Steps to Setup and Run the Trip-Based Model (beginning with c23q2)

# What’s New

* A new file (Database\batch\_file.yaml) is used to provide arguments to the batch files that perform trip generation, run the full model, and perform transit assignment.
* The setup incudes a full integration of select link analysis procedures with the SOLA assignment.
* The procedures to update DISTR and M01 files have been rewritten in R and are called automatically when the full model is submitted. *See the Tip below for the first time you run this setup.*

# Tips and Troubleshooting

* **Running this model setup for the first time on a server** – to avoid any issues with the new DISTR/M01 file procedures, manually install the R packages “sf”, “tidyverse” and “foreign” (and their dependencies) on the server. An easy way to do this is to open RStudio and use Tools > Install.

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Reinstalling a package that has already been installed will not cause any issues.

* **Instructions on installing the new trip-based model on a server** – use [these instructions](https://cmapil.sharepoint.com/:w:/r/sites/CMAPTrip-BasedModelUpdateFY21/_layouts/15/Doc.aspx?sourcedoc=%7B252C6998-47E6-45E3-804A-AA066238E381%7D&file=FY22%20Trip-Based%20Model%20Installation%20instructions.docx&action=default&mobileredirect=true) until the CMAP repo is set up.
* **Using Emme for the first time on a specific server** – open Emme and accept the software user agreement.
* **Using Emme for the first time after a new version has been installed** – open Emme and accept the software user agreement.
* **The command prompt states that emme is not recognized** – Set the Windows environment variable using [these instructions](http://wiki.cmap.local/mediawiki/index.php/Fixing_Emme_path_in_Windows_environment_variables).
* **The destination-mode choice model does not run** – rebuild the conda environment (make sure you have the current conda-environment.yml file).

# ON TO 2050 Plan Update Scenarios

|  |  |  |
| --- | --- | --- |
| **Scenario number** | **Analysis year** |  |
| 100 | 2019 |  |
| 200 | 2025 |  |
| 300 | 2030 |  |
| 400 | 2035 |  |
| 500 | 2040 |  |
| 600 | 2045 | *Used for UrbanSim but not Conformity analyses* |
| 700 | 2050 |  |

# **Setting up the model run**

Start by updating necessary values in **batch\_file.yaml.** Parameters:

* **Scenario**: three-digit scenario number
* Work from home module information for the trip generation model:
  + **Validationfiles**: N to not produce the validation files (standard option), Y to produce the validation files
  + **Usualwfhpct**: enter the percentage of workers who usually work from home
  + **Tc14pct**: enter the percentage of workers who work from home 1-4 days per week
* Select link analysis information:
  + **selectLinkFile**: enter the name of the file storing the links to be used for the select link analysis (note: this file **must** reside in the Database\Select\_Link\ folder). If no select link analysis will be performed, enter None for this parameter.
  + The select link file must be formatted for Emme to read the links, like this:

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Beginning a line with “~#” or “~/” indicates to Emme it is a comment line, and it will be ignored. This is optional but is useful to identify a specific project. Links should be identified in the format l=<*inode*>,<*jnode*>

* Transit assignment information:
  + **transit\_file\_path**: enter the path to the transit network transaction files enclosed in “”. The path should stop at the directory above transit\. Spaces in the path name are OK. This is only used if a separate transit assignment is run so it could be left blank when submitting a full model run.

# **Setting up the Trip Generation model**

## **Input files and settings**

* 1. **UrbanSim files (..\Database\tg\UrbanSim\_inputs)**

All appropriate UrbanSim files for the scenario must be stored in the folder (no other files should be present). The set of files should have the same scenario year and UrbanSim run number. File labels may differ from those shown below but each of the seven files must be present and contain one of the key words in the file name:

* buildings – the seven-county building file (used for heavy commercial vehicle trip allocation)
* hhtm, xhhtm – household files for the seven-county area and the external modeling area
* persons, xpersons – person files for the seven-county area and the external modeling area
* subzonetm, xsubzonetm – subzone files for the seven-county area and the external modeling area

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* 1. **Heavy commercial vehicle allocation files (..\Database\data)**

These files are required to develop the heavy commercial vehicle trip allocation weights.

* hcv\_building\_naics\_corresp.csv – correspondence between building type and NAICS industry.
* hcv\_intermodal.csv – estimate of 2018 truck trips for intermodal facilities in the region, which would not be reflected by relying on truck trips by building type from UrbanSim.
* hcv\_sqft\_per\_job.csv – average square feet per job (by building type) used to inform UrbanSim.
* hcv\_tg\_rates.txt – heavy truck trip generation rates (per 1,000 SQFT of space by building type) from NCHRP 298, which uses Quick Response Freight Manual rates.
  1. **UrbanSim data processing scripts (..\Database\tg\scripts)**

Two scripts are required to process the UrbanSim files into data usable by the trip generation model:

* urbansim\_hcv\_allocation.py – creates the heavy truck trip allocations weights, written to ..Database\data\mo20.txt.
* urbansim\_update\_tg\_input\_files.py – creates ATTR\_IN.TXT, HH\_IN.TXT and POPSYN\_HH.CSV from the trip generation model. It also creates files of synthetic households and persons for the work from home allocation model.
  1. **Airport and school files (..\Database\tg\fortran)**

Ensure scenario-appropriate versions of these files are in place:

* Airport\_sz.csv – identifies airport subzones (future scenarios include the South Suburban Airport).
* School\_in.csv – lists subzone level school enrollment (high school and college combined).
  1. **Work from home allocation model**

This model identifies specific synthetic households that include at least one worker who works from home on the simulated day. The work from home allocation model is controlled by two rates: the overall share of workers who usually work from home (*usualwfhpct*) and the overall share of workers who work remotely 1-4 days per week (*tc14pct*). These rates must be set in **batch\_file.yaml** before submitting the trip generation model. The *usualwfhpct* and *tc14pct* values vary by scenario.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **2019** | **2025** | **2030** | **2035** | **2040** | **2045** | **2050** |
| usualwfhpct | 0.0510\* | 0.0869 | 0.0875 | 0.0880 | 0.0884 | 0.0884 | 0.0882 |
| tc14pct | 0.1031 | 0.1257 | 0.1263 | 0.1270 | 0.1273 | 0.1272 | 0.1269 |

\* Uses ACS rate rather than My Daily Travel.

The appropriate industry mix file (*indusmix.csv*) for the scenario must be copied into the wfhmodule folder. This file lists the *usualwfhpct* and *tc14pct* values for each industry.

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* 1. **Growth rates**

The growth factors in the following scripts must reflect simple 1% growth per year from a 2000 base year. So the growth factor for a 2035 scenario is 1.35.

* prep\_macros\distribute.trucks– ~r104 variable must be updated.
* prep\_macros\distribute.poes– ~r5 variable must be updated.

## **Submitting trip generation**

There are three modules that can be selected to execute; running module 3 is recommended as it will execute all tasks.

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Processing the UrbanSim files looks like this:

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Work from home module processing looks like this:

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# **Setting up the full model**

## **Updating scenario networks**

* 1. Submit useful\_macros\cleanup.for.rerun <3-digit scenario>: Deletes extraneous scenarios, matrices, and report files.
  2. Submit prep\_macros\build\_tod\_transit <3-digit scenario> <transit network code>: Creates the transit network from the batchin files.
     1. The transit network code entered should be **zero** (only the AM Peak and Midday skimming networks will be built).
     2. ~t2 variable must be changed to the location of the files.
     3. Calls *prep\_macros\build\_transit\_error\_check.bat* to verify successful batchin file import.
  3. Submit useful\_macros\delete.initial.batchin.scenarios <3-digit scenario>: Removes any remaining highway network scenarios, leaving only transit.
  4. Submit prep\_macros\initialize.scenarios <3-digit scenario>: Builds time-of-day highway networks.
     1. ~t2 variable must be changed to the location of the batchin files.
     2. Calls *prep\_macros\call\Ftime.Capacity* to calculate link capacity.
     3. Calls *prep\_macros\call\Arterial.Delay* to calculate intersection delay.

## **Input files and settings**

* + **Visitor trip growth rate**

The new model includes a base year visitor demand table developed using location-based services data. The following factors should be used the increase his demand in future year scenarios.

|  |  |
| --- | --- |
| Scenario Year | Visitor trip growth factor |
| 2019 | 1.00 |
| 2025 | 1.05 |
| 2030 | 1.18 |
| 2035 | 1.34 |
| 2040 | 1.51 |
| 2045 | 1.70 |
| 2050 | 1.92 |

This value is updated in ..Database\cmap\_trip\_config.yaml.



* + **TNC Surcharge**

The file ..Database\cmap\_trip\_config.yaml includes the pricing structure for TNC trips (both regular and pooled service). The City of Chicago implemented a downtown surcharge in 2020 that should be reflected in all scenarios after 2019. This surcharge should be 175 ($1.75 in cents) and is applied to both single rider and pooled service, so values on lines 124 and 165 must be updated.

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* + **Pre-load congested travel times**

A set of files used to pre-load congested travel times is stored in Database\default\_base\_year. By providing reasonable congested conditions for global iteration 0 of the model, it allows us to run fewer global iterations and provides for greater stability between model iterations. These files must be loaded or updated when a new model scenario is created. Congested files for a 2050 RSP scenario can come from the 2050 scenario of the most recent Conformity runs.

Copy *useful\_macros\input\_data.mac* from the new model setup into the source Emmebank and run the macro. The output files can then be copied into the new model run.

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# **Submitting the full model**

Submit\_Full\_Regional\_Model\_SOLA.bat offers two options on running the destination choice-mode choice model.

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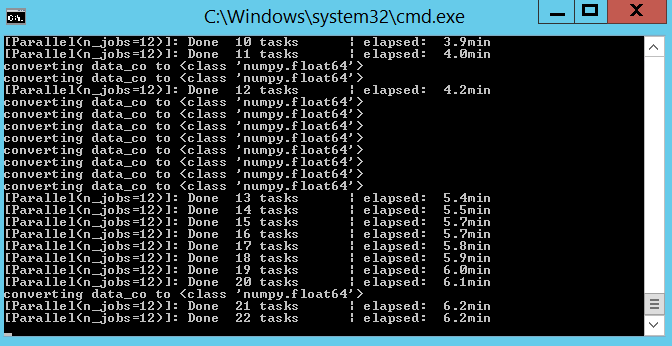
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Option 1 is recommended to submit a single model run and have it finish as quickly as possible. It will take advantage of the processors available on the servers and will use most of the server’s RAM.

Option 2 is recommended for submitting two model runs simultaneously. Do **NOT** submit more than two runs at a time.

Model run steps summary:

1. Submits the procedures to update the DISTR and M01 files.
   * DISTR files contain zonal transit approach distribution parameters, which are used by the destination-mode choice model. The M01 file contains zonal transit availability information and zonal median household income used by the destination-mode choice model. Updating these files ensures they reflect any changes in transit service or changes in the socioeconomic files.
   * Callsprep\_macros\distr\_m01\_data.macto punch transit network attributes and store files in prep\_macros\temp\.
   * Calls prep\_macros\create\_distr\_m01\_files.R to perform the spatial analysis and create the final files.
   * All temporary files used for the analysis are written to prep\_macros\temp\, which is deleted are the end of the processing.
   * Two shapefiles and a .dbf file must be present in Database\data\distr\:
     1. A shapefile of the current zone system (including a SQMI field).
     2. A shapefile of the current subzone system centroids (including a ZONE field).
     3. DBF file of zone centroid coordinates (zncntrd.dbf)
2. Submits useful\_macros\cleanup.for.rerun and prep\_macros\free.skim.mac.
3. Checks for a set of files stored in ..\defaults\_base\_year\ to pre-load congested travel times and distances into Emme.
   * If all of the files are present, prep\_macros\preload\_congested\_times.mac is submitted to replace the free skim macros with congested times and distances (this is the preferred option).
4. Submits macros\skim.transit.all to do the transit skimming.
   * Calls macros\transit\_skim\_final\_matrices1.py – performs the matrix convolution portion of the transit skimming procedures for the AM peak period.
   * Calls macros\transit\_skim\_final\_matrices2.py – performs the matrix convolution portion of the transit skimming procedures for the midday period.
   * Calls macros\finish.transit.skims – moves transit skim matrices into final locations.
5. Runs macros\init\_HOVsim\_databk.mac to initialize the matrices in the emmebank.
6. Activates the CMAP-TRIP environment and runs the destination choice-mode choice-time of day choice model.
   * Calls cmap\_modedest with arguments:
     1. --njobs: Number of jobs to process in parallel.
     2. --max\_zone\_chunk: Maximum number of zones to process in one chunk.



1. Runs the time-of-day procedures.
   * Calls macros\ttables.mac – creates time-of-day user class demand matrices (trucks and external trips).
   * Calls macros\net5I\_7c.mac – prepares time-of-day highway networks.
   * Conditional logic:
     1. **Global iteration 0 and 1**: If time period is not 3 (AM peak) or 5 (midday):
        + Calls macros\SOLA\_assignment.py – performs the time-of-day SOLA traffic assignments.
     2. **Global iteration 0 and 1:** If time period is 3 (AM peak) or 5 (midday):
        + Calls macros\init\_toll\_skim\_matrices.py – initialize matrices for toll skims.
        + Calls macros\SOLA\_assignment.py – performs the time-of-day SOLA traffic assignments including generating toll skims along accumulated paths for HW trips (period 3) and for non-work trips (period 5).
        + Calls macros\complete\_toll\_skim\_matrices.py – weighted average toll values are calculated based on the actual trips made by user classes.
     3. **Global iteration 2:** no select link analysis:
        + Calls macros\SOLA\_assignment\_final\_global\_iteration.py rather than SOLA\_assignment.py. Performs the time-of-day SOLA traffic assignments and captures the link volumes for medium and heavy truck trips of 200+ miles for MOVES input.
     4. **Global iteration 2:** including aselect link analysis:
        + Calls macros\ SOLA\_assignment\_final\_global\_iteration\_SelectLink.py. Performs the same functions as SOLA\_assignment\_final\_global\_iteration.py plus collects the select link volumes and demand.
   * Calls macros\balance5I\_7c.mac – balances user class link volumes (with the assignment from the prior Global Iteration) using the Method of Successive Averages.
   * Calls macros\tod\_skim\_setup.mac – sums class average volumes into extra attribute @avtot.
   * Calls macros\tod\_skim.py – creates travel time skims for each time-of-day period, which are used in the utility calculations in the time-of-day model.
   * After the last time period is assigned:
     1. Calls macros\ MSA\_iteration\_skims.py – creates time and distance skims for the AM peak and midday periods, used to inform the Destination Choice-Mode Choice model.
2. After the final global iteration, runs macros\Daily.Total.Asmt5I\_7c.mac, which tabulates time-of-day link volumes from the final Global Iteration runs into daily link volumes (stored in scenario x0029).
   * Calls macros\call\vht.summary\_v3\_7c.mac – calculates vehicle hours of travel for each time-of-day period in the final Global Iteration and stores the accumulated values in scenario xxxx9.
3. If a select link analysis was run: calls macros/complete\_select\_link.py – accumulates the time-of-day vehicle class select link values (VEQs) into daily totals in vehicles.

# **Select Link Analysis results**

Select link trip demand is stored in the following matrices:

* mf60: select link daily total vehicle demand
* mf68: select link period 3 auto vehicle demand (user classes 1-4)
* mf69: select link period 3 truck vehicle demand (user classes 5-7)
* mf61: select link daily mode S VOT1 vehicle demand (user class 1)
* mf62: select link daily mode S VOT2 vehicle demand (user class 2)
* mf63: select link daily mode S VOT3 vehicle demand (user class 3)
* mf64: select link daily mode H vehicle demand (user class 4)
* mf65: select link daily mode B and L truck vehicle demand (user class 5)
* mf66: select link daily mode M truck vehicle demand (user class 6)
* mf67: select link daily mode H truck vehicle demand (user class 7)

Select link volumes are stored in the following attributes in scenario x0029:

* @slvol – select link daily total volumes (VEH)
* @slcl1 – select link class 1 daily volumes (VEQ)
* @slcl2 – select link class 2 daily volumes (VEQ)
* @slcl3 – select link class 3 daily volumes (VEQ)
* @slcl4 – select link class 4 daily volumes (VEQ)
* @slcl5 – select link class 5 daily volumes (VEQ)
* @slcl6 – select link class 6 daily volumes (VEQ)
* @slcl7 – select link class 7 daily volumes (VEQ)

*These same attributes are available in scenarios x0021-x0028 but represent time-of-day volumes.*

# **Matrix documentation**

See [here](https://cmapil.sharepoint.com/:x:/r/sites/TransportationModelingResources/_layouts/15/Doc.aspx?sourcedoc=%7BC3CEB41D-7A42-4C1B-9AFC-DB33E2267009%7D&file=matrix%20documentation.xlsx&action=default&mobileredirect=true) for a list of matrices used by the model.

# **Post model run procedures**

## **Create MOVES Model Input Data**

* + Submit post\_macros\punch.moves.data.mac <3-digit scenario> to create data files for processing.
    - Calls *post\_macros\run\_vmt\_statistics.mac <3-digit scenario>* to create a summary of VMT values by district and facility type.
  + Run ***post\_macros\create.MOVES.input.file.IMversion.sas*** to create final MOVES data file.
    - Update project, run and year variables prior to running.

## **Run a Transit Assignment following the full TOD Model Run**

These procedures perform a capacitated transit assignment. Prerequisites:

* Make sure the emmebank is dimensioned for 1999 full matrices and at least 3500000 allocated for Extra Attribute Values (no need to keep an emmebank backup if you must increase the dimensions).
* Update the transit network transaction file location in **batch\_file.yaml**.
* Ensure the transit\_asmt\_macros\data\ folder contains appropriate versions of:
  + bus\_node\_extra\_attributes.csv
  + rail\_node\_extra\_attributes.csv
  + boarding\_ease\_by\_line\_id.csv
  + *The default files may be used if scenario-specific versions are not available*.

1. Submit transit\_asmt\_macros\**create\_transit\_demand.bat** to prepare the transit networks and demand.
   * Calls **setup\_transit\_asmt\_1\_build\_transit\_asmt\_networks.mac** to create the transit networks. For scenario 100, the transit assignment scenarios are 121 (6pm-6am), 123 (6am-9am), 125 (9am-4pm) and 127 (4pm-6pm).
   * Calls **setup\_transit\_asmt\_2\_initialize\_matrices.py** to initialize matrices to hold time-of-day transit demand:
     1. MF501: Period NT transit demand (O-D format) - VOT 1
     2. MF502: Period NT transit demand (O-D format) - VOT 2
     3. MF503: Period NT transit demand (O-D format) - VOT 3
     4. MF504: Period AM transit demand (O-D format) - VOT 1
     5. MF505: Period AM transit demand (O-D format) - VOT 2
     6. MF506: Period AM transit demand (O-D format) - VOT 3
     7. MF507: Period MD transit demand (O-D format) - VOT 1
     8. MF508: Period MD transit demand (O-D format) - VOT 2
     9. MF509: Period MD transit demand (O-D format) - VOT 3
     10. MF510: Period PM transit demand (O-D format) - VOT 1
     11. MF511: Period PM transit demand (O-D format) - VOT 2
     12. MF512: Period PM transit demand (O-D format) - VOT 3
   * Calls setup\_transit\_asmt\_3\_TOD\_transit\_demand.py to develop time-of-day transit demand and populate the matrices. Transit trips are enumerated and are assigned to time-of-day periods and value of time categories. Where necessary trips are moved from Origin zone to Boarding zone and final values are written to the matrices.
2. Submit **run\_transit\_assignment.bat** to perform the assignment.
   * Calls **cmap\_transit\_assignment\_runner.py** which identifies the scenarios to be assigned.
     1. Calls **cmap\_transit\_assignment.py** to conduct the capacitated transit assignment using journey levels.
   * Calls **summarize\_transit\_boardings.mac** to write a summary file (transit\_asmt\_macros\report\Boarding\_summary.csv) of transit boardings by service and time-of-day.
   * Calls **delete\_transit\_skims.py,** which removes the following matrices:
     1. mf1100-1154
     2. mf1300-1354
     3. mf1500-1554
     4. mf1700-1754