00	6:14:20	0:01:00	202627	Campbell Pde
373663	6:15:00	6:15:20	0:10:00	202627	Campbell Pde
254072	6:25:00	6:25:20	0:01:00	202627	Campbell Pde
373664	6:26:00	6:26:20	0:04:00	202627	Campbell Pde
257063	6:30:00	6:30:20	0:05:00	202627	Campbell Pde
248502	6:35:00	6:35:20	0:10:00	202627	Campbell Pde
248503	6:45:00	6:45:20	0:01:00	202627	Campbell Pde



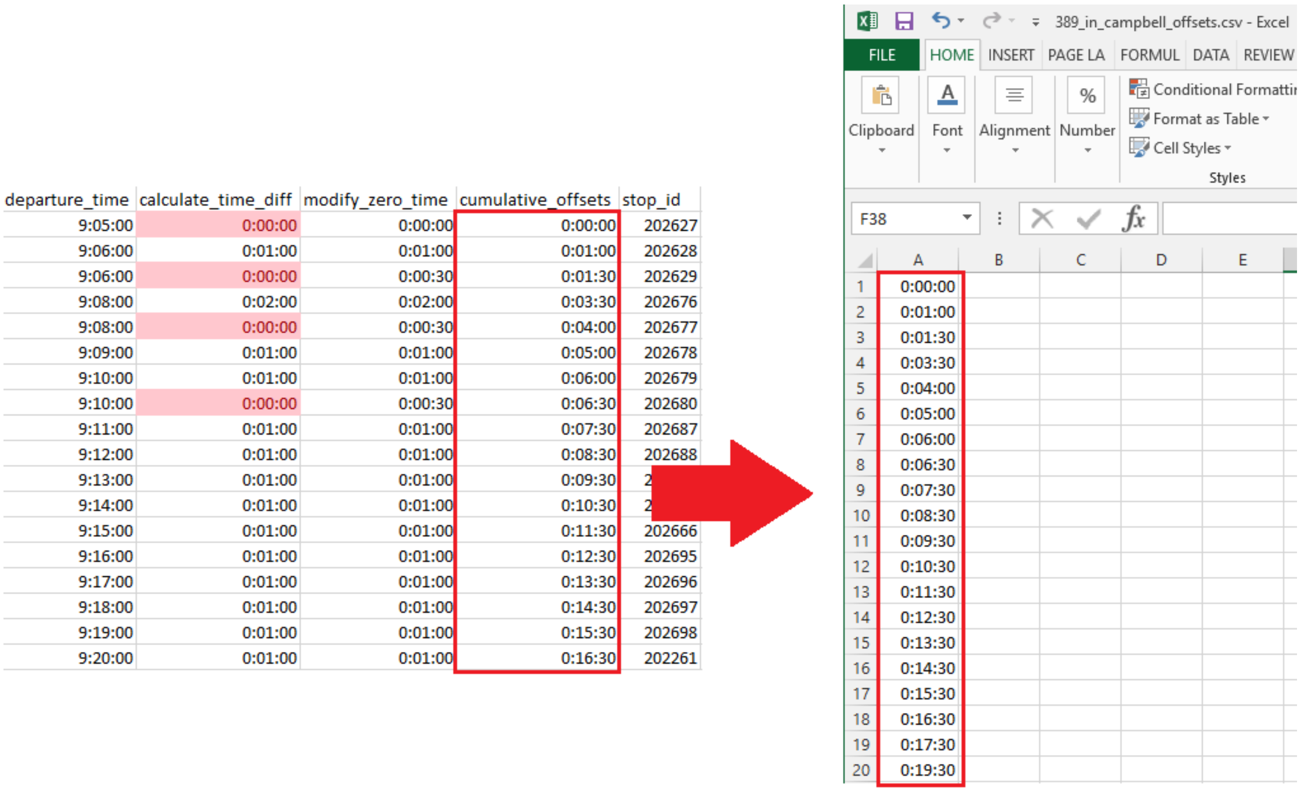
	A	B	C
1	0:15:00	0:15:20	4:12:00
2	4:27:00	4:27:20	0:03:00
3	4:30:00	4:30:20	0:30:00
4	5:00:00	5:00:20	0:02:00
5	5:02:00	5:02:20	0:01:00
6	5:03:00	5:03:20	0:19:00
7	5:22:00	5:22:20	0:01:00
8	5:23:00	5:23:20	0:07:00
9	5:30:00	5:30:20	0:12:00
10	5:42:00	5:42:20	0:01:00
11	5:43:00	5:43:20	0:17:00
12	6:00:00	6:00:20	0:02:00
13	6:02:00	6:02:20	0:01:00
14	6:03:00	6:03:20	0:11:00
15	6:14:00	6:14:20	0:01:00
16	6:15:00	6:15:20	0:10:00
17	6:25:00	6:25:20	0:01:00
18	6:26:00	6:26:20	0:04:00
19	6:30:00	6:30:20	0:05:00
20	6:35:00	6:35:20	0:10:00
21	6:45:00	6:45:20	0:01:00

6. For each route variation, select **one trip ID** from the peak time period and select the all the rows for that trip

trip_id	arrival_tir	departure	stop_id	stop_name	stop_sequence	shape_dis	timepoint	direction_	route_direction
92999	18:30:00	18:30:00	2000425	Town Hall Station, Park St, Stand J	1	0	1	1	North Bondi to Marit
92999	18:43:00	18:43:00	200926	Harris St near Allen St	2	1673	1	1	North Bondi to Marit
92999	18:44:00	18:44:00	200928	Harris St near Pyrmont Bridge Rd	3	2027	0	1	North Bondi to Marit
92999	18:44:00	18:44:00	200913	Harris St near Miller St	4	2221	0	1	North Bondi to Marit
92999	18:44:00	18:44:00	200912	Harris St near John St	5	2429	0	1	North Bondi to Marit
92999	18:44:00	18:44:00	200934	Harris St near Bowman St	6	2638	0	1	North Bondi to Marit
92999	18:45:00	18:45:00	200911	Pirrama Rd near Bayview St	7	3155	0	1	North Bondi to Marit
92999	18:46:00	18:46:00	200918	Pirrama Rd near Darling Island Rd	8	3580	0	1	North Bondi to Marit
92999	18:47:00	18:47:00	200931	Pirrama Rd near The Star	9	4424	1	1	North Bondi to Marit
92999	18:48:00	18:48:00	200015	Maritime Museum	10	4802	1	1	North Bondi to Marit

- Sort the arrival times from smallest to largest
- Calculate the time between each consecutive bus stop
    - The first stop will always be 0:00:00 because the offset is calculated relative to the time the bus leaves that stop
    - If the time between stops is 0:00:00, it may either be due to truncation errors since the data is rounded to the nearest minute, or simply that there were no passengers to pick up or set down. Use conditional formatting to identify times with 0:00:00 and add 30 seconds to those cases in the “modify_zero_time” column since it is assumed that the bus stops at every stop.

- Cumulatively add the times from “modify_zero_time” to get the CUMULATIVE offset time for each stop relative to the first stop.
- Save the values from the ‘cumulative_offsets’ column as “name_offsets.csv”



departure_time	calculate_time_diff	modify_zero_time	cumulative_offsets	stop_id
9:05:00	0:00:00	0:00:00	0:00:00	202627
9:06:00	0:01:00	0:01:00	0:01:00	202628
9:06:00	0:00:00	0:00:30	0:01:30	202629
9:08:00	0:02:00	0:02:00	0:03:30	202676
9:08:00	0:00:00	0:00:30	0:04:00	202677
9:09:00	0:01:00	0:01:00	0:05:00	202678
9:10:00	0:01:00	0:01:00	0:06:00	202679
9:10:00	0:00:00	0:00:30	0:06:30	202680
9:11:00	0:01:00	0:01:00	0:07:30	202687
9:12:00	0:01:00	0:01:00	0:08:30	202688
9:13:00	0:01:00	0:01:00	0:09:30	2
9:14:00	0:01:00	0:01:00	0:10:30	2
9:15:00	0:01:00	0:01:00	0:11:30	202666
9:16:00	0:01:00	0:01:00	0:12:30	202695
9:17:00	0:01:00	0:01:00	0:13:30	202696
9:18:00	0:01:00	0:01:00	0:14:30	202697
9:19:00	0:01:00	0:01:00	0:15:30	202698
9:20:00	0:01:00	0:01:00	0:16:30	202261

	A	B	C	D	E
1	0:00:00				
2	0:01:00				
3	0:01:30				
4	0:03:30				
5	0:04:00				
6	0:05:00				
7	0:06:00				
8	0:06:30				
9	0:07:30				
10	0:08:30				
11	0:09:30				
12	0:10:30				
13	0:11:30				
14	0:12:30				
15	0:13:30				
16	0:14:30				
17	0:15:30				
18	0:16:30				
19	0:17:30				
20	0:19:30				

To import the data for one route variation in Aimsun, there are some variables in the code that need to be changed.

1. Add the numerical ID to the list of PT Line ID’s, and replace the variable in the line

   if ptLine.getId() == outbound_westryde_501:

2. Name of the timetable

   timetableName = “timetable.csv”

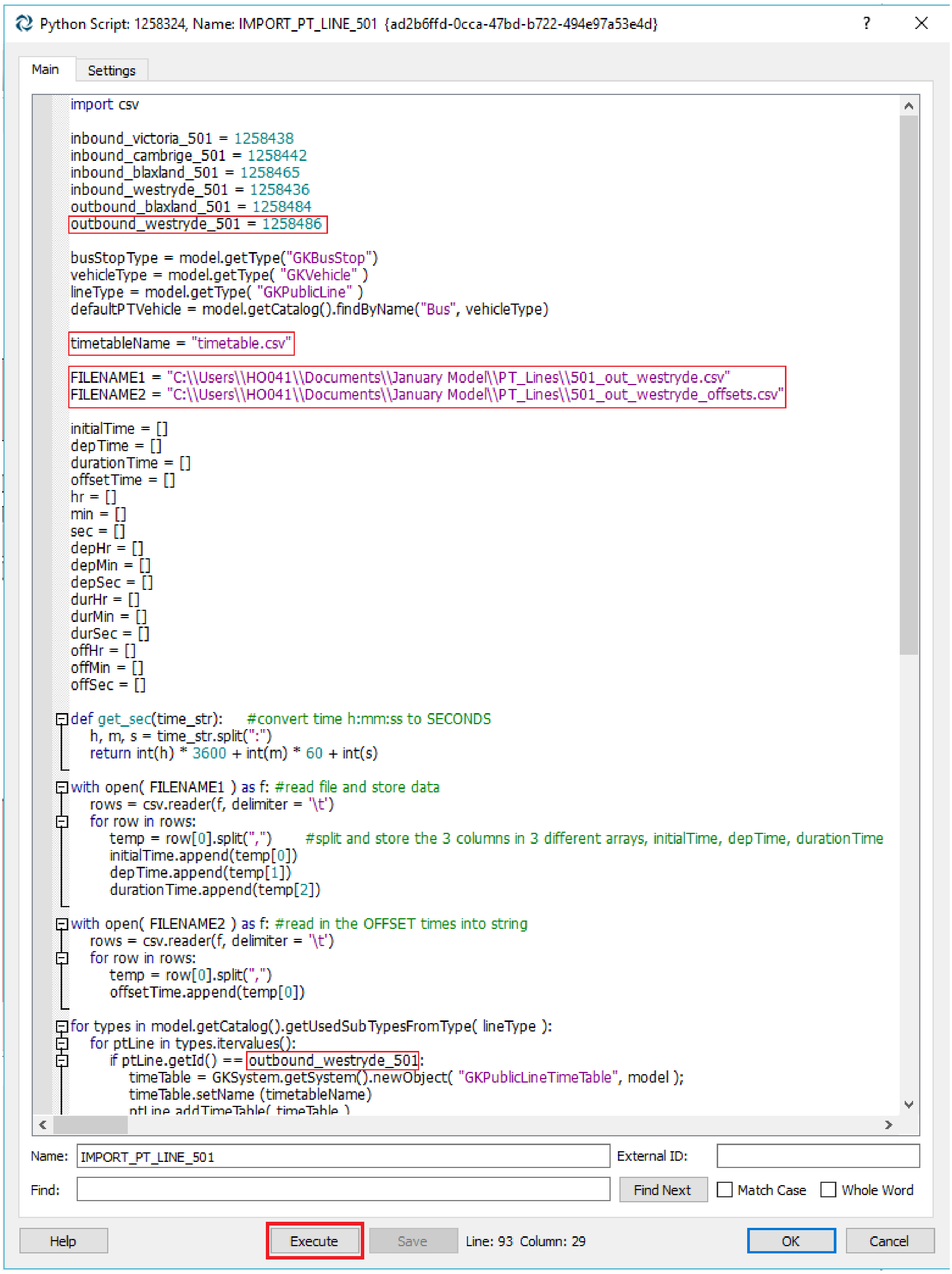
3. Name of the file containing ARRIVAL time, DEPARTURE time, and DURATION of the schedule

   FILENAME1 = "C:\\Users\\HO041\\Documents\\JanuaryModel\\PT_Lines\\501_out_westryde.csv"

4. Name of the file containing the OFFSETS

FILENAME2 = "C:\\Users\\HO041\\Documents\\JanuaryModel\\PT_Lines\\501_out_westryde_offsets.csv"

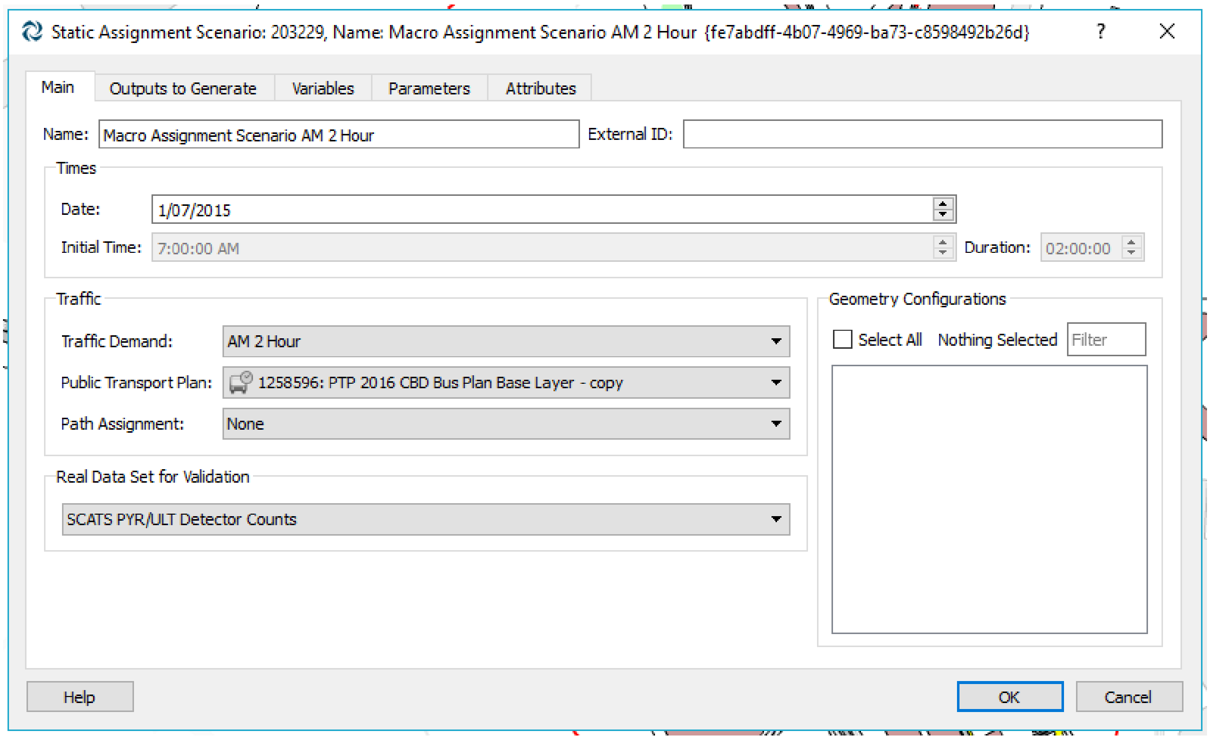
Execute the code.



DTA Execution in Aimsun

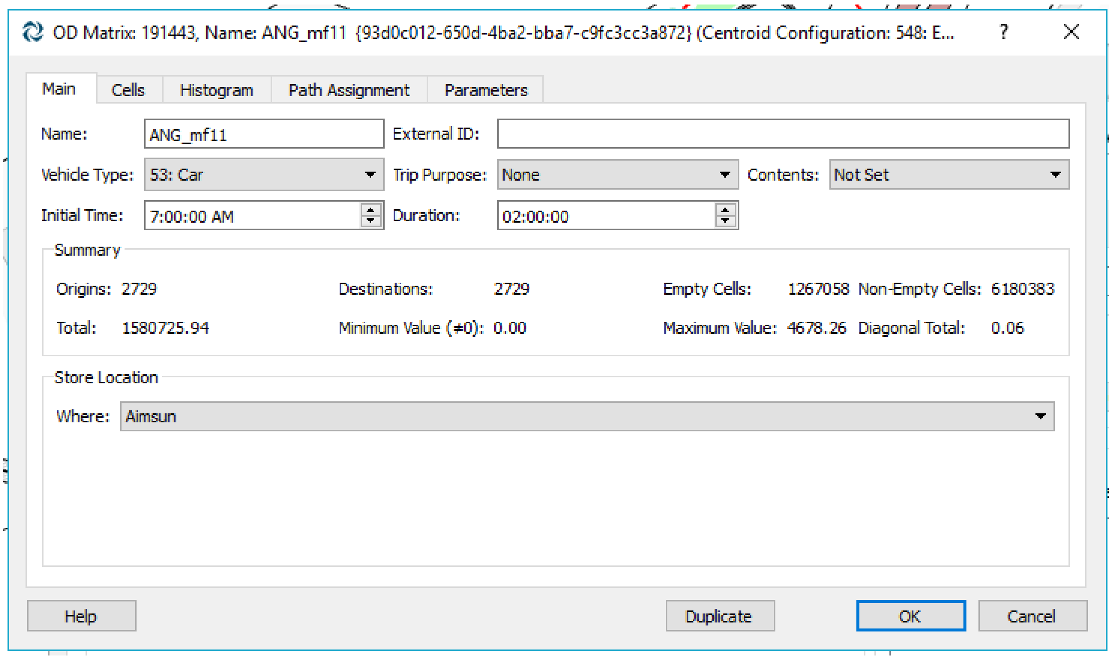
Procedure for Dynamic Traffic Assignment in Aimsun

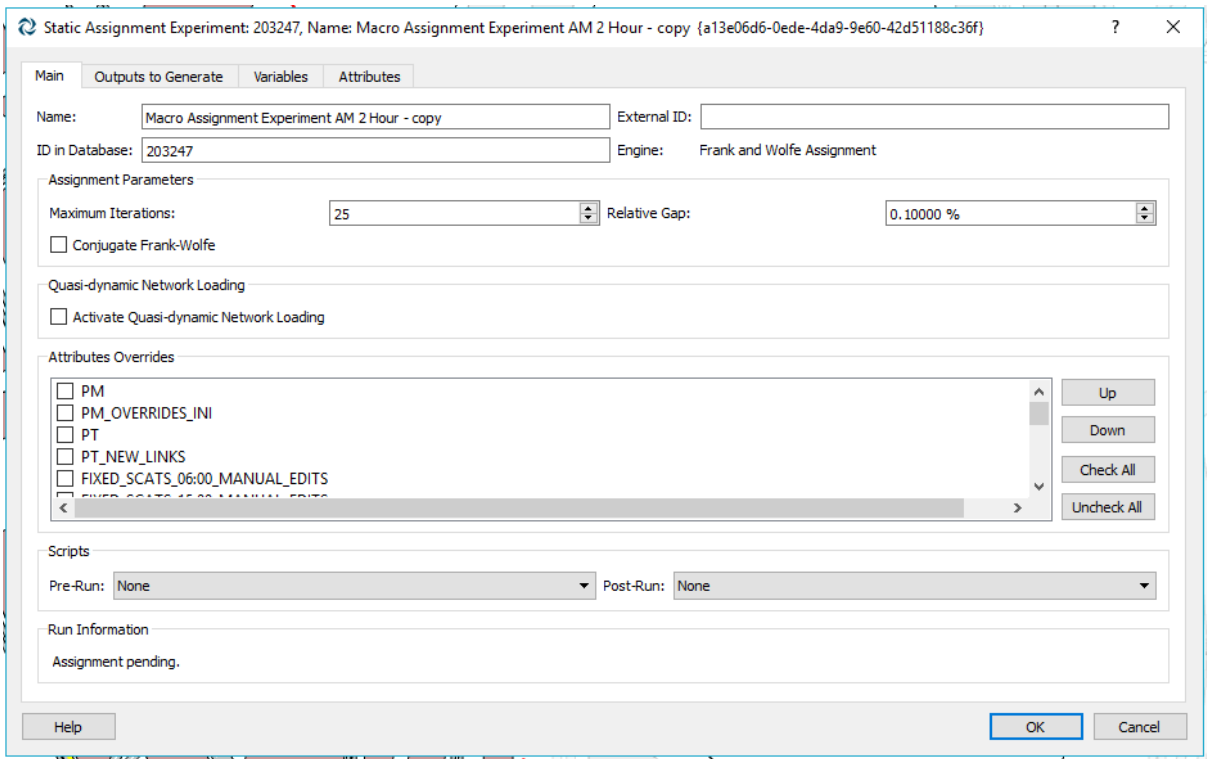
1. Macro Assignment of the Full Network



- The Traffic Demand “AM 2 Hour” comes from the OD Matrix “ANG_mf11” for cars. To create a more realistic demand, the values should be extrapolated for 6-10am.

- PTP 2016 CBD Bus Plan Base Layer – copy is an existing PT Plan with updated timetables for the 501 and 389 routes

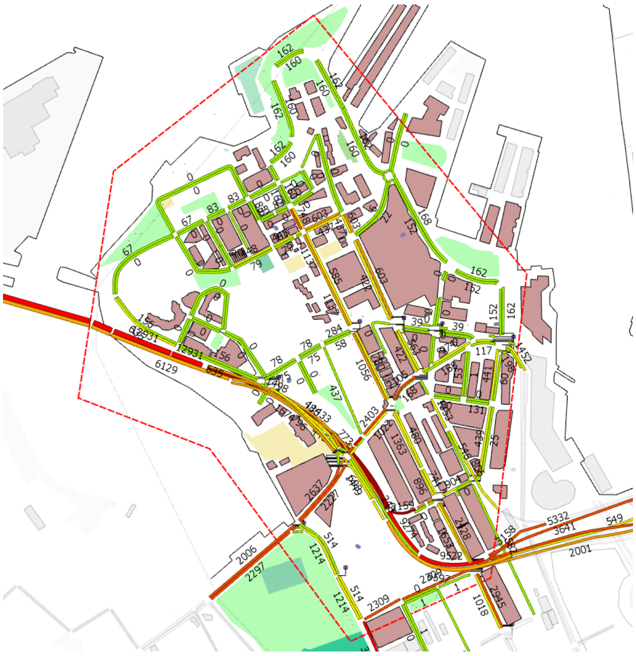


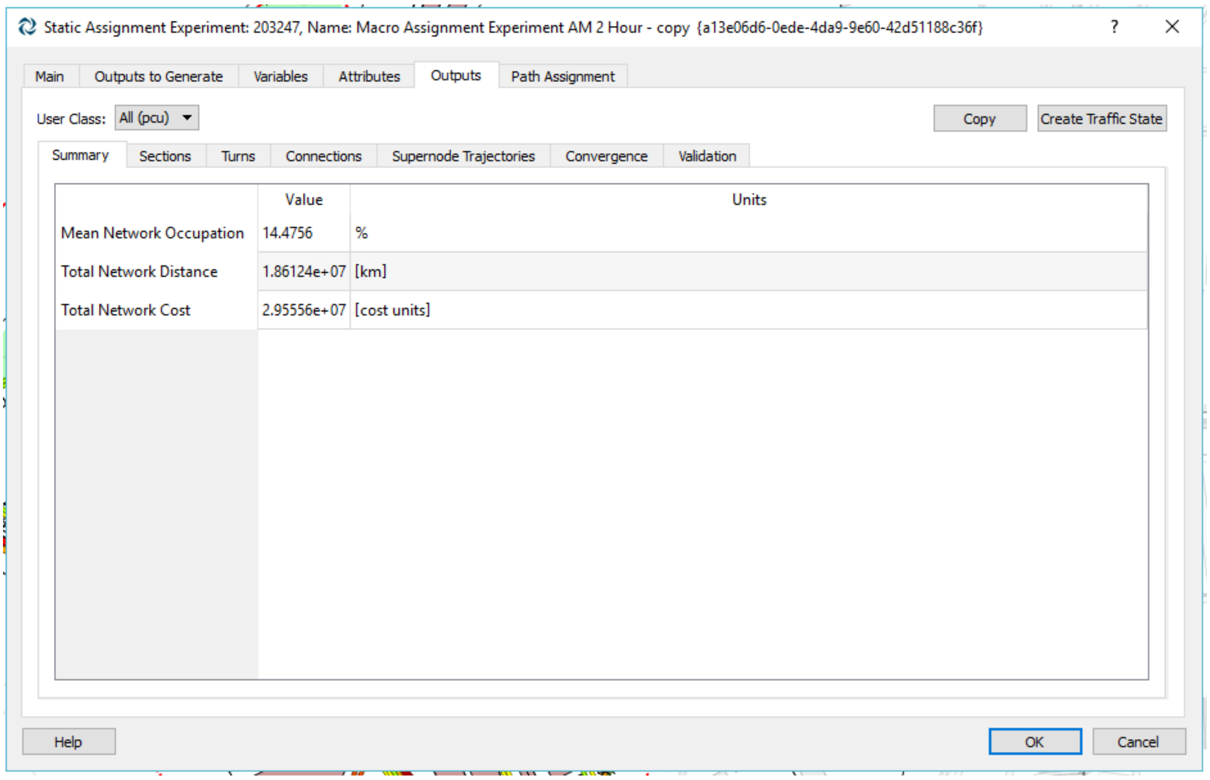


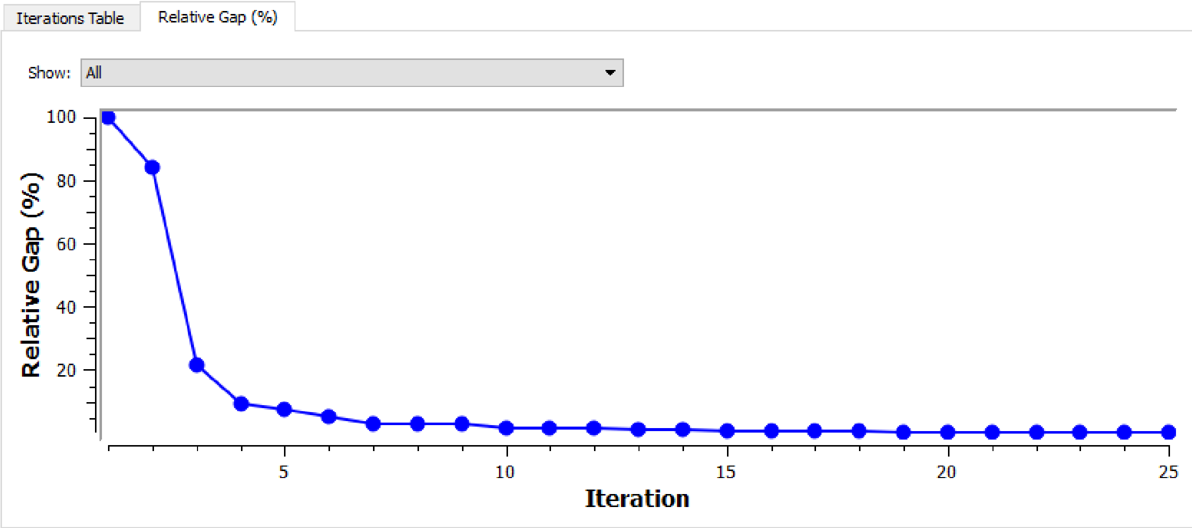
- Frank-Wolfe assignment method
- In the tab *Outputs to Generate*, the *Keep in Memory* option for Path Assignment has been made active.

Run time for this assignment: 0 h 31 m 1 s

After running the assignment, volumes are assigned to the full network. Below shows the volumes for the subnetwork.







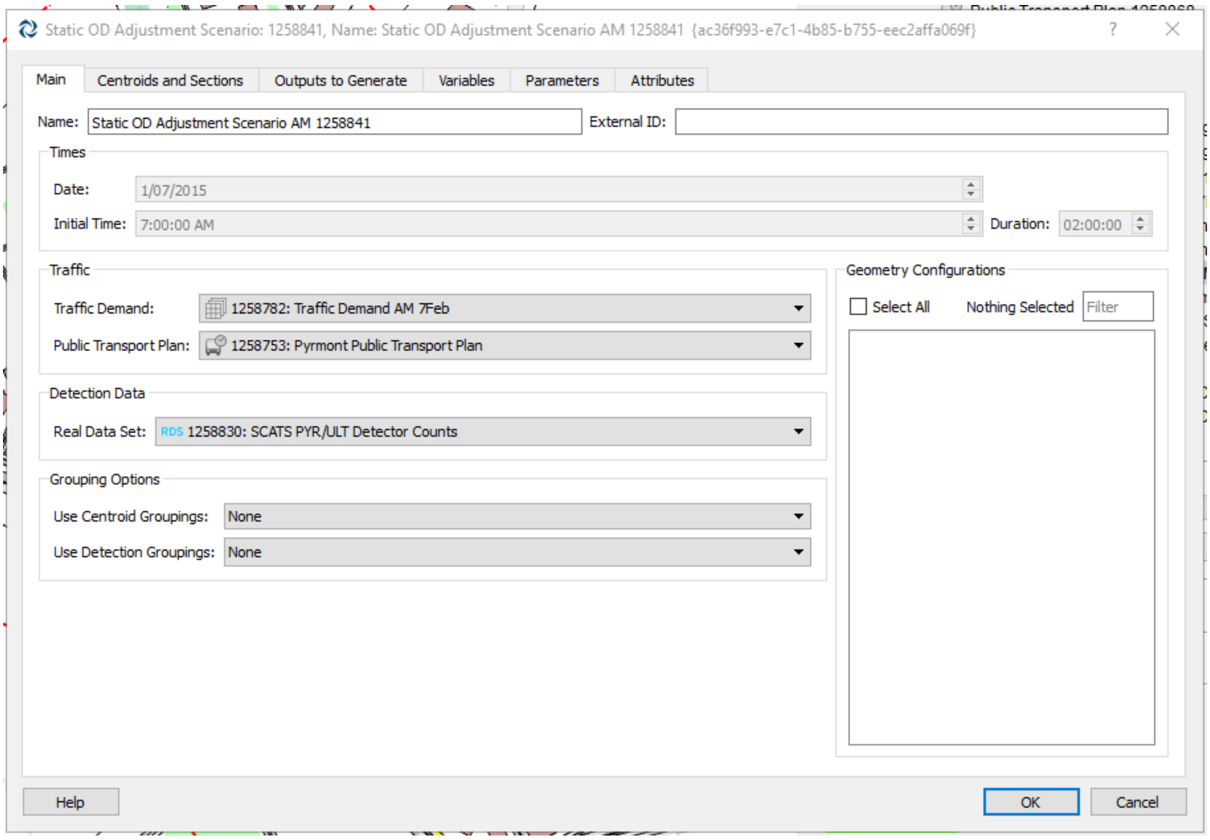
In the Pyrmont Subnetwork, generate a new static traversal matrix and add it to the traffic demand, “Traffic Demand AM 7Feb”.

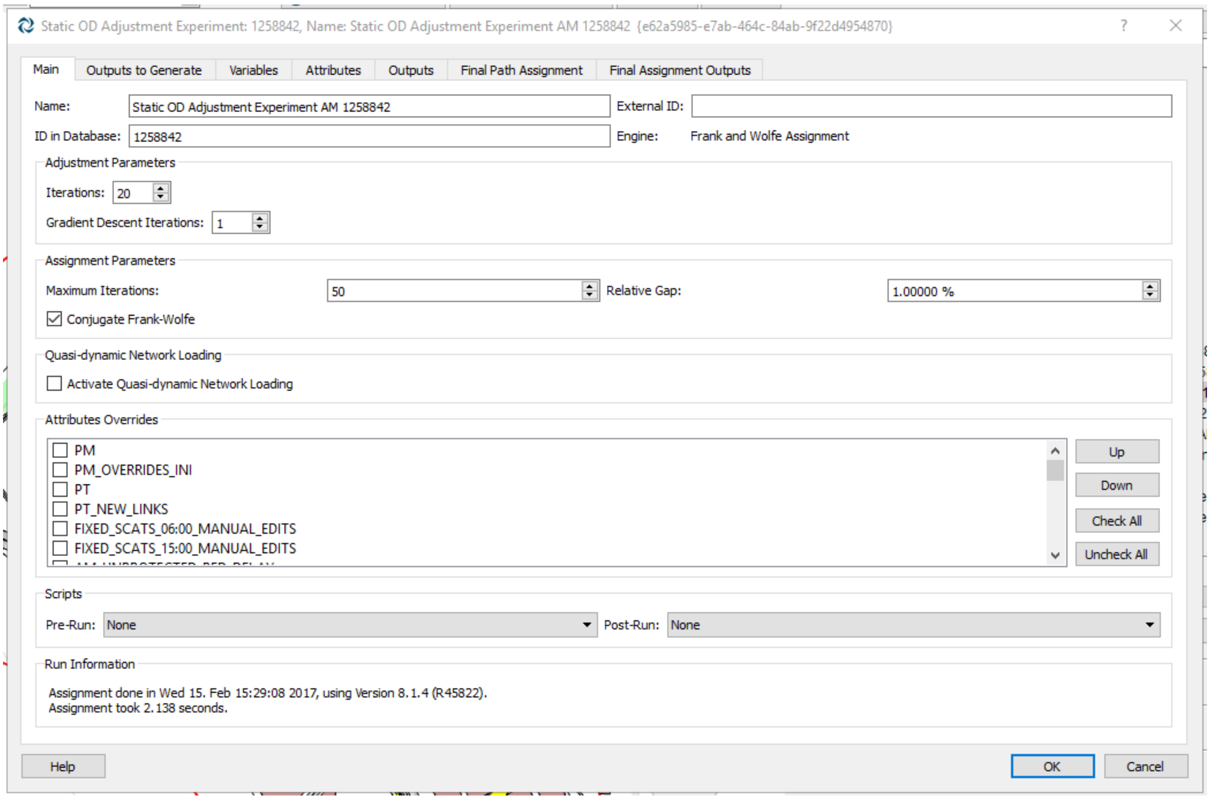
The extracted traversal matrix for the subnetwork contains 33 origins and 39 destinations.

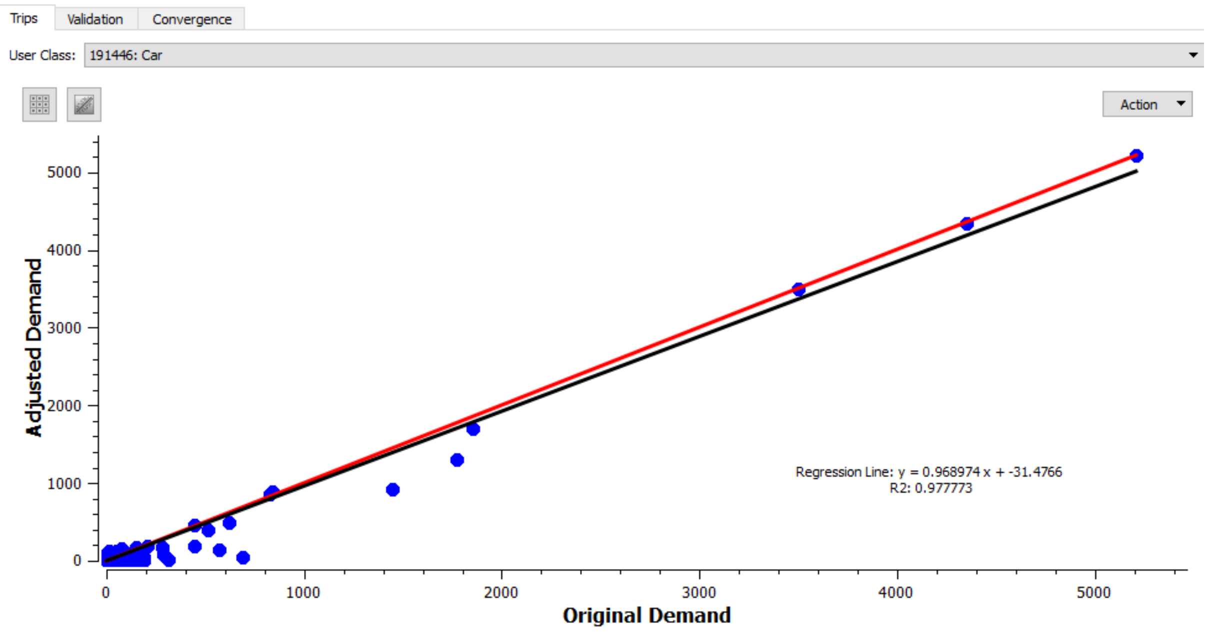
Retrieve the Real Data Set “SCATS PYR/ULT Detector Counts”

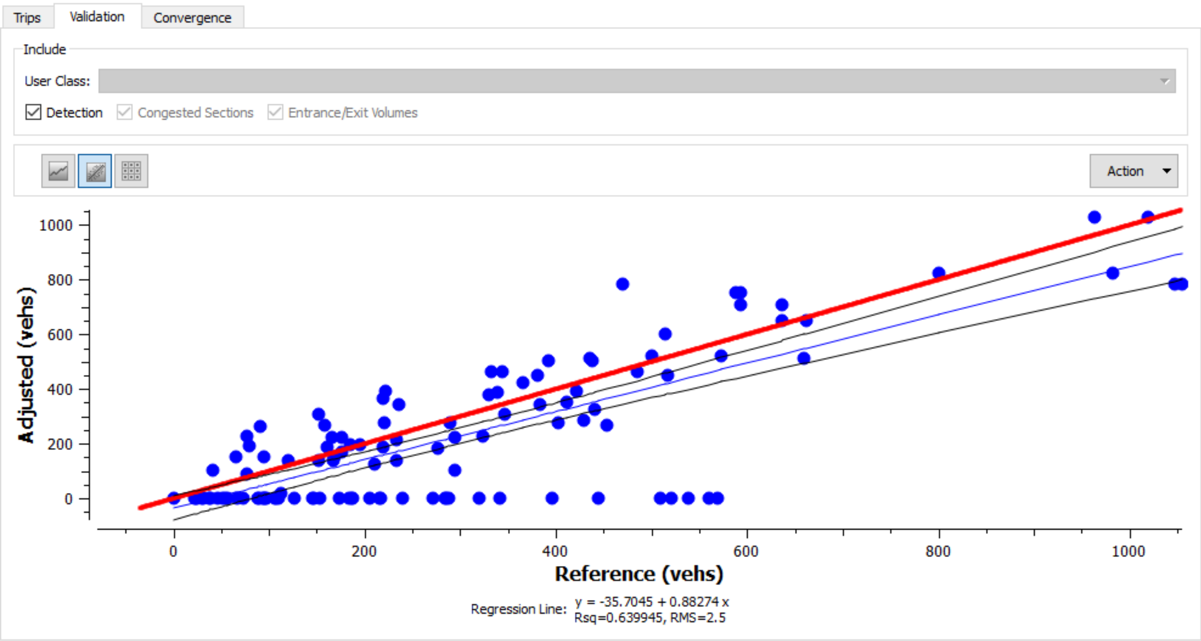
OD Adjustment Scenario

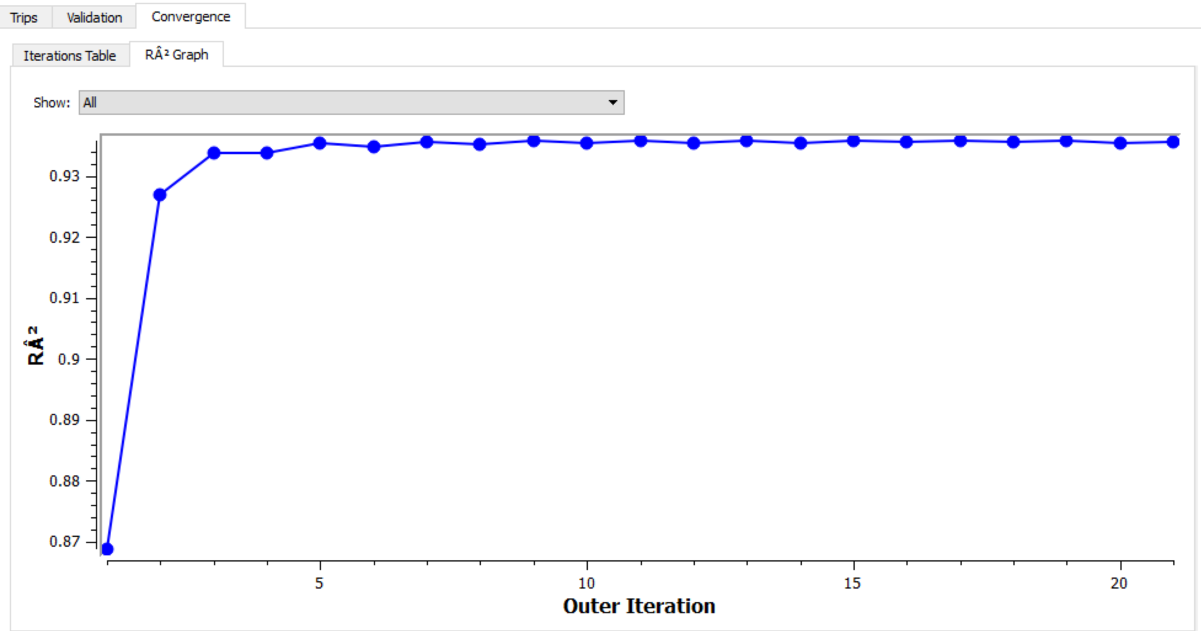
Run time: 0 h 0 m 14 s




Static OD Adjustment Experiment: 1258842, Name: Static OD Adjustment Experiment AM 1258842 {e62a5985-e7ab-464c-84ab-9f22d4954870}
Main
Outputs to Generate
Variables
Attributes
Outputs
Final Path Assignment
Final Assignment Outputs
Name:
Static OD Adjustment Experiment AM 1258842
External ID:
ID in Database:
1258842
Engine:
Frank and Wolfe Assignment
Adjustment Parameters
Iterations:
20
Gradient Descent Iterations:
1
Assignment Parameters
Maximum Iterations:
50
Relative Gap:
1.00000 %
Conjugate Frank-Wolfe
Quasi-dynamic Network Loading
Activate Quasi-dynamic Network Loading
Attributes Overrides
PM
PM_OVERRIDES_INI
PT
PT_NEW_LINKS
FIXED_SCATS_06:00_MANUAL_EDITS
FIXED_SCATS_15:00_MANUAL_EDITS
Up
Down
Check All
Uncheck All
Scripts
Pre-Run:
None
Post-Run:
None
Run Information
Assignment done in Wed 15. Feb 15:29:08 2017, using Version 8.1.4 (R45822).
Assignment took 2.138 seconds.
Help
OK
Cancel

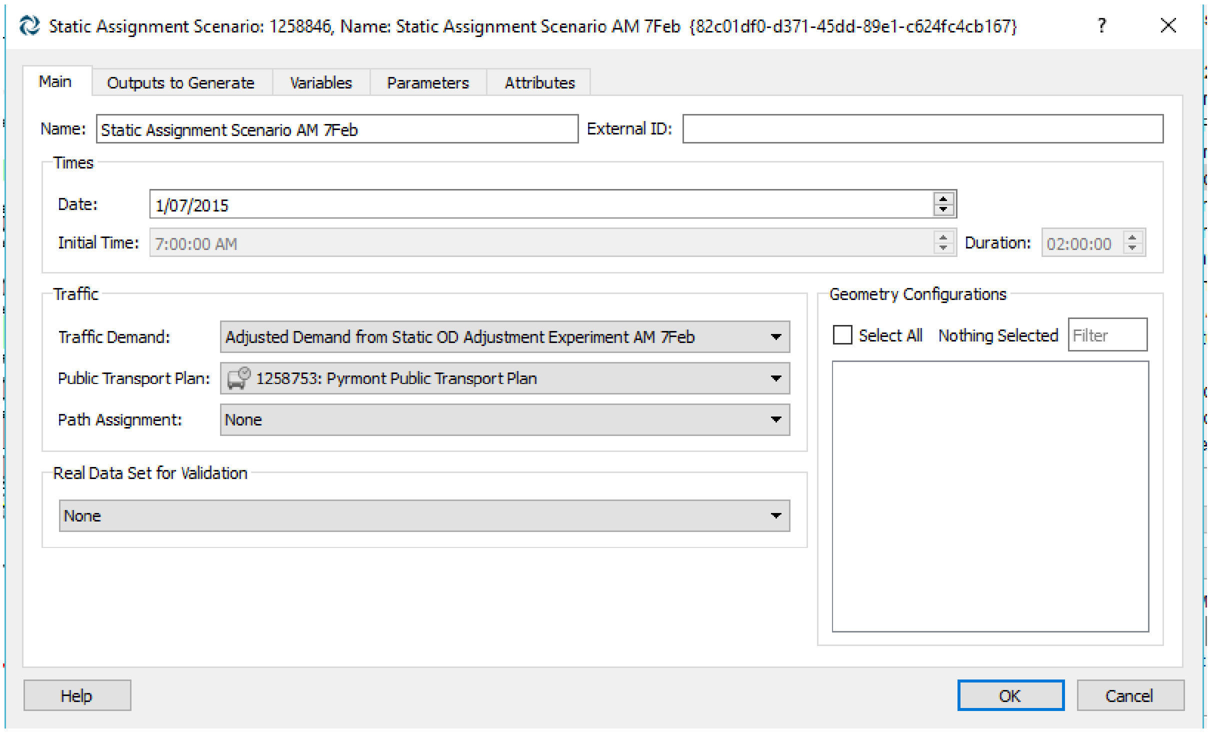

Trips
Validation
Convergence
User Class:
191446: Car
Action
Adjusted Demand
Original Demand
0
1000
2000
3000
4000
5000
Regression Line: y = 0.968974 x + -31.4766
R2: 0.977773

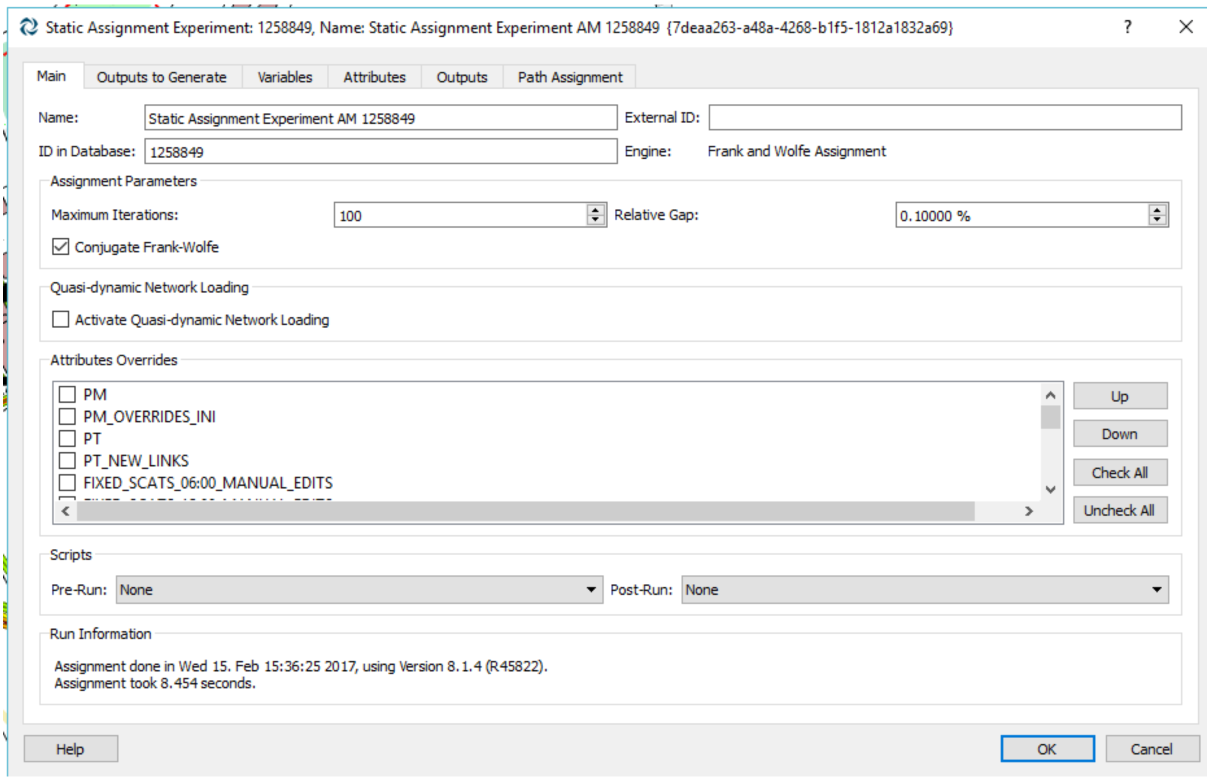


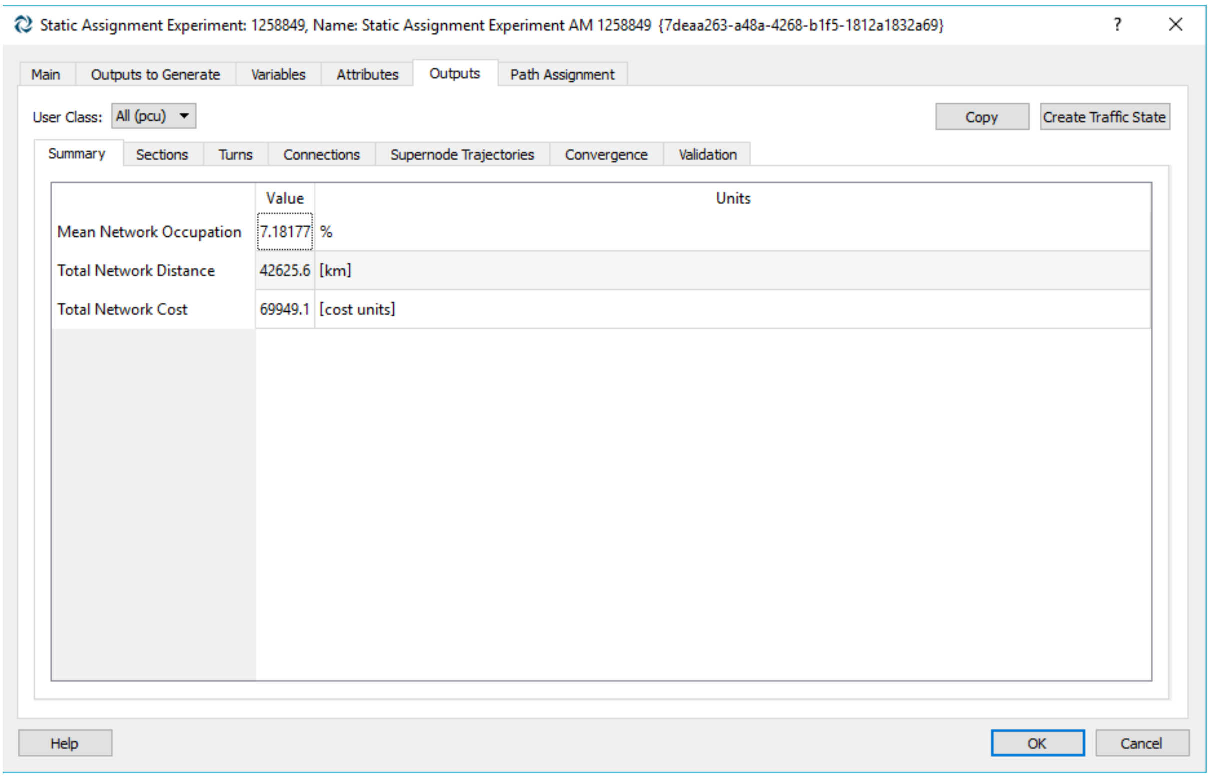


STA for the Subnetwork

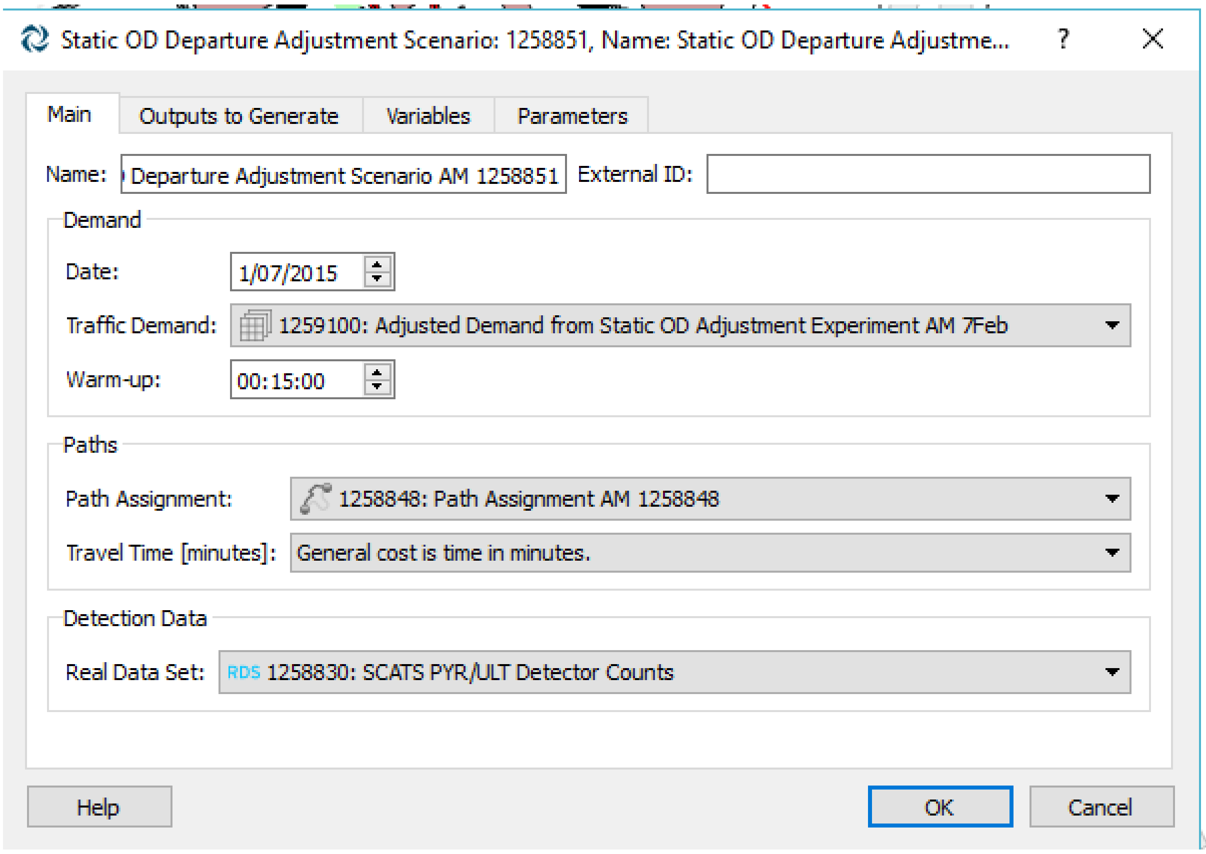
Run time: 0 h 0 m 8 s


Static Assignment Scenario: 1258846, Name: Static Assignment Scenario AM 7Feb {82c01df0-d371-45dd-89e1-c624fc4cb167}
Main
Outputs to Generate
Variables
Parameters
Attributes
Name: Static Assignment Scenario AM 7Feb
External ID:
Times
Date: 1/07/2015
Initial Time: 7:00:00 AM
Duration: 02:00:00
Traffic
Traffic Demand: Adjusted Demand from Static OD Adjustment Experiment AM 7Feb
Public Transport Plan: 1258753: Pyrmont Public Transport Plan
Path Assignment: None
Geometry Configurations
Select All
Nothing Selected
Filter
Real Data Set for Validation
None
Help
OK
Cancel


Static Assignment Experiment: 1258849, Name: Static Assignment Experiment AM 1258849 {7deaa263-a48a-4268-b1f5-1812a1832a69}
Main
Outputs to Generate
Variables
Attributes
Outputs
Path Assignment
Name: Static Assignment Experiment AM 1258849
External ID:
ID in Database: 1258849
Engine: Frank and Wolfe Assignment
Assignment Parameters
Maximum Iterations: 100
Relative Gap: 0.10000 %
Conjugate Frank-Wolfe
Quasi-dynamic Network Loading
Activate Quasi-dynamic Network Loading
Attributes Overrides
PM
PM_OVERRIDES_INI
PT
PT_NEW_LINKS
FIXED_SCATS_06:00_MANUAL_EDITS
Up
Down
Check All
Uncheck All
Scripts
Pre-Run: None
Post-Run: None
Run Information
Assignment done in Wed 15. Feb 15:36:25 2017, using Version 8.1.4 (R45822).
Assignment took 8.454 seconds.
Help
OK
Cancel

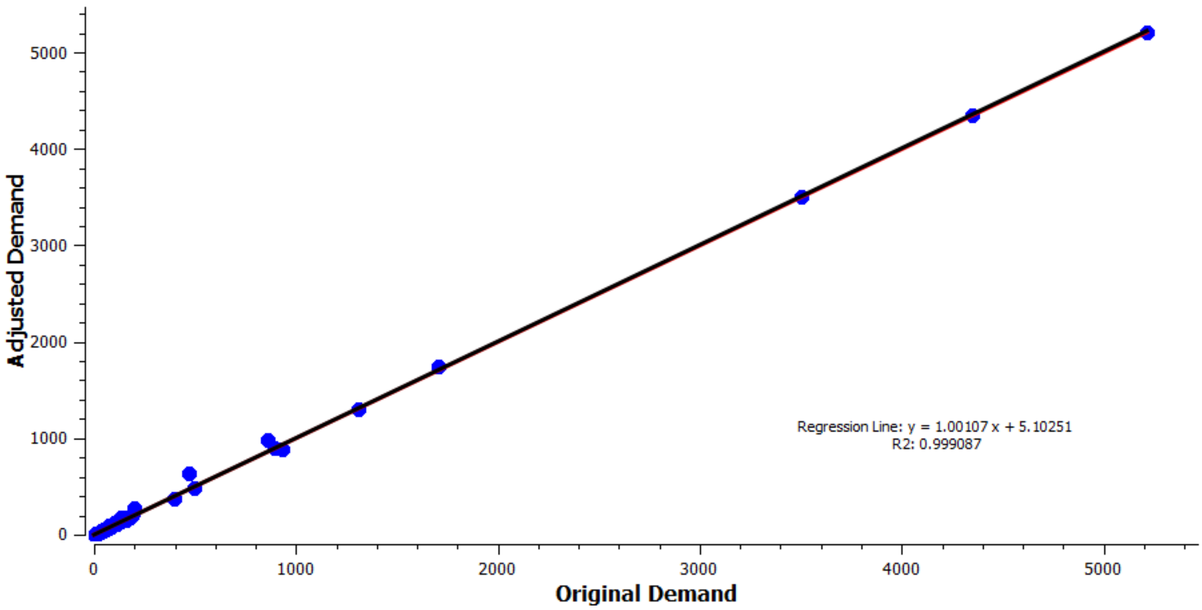

Static Assignment Experiment: 1258849, Name: Static Assignment Experiment AM 1258849 {7deaa263-a48a-4268-b1f5-1812a1832a69}
Main
Outputs to Generate
Variables
Attributes
Outputs
Path Assignment
User Class: All (pcu)
Copy
Create Traffic State
Summary
Sections
Turns
Connections
Supernode Trajectories
Convergence
Validation
Value
Units
Mean Network Occupation 7.18177 %
Total Network Distance 42625.6 [km]
Total Network Cost 69949.1 [cost units]
Help
OK
Cancel

OD Departure Adjustment

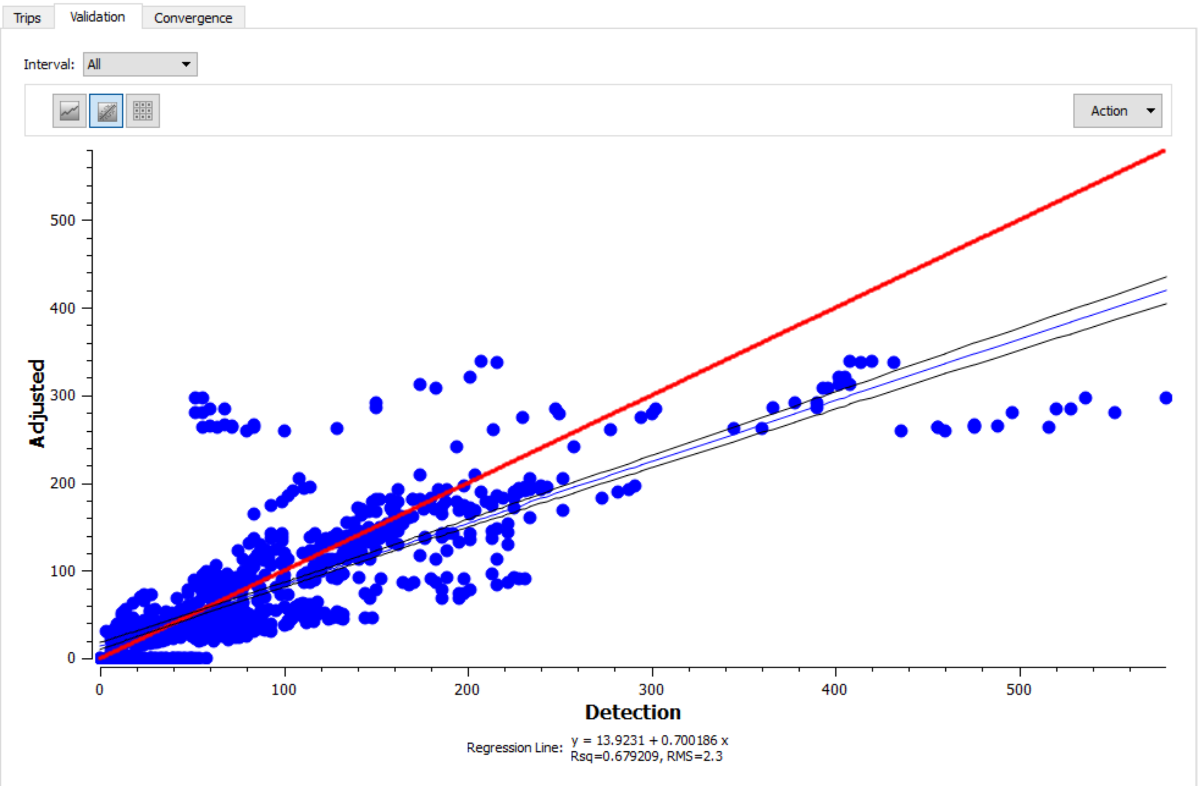


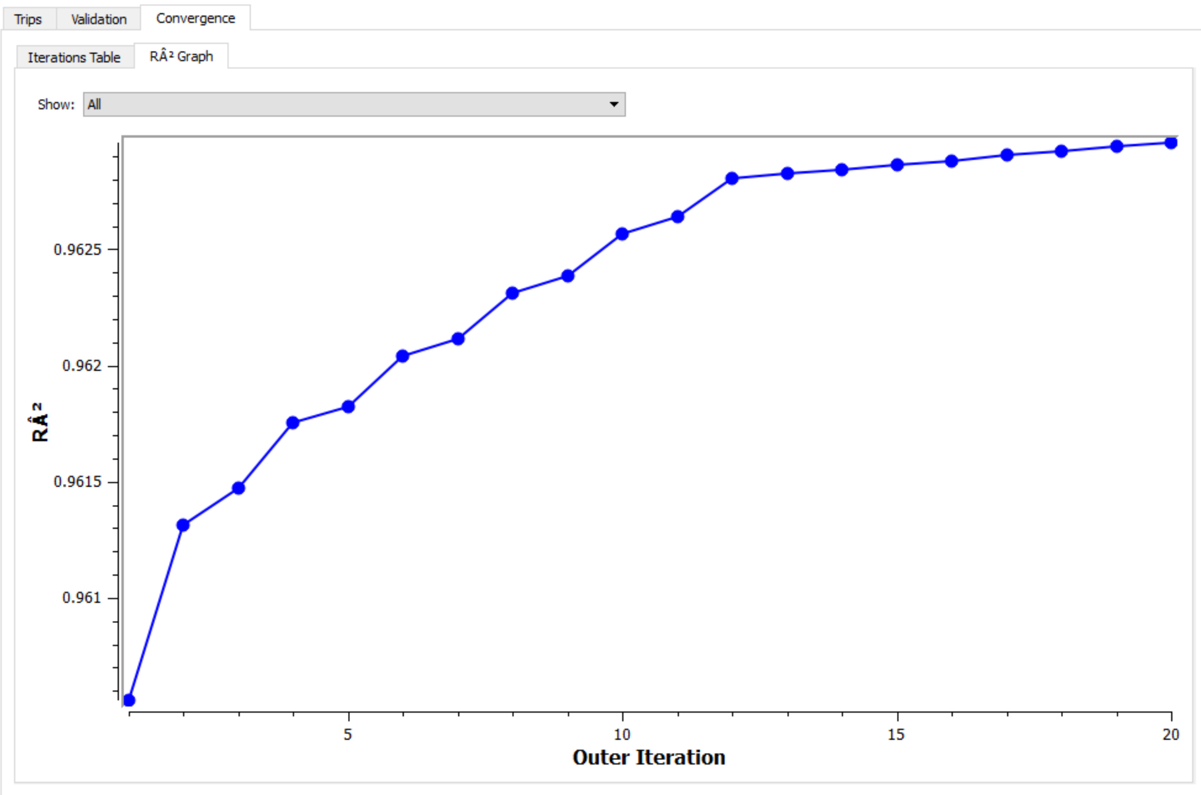
Run time: 0 h 0 m 10 s

Trips:

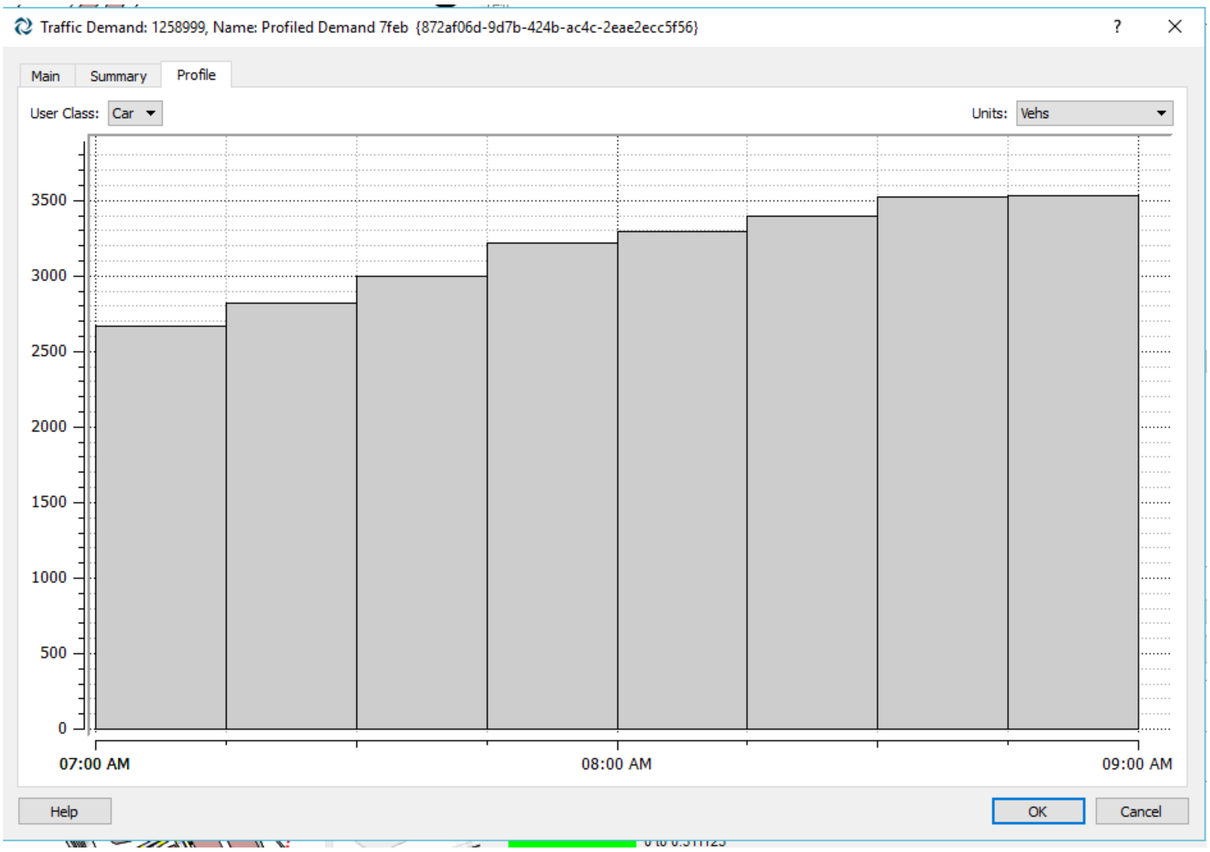


Validation:

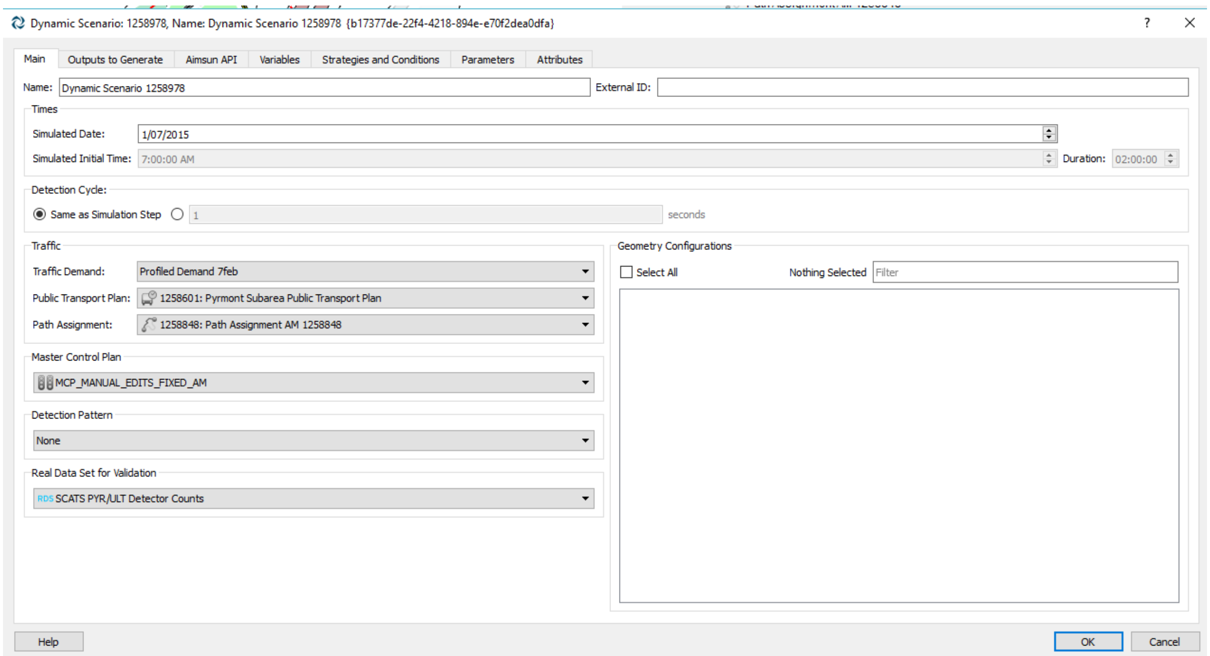

Trips
Validation
Convergence
Interval: All
Action
Adjusted
500
400
300
200
100
0
0
100
200
300
400
500
Detection
Regression Line: y = 13.9231 + 0.700186 x
Rsq=0.679209, RMS=2.3

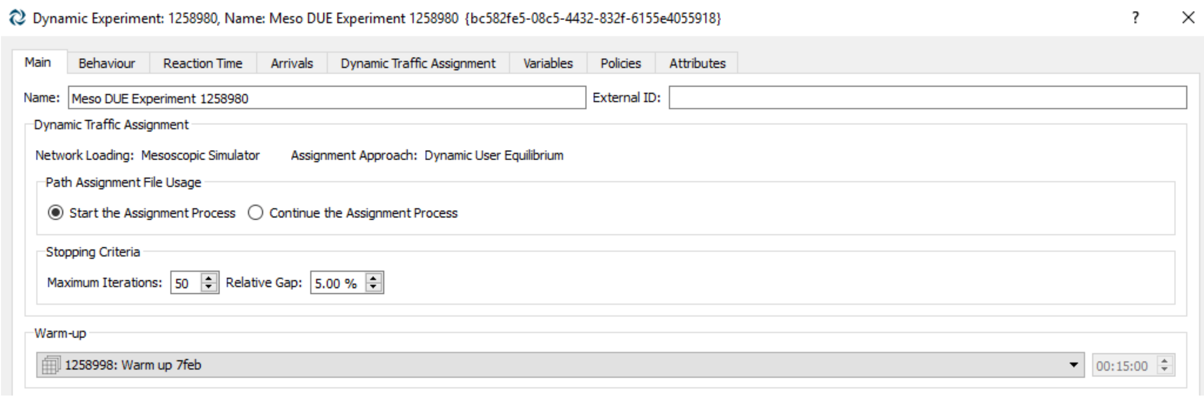

Trips
Validation
Convergence
Iterations Table
RÂ² Graph
Show: All
RÂ²
0.9625
0.962
0.9615
0.961
5
10
15
20
Outer Iteration

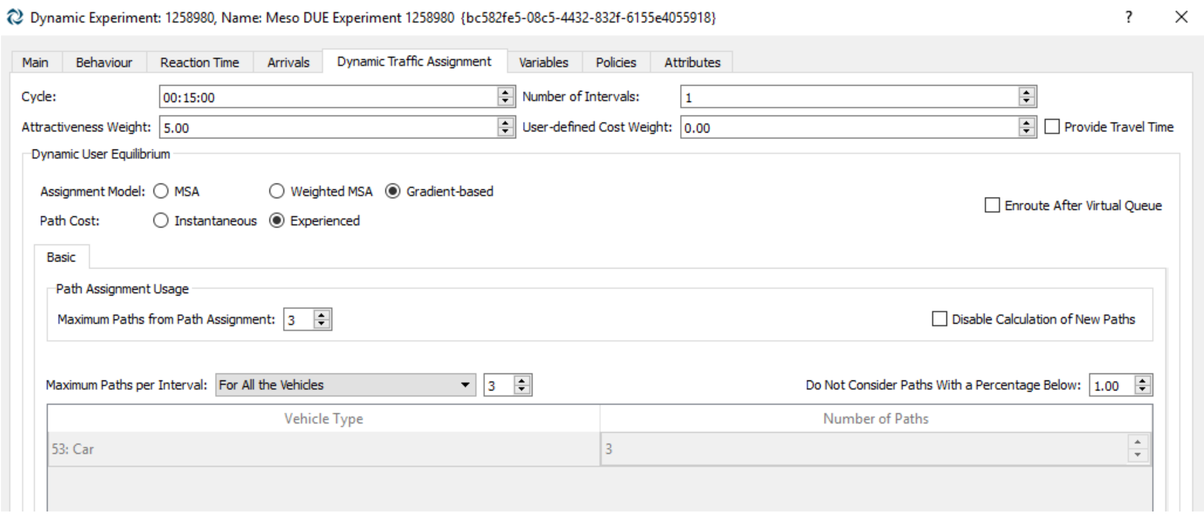
New Profiled Demand:

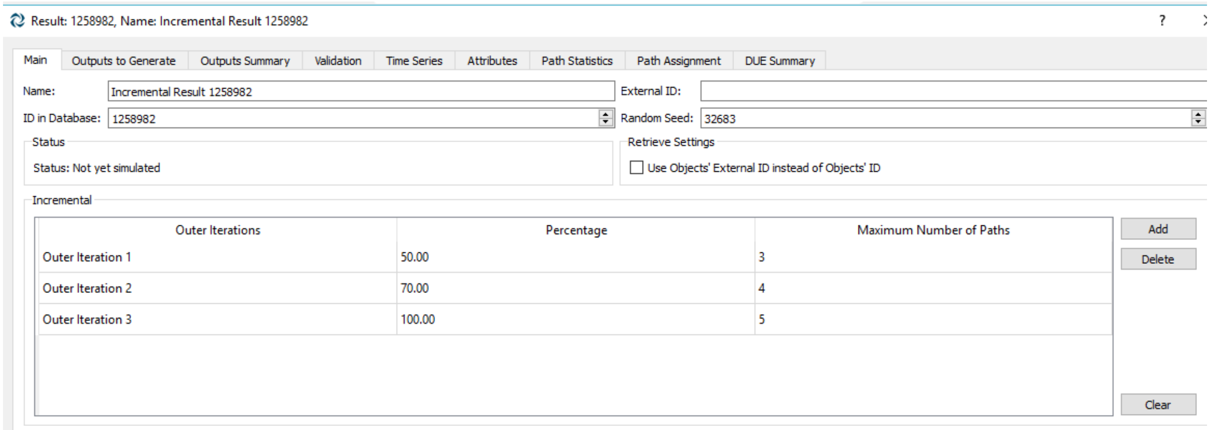


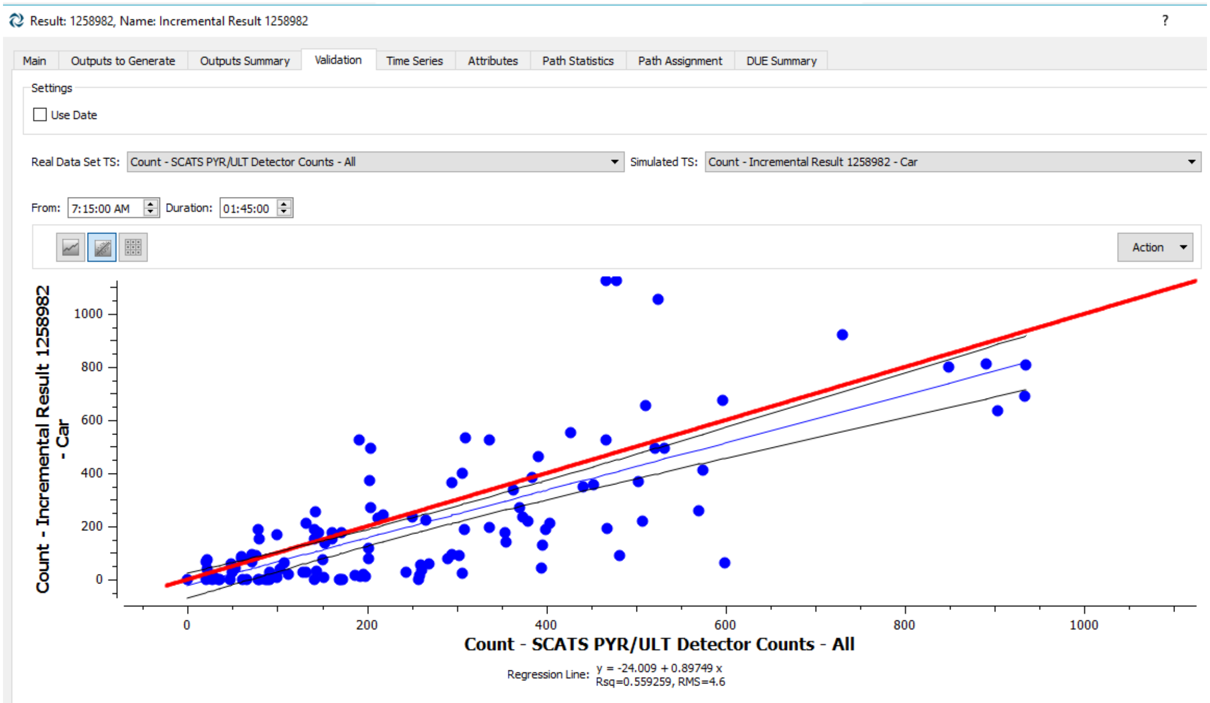
Mesoscopic Dynamic User Equilibrium Experiment



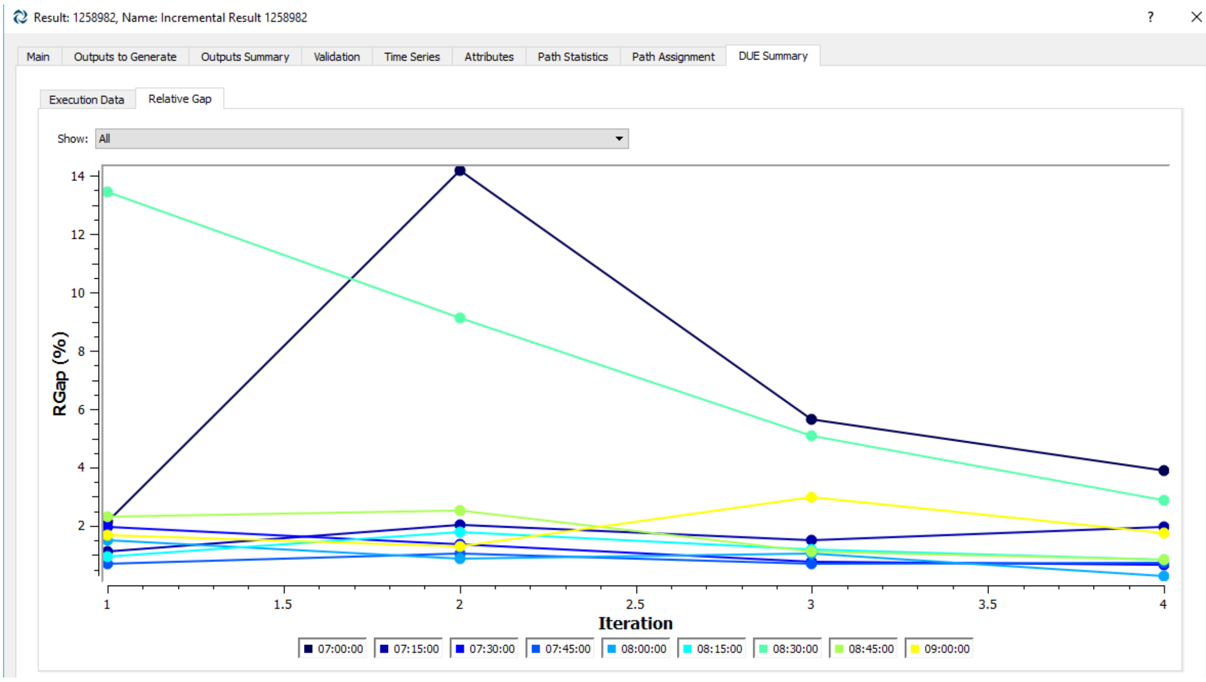

Dynamic Experiment: 1258980, Name: Meso DUE Experiment 1258980 {bc582fe5-08c5-4432-832f-6155e4055918}
Main
Behaviour
Reaction Time
Arrivals
Dynamic Traffic Assignment
Variables
Policies
Attributes
Name: Meso DUE Experiment 1258980
External ID:
Dynamic Traffic Assignment
Network Loading: Mesoscopic Simulator
Assignment Approach: Dynamic User Equilibrium
Path Assignment File Usage
Start the Assignment Process
Continue the Assignment Process
Stopping Criteria
Maximum Iterations: 50
Relative Gap: 5.00 %
Warm-up
1258998: Warm up 7feb
00:15:00


Dynamic Experiment: 1258980, Name: Meso DUE Experiment 1258980 {bc582fe5-08c5-4432-832f-6155e4055918}
Main
Behaviour
Reaction Time
Arrivals
Dynamic Traffic Assignment
Variables
Policies
Attributes
Cycle: 00:15:00
Number of Intervals: 1
Attractiveness Weight: 5.00
User-defined Cost Weight: 0.00
Provide Travel Time
Dynamic User Equilibrium
Assignment Model: MSA
Weighted MSA
Gradient-based
Path Cost: Instantaneous
Experienced
Enroute After Virtual Queue
Basic
Path Assignment Usage
Maximum Paths from Path Assignment: 3
Disable Calculation of New Paths
Maximum Paths per Interval: For All the Vehicles
3
Do Not Consider Paths With a Percentage Below: 1.00
Vehicle Type
Number of Paths
53: Car
3


Result: 1258982, Name: Incremental Result 1258982
Main
Outputs to Generate
Outputs Summary
Validation
Time Series
Attributes
Path Statistics
Path Assignment
DUE Summary
Name: Incremental Result 1258982
External ID:
ID in Database: 1258982
Random Seed: 32683
Status
Status: Not yet simulated
Retrieve Settings
Use Objects' External ID instead of Objects' ID
Incremental
Outer Iterations
Percentage
Maximum Number of Paths
Outer Iteration 1
50.00
3
Outer Iteration 2
70.00
4
Outer Iteration 3
100.00
5
Add
Delete
Clear



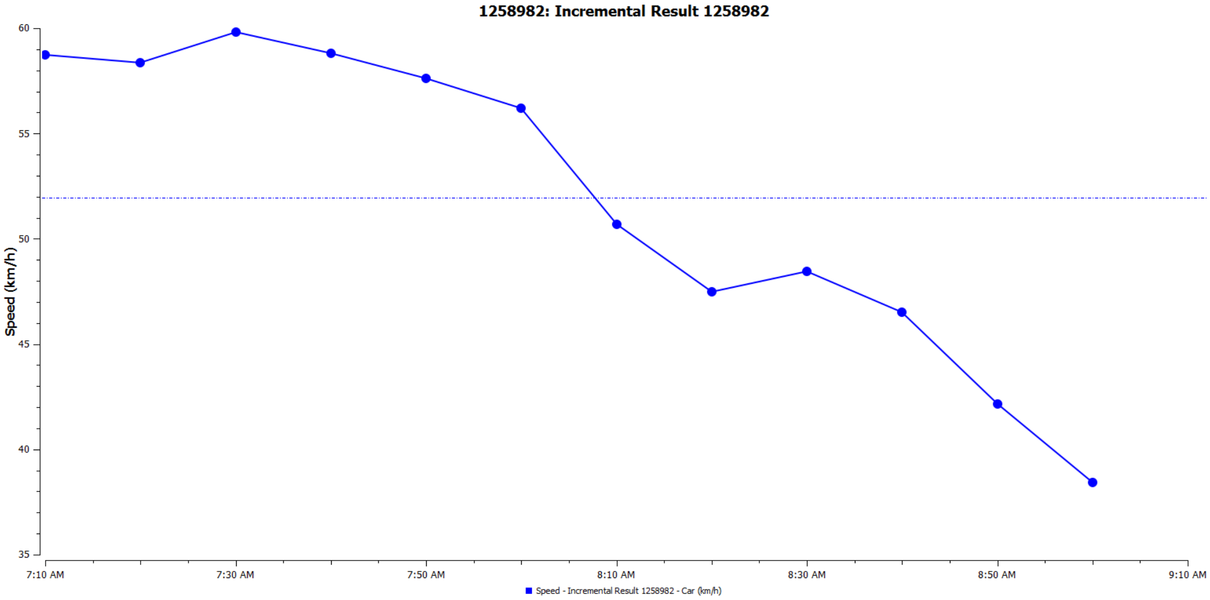
Result: 1258982, Name: Incremental Result 1258982
Main
Outputs to Generate
Outputs Summary
Validation
Time Series
Attributes
Path Statistics
Path Assignment
DUE Summary
Settings
Use Date
Real Data Set TS: Count - SCATS PYR/ULT Detector Counts - All
Simulated TS: Count - Incremental Result 1258982 - Car
From: 7:15:00 AM
Duration: 01:45:00
Action
Count - Incremental Result 1258982 - Car
Count - SCATS PYR/ULT Detector Counts - All
Regression Line: y = -24.009 + 0.89749 x
Rsq=0.559259, RMS=4.6



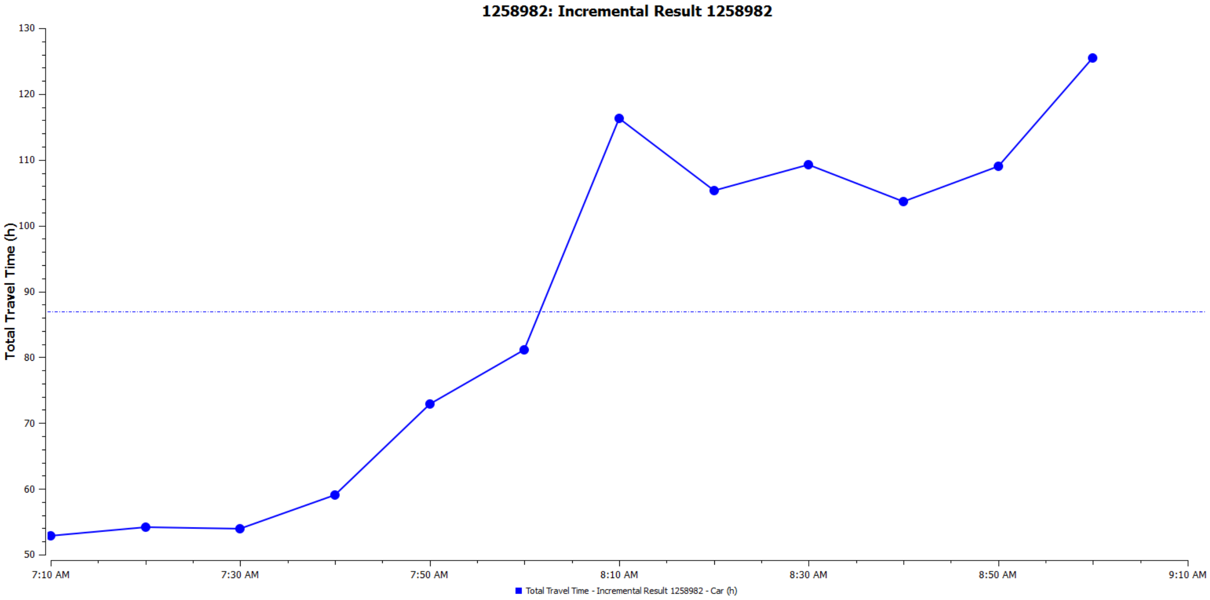
Result: 1258982, Name: Incremental Result 1258982
Main
Outputs to Generate
Outputs Summary
Validation
Time Series
Attributes
Path Statistics
Path Assignment
DUE Summary
Execution Data
Relative Gap
Show: All
RGap (%)
Iteration
07:00:00
07:15:00
07:30:00
07:45:00
08:00:00
08:15:00
08:30:00
08:45:00
09:00:00

Results & Discussion

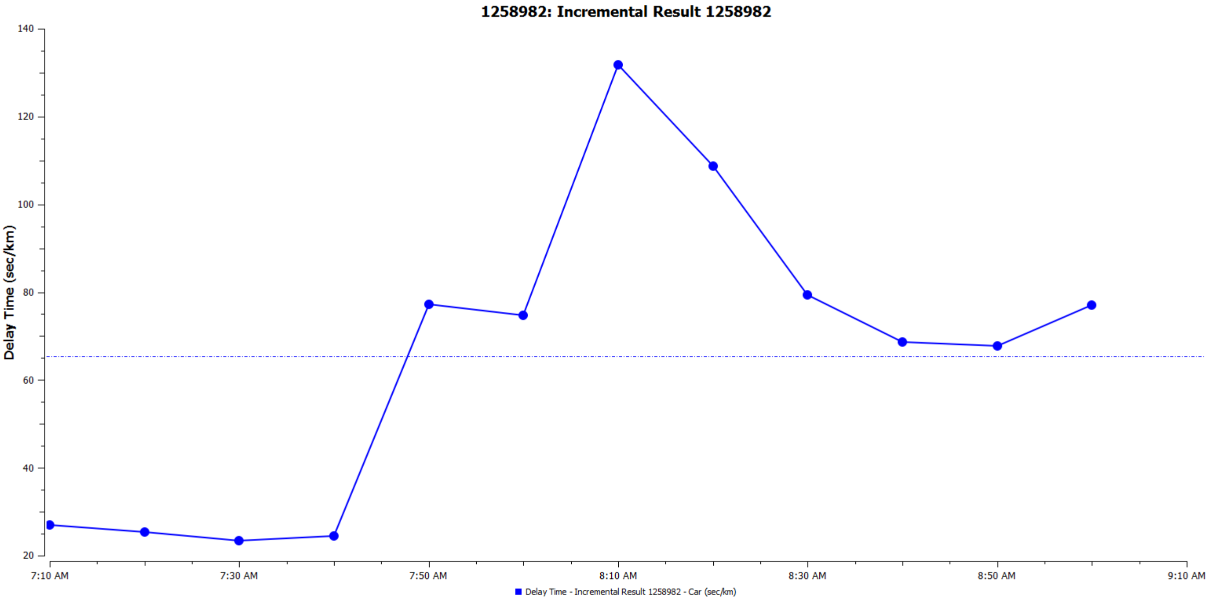
The following graphs are outputs from the Dynamic User Equilibrium experiment.



This shows the average speed for all vehicles that have left the system. This is calculated using the mean journey speed for each vehicle.

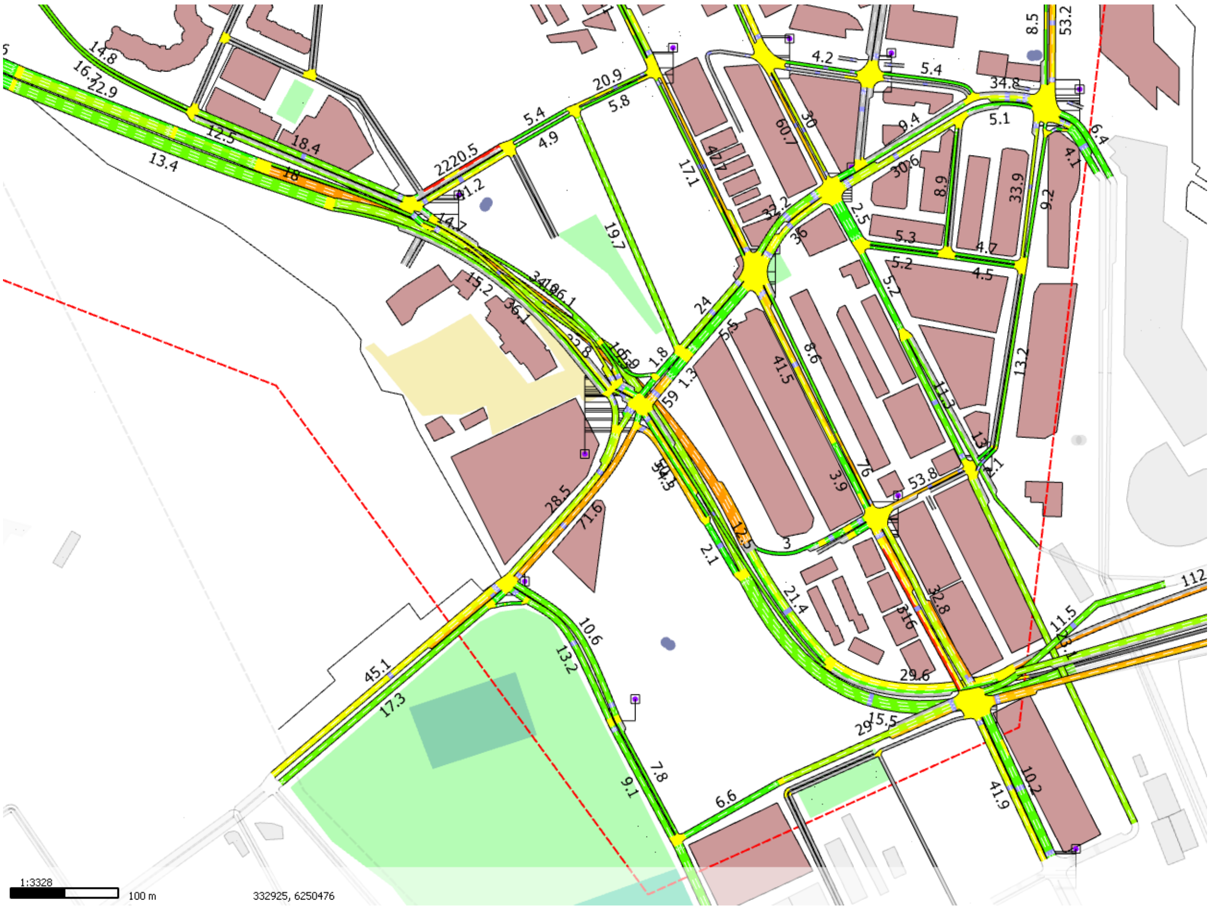


The total travel time experienced by all the vehicles that have crossed the network.



This graph shows the delay time per vehicle per kilometre. This is the difference between the expected travel time (the time it would take to traverse the system under ideal conditions) and the travel time. It is calculated as the average of all vehicles and then converted into time per kilometre.

The delay times and total travel times both peak at approximately 8am.

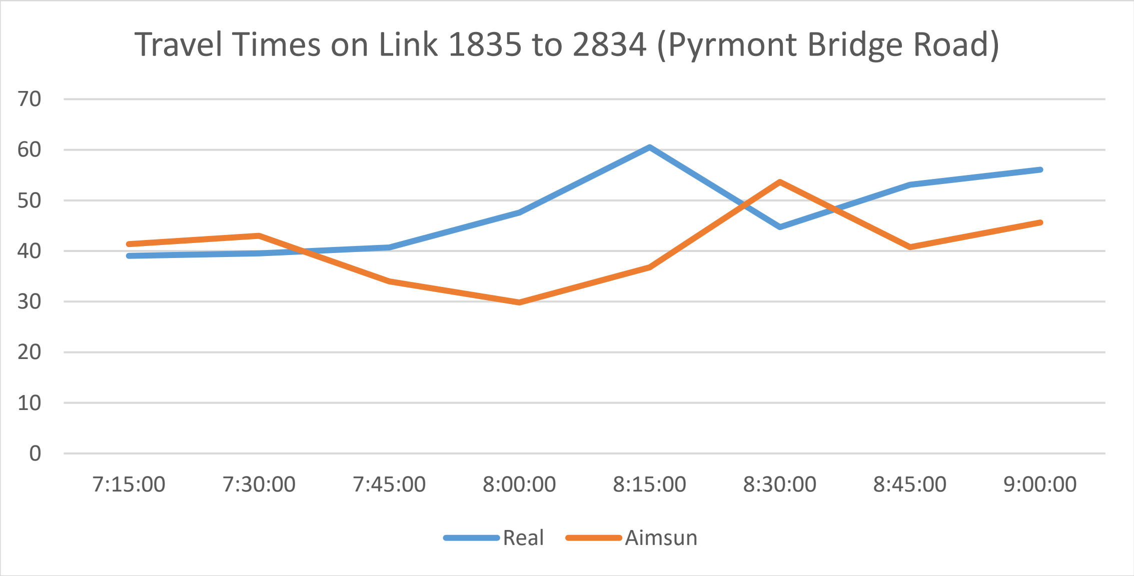


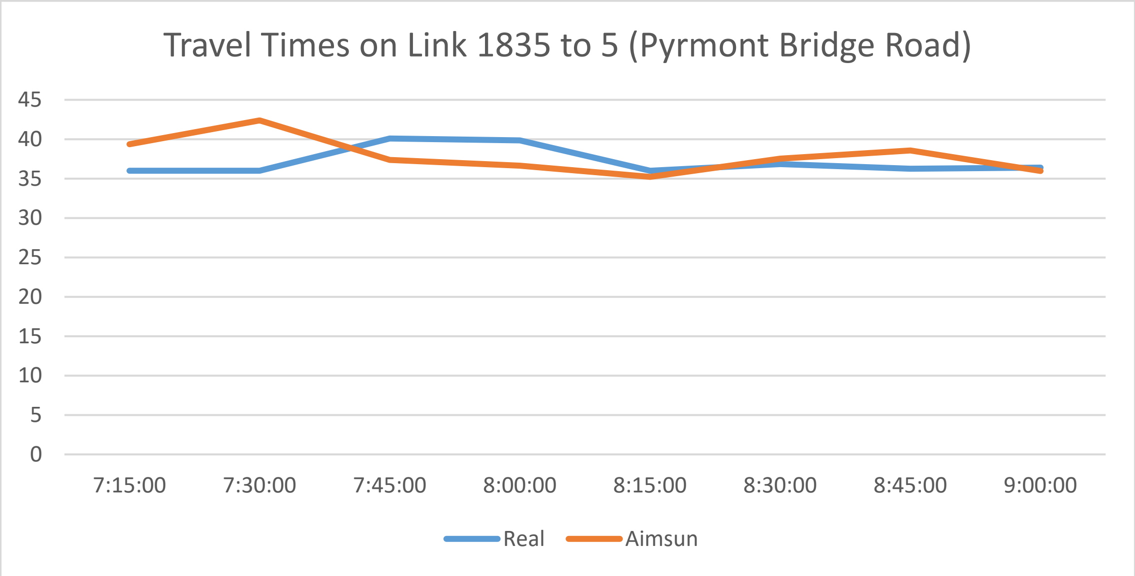
•

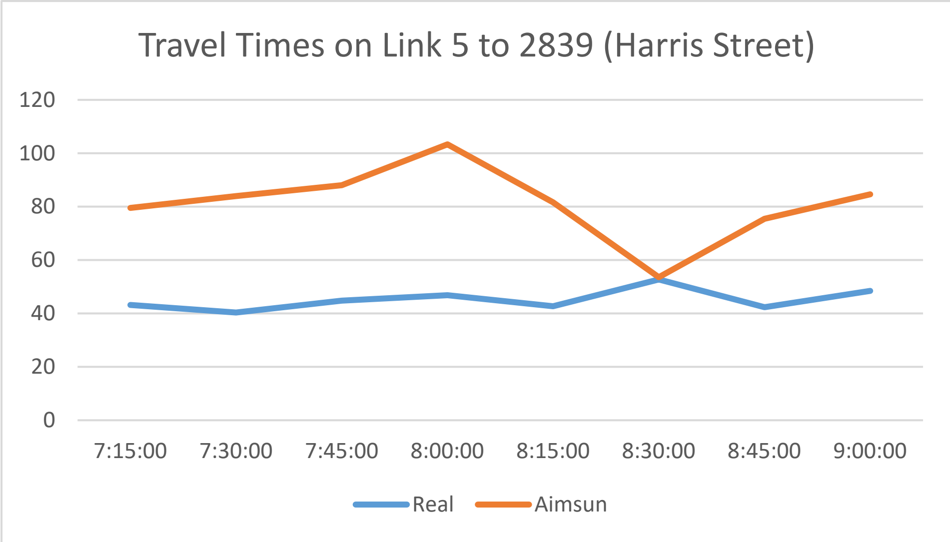
In this 9 o'clock snapshot, there are several areas of interest in the southern region of the study area:

- Major area of congestion along the inbound Western Distributor (coming from Anzac Bridge and heading towards the CBD), which peaks at 9 o'clock
- Unintuitive delays along Miller St near Jones St and towards the intersection of Harris St and Fig St

The following graphs compare the simulated outputs with the observed data along major roads. There are some sections with relatively close values, but there is much variation amongst the links.







Future Work

Suggestions from Timothy Lim, TSS-Transport Simulation Systems

- Visual sanity checks at each stage of the process
  - Compare the section volumes for the main used routes
  - Screenline count checks at major entrances into the study area
- Validation of the full network for models built from scratch
  - Generating outputs from an existing model and storing them as either a Real Data Set or as object attributes for comparison
- Individual detector counts are useful for dynamic experiments as they show the distribution of vehicles across lanes. For static assignment, section counts are more appropriate. If detector counts are used, every lane in the network would have to be calibrated. The algorithms struggle to adjust and match the counts to all detectors because there may be too much variance between the volumes.
  - Instead, section wide counts should be used to calibration the traffic flows. This should improve the R squared value after calibration.
- Flow profiles should be graphed to identify times of peak demand
  - Longer study time periods should be used to show greater variance of the demand
  - Since the demand given in the model is restricted for 2 hour periods, the demand can be extrapolated to longer periods.
- Another path assignment should be stored after the profiled demand and used to run a new Static Assignment
- Incremental Results in a Dynamic Experiment are used for really congested networks, where the demand needs to be gradually added.
- Simulated Travel Times for main routes, instead of sections, in a network (using the sub path function) can be used for comparison. They should be within ±15% of the observed values.

Other tasks:

- Updating road geometry for the full network
- Obtaining SCATS intersection signal information, section wide counts and turning movement counts. Using the section wide counts to calibrate will hopefully produce more accurate result.
- Extrapolating the OD matrix for a longer time period

Conclusion

The main challenges for this project were identifying appropriate data, formatting and pre-processing data to import into the software. In addition, the data must be using the same ID naming system at the objects existing in the model. The current outputs could be improved by using more appropriate data forms such as the section wide counts to calibrate, and produce more realistic outputs. However, it is clear that DTA is a much more appropriate tool to use to capture time variance than STA.

1. References

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3. Mihaita A.S., Mocanu S., Lhoste, P., "Probabilistic analysis of a class of continuous-time stochastic switching systems with event-driven control", European Journal of Automation (JESA), July 2016.
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5. Monticolo, D. Mihaita A.S. "A multi Agent System to Manage Ideas during Collaborative Creativity Workshops", International Journal of Future Computer and Communication (IJFCC), vol 3., nr 1, February 2014, P66-71, (extended version of the paper presented in ICFCC 2013).
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8. Wen Tao, Mihaita A.S., Nguyen Hoang, Cai Chen, Integrated Incident decision support using traffic simulation and data-driven models. Transportation Research Board 97th Annual Meeting (TRB 2018), Washington D.C., January 7-11, 2018.

9. Mihaita A. S., Tyler Paul, Wall John, Vecovsky Vanessa, Cai Chen, Positioning and collision alert investigation for DSRC-equipped light vehicles through a case study in CITI, 24th World Congress on Intelligent Transportation Systems (ITSWC 2017), Montreal, Canada, 29 October - 2 November 2017.
10. Mihaita A. S, Cai Chen, Chen Fang, Event-triggered control for improving the positioning accuracy of connected vehicles equipped with DSRC, International Federation of Automatic Control World Congress (IFAC WC 2017), 9-14 July 2017, Toulouse, France.
11. Mihaita A. S, Tyler Paul, Menon Aditya, Wen Tao, Ou Yuming, Cai Chen, Chen Fang, "An investigation of positioning accuracy transmitted by connected heavy vehicles using DSRC", Transportation Research Board 96th Annual Meeting (TRB 2017), Washington D.C., January 8-12, Paper number 17-03863, 2017, https://pubsindex.trb.org/view/2017/C/1438533.
12. Mihaita A. S., Benavides, M., Camargo, M., "Integrating a mesoscopic traffic simulation model and a simplified NO2 estimation model", 23rd World Congress on Intelligent Transportation Systems (ITSWC 2016), Melbourne, Australia, 10-14 October 2016.
13. Mihaita A.S., Camargo, M., Lhoste, P. , " Evaluating the impact of the traffic reconfiguration of a complex urban intersection ", 10th International Conference on Modelling, Optimization and Simulation (MOSIM 2014), Nancy, France, 5-7 November 2014 (accepted on 18th of July 2014).
14. Mihaita A.S., Camargo, M., Lhoste, P. "Optimization of a complex urban intersection using discrete-event simulation and evolutionary algorithms", International Federation of Automatic Control World Congress (IFAC WC 2014), Cape Town, Africa, 24-29 August 2014.
15. Issa, F., Monticolo, D., Gabriel, A. , Mihaita, A.S., "An Intelligent System based on Natural Language Processing to support the brain purge in the creativity process", IAENG International Conference on Artificial Intelligence and Applications (ICAIA 2014), Hong Kong, 12-14 March, 2014.
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18. Mihaita A. S., Mocanu S., "An Energy Model for the Event-Based Control of a Switched Integrator", International Federation of Automatic Control World Congress (IFAC WC 2011), Milano, September 2011.