ABM2+ Traffic Assignment

SOLA assignment

The traffic assignment is a 15-class assignment with generalized cost on links and BPR-type volume-delay functions that include capacities on links and at intersection approaches. The assignment is run using the fast-converging Second-Order Linear Approximation (SOLA) method in Emme to a relative gap of $5x10^{-4}$. The per-link fixed costs include toll values and operating costs which vary by vehicle class. Trip tables are in vehicles and the resulting network flows (volau) are in PCE.

The 15 vehicle classes are listed below:

Name	PCE	# of Classes
SOV non transponder by values of time (L, M, H)	1	3
SOV transponder by values of time (L, M, H)	1	3
SR2 by values of time (L, M, H)	1	3
SR3+ by values of time (L, M, H)	1	3
Light truck	1.3	1
Medium truck	1.5	1
Heavy truck	2.5	1

Generalized cost and Values-of-Time (VOT)

In SANDAG ABM, trip demand by vehicle class is assigned to the roadway network based on the shortest path or lowest generalized cost. Generalized cost is the sum of the travel time, operating costs, and toll values, where applicable. The operation cost includes fuel and maintenance costs. Both operating costs and toll values are calculated based on mileage and vary by the horizon year. The former is defined in parametersByYears.csv in the input folder. The latter is imported into the EMME database and saved in the extra attribute of @toll_tod.

To calculate the generalized cost, dollar values are first converted to time, through VOTs of $8.81, $18, and $85 per hour representing 33, 66, and 99 percentiles for the low, medium and high-income groups, respectively; and then added up to the travel time (see the formula below). The VOTs are 2010 based values.

$$Generalied\ cost = travel\ time\ + \frac{(operating\ cost + toll\ cost\ if\ applicaple)}{VOT\ by\ income\ group}$$

Volume Delay Function (VDF)

The volume-delay functions are specified as open-ended algebraic expressions supporting standard functions. The VDF functions for SANDAG are a modified BPR of the form:

$$T_0 * \left(1.0 + ALPHA_1 * \left(\frac{FLOW + PRELOAD}{CAPACITY}\right)^{Beta_1}\right) +$$

$$\frac{CYCLE}{2} * (1 - GC)^2 * (1.0 + ALPHA_2 * \left(\frac{FLOW + PRELOAD}{INT\_CAPACITY}\right)^{Beta_2})$$

Where

- T_0 is the free-flow travel time along the link in minutes
- $ALPHA_1$, $BETA_1$, $ALPHA_2$ and $BETA_2$ are BPR calibration terms
- FLOW is the assigned flow from the traffic demand in PCEs
- PRELOAD is the background volume from transit vehicles in PCEs
- CAPACITY is the link mid-block capacity and INT_CAPACITY is the total intersection approach capacity in PCEs
- CYCLE is the signal cycle length in minutes
- GC is the green-to-cycle length for the link approach

The attribute keyword for FLOW is volau.

The attribute for the background traffic PRELOAD is volad.

- This is calculated from the transit itineraries, their frequency, and the length of the period and is also stored in link data 2 (ul2)

Per-link attributes:

- T_0: link data 1 (ul1)
- CAPACITY: link data 2 (ul3)
- GC: @green_to_cycle, which is cross-referenced by el1
- INT_CAPACITY: @capacity_inter, which is cross-referenced by el3

Global parameters (small subset of values for all links):

- CYCLE, either 1.25, 1.5, 2.0 or 2.5
- $ALPHA_1$, always 0.8
- $BETA_1$, always 4
- $ALPHA_2$, either 6.0 or 4.5
- $BETA_2$, always 2

With the global parameters, there are a total of 6 volume delay functions:

- fd10 for freeways and links which do not end at an intersection

$$ul1 * \left(1.0 + 0.8 * \left(\frac{volau + volad}{ul3}\right)^4\right)$$

- fd20 for local collector and lower intersection and stop controlled approaches

$$ul1 * \left(1.0 + 0.8 * \left(\frac{volau + volad}{ul3}\right)^4 + \frac{1.25}{2} * (1 - el1)^2 * \left(1 + 4.5 * \left(\frac{volau + volad}{el3}\right)^2\right)\right)$$

- fd21 for collector intersection approaches

$$ul1 * \left(1.0 + 0.8 * \left(\frac{volau + volad}{ul3}\right)^4 + \frac{1.5}{2} * (1 - el1)^2 * \left(1 + 4.5 * \left(\frac{volau + volad}{el3}\right)^2\right)\right)$$

- fd22 for major arterial and major or prime arterial intersection approaches

$$ul1 * \left(1.0 + 0.8 * \left(\frac{volau + volad}{ul3}\right)^4 + \frac{2.0}{2} * (1 - el1)^2 * \left(1 + 4.5 * \left(\frac{volau + volad}{el3}\right)^2\right)\right)$$

- fd23 for primary arterial intersection approaches

$$ul1 * \left(1.0 + 0.8 * \left(\frac{volau + volad}{ul3}\right)^4 + \frac{2.5}{2} * (1 - el1)^2 * \left(1 + 4.5 * \left(\frac{volau + volad}{el3}\right)^2\right)\right)$$

- fd24 for metered ramps

$$ul1 * \left(1.0 + 0.8 * \left(\frac{volau + volad}{ul3}\right)^4 + \frac{2.5}{2} * (1 - el1)^2 * \left(1 + 6.0 * \left(\frac{volau + volad}{el3}\right)^2\right)\right)$$

Convergence criteria of traffic assignment

The default SANDAG ABM assignment is run using a convergence criterion of $5x10^{-4}$. A convergence test study was conducted for the ABM 2+ peer review – TAC 2020. The report can be accessed at *https://github.com/SANDAG/ABM/wiki/files/convergence_test_report.pdf*.

The study compared convergence criteria of $5x10^{-4}$ and $1x10^{-4}$ as the stopping criteria for the 2016 scenarios. It was concluded that the difference in the accuracy between the two stop criteria is not significant. However, model run time increased by four hours when reducing the convergence criteria from of $5x10^{-4}$ and $1x10^{-4}$.