CMAP Activity-Based Modeling System

User Guide

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Contents

Overview

The Chicago Metropolitan Agency for Planning (CMAP) Activity-Based Model (ABM) has been developed to ensure that the regional transportation planning process can rely on forecasting tools that will be adequate for new socioeconomic environments and emerging planning challenges. It is equally suitable for conventional highway projects, transit projects, and various policy studies such as highway pricing and HOV analysis. However, the scope of the current project was limited to demonstration of the ABM sensitivity for different highway pricing policies.

The CMAP model is based on the CT-RAMP (Coordinated Travel & Regional Activity-Based Modeling Platform) family of Activity-Based Models. This model system is an advanced, but operational, AB model that fits the needs and planning processes of CMAP. The CMAP ABM model is implemented in EMME and Java and runs in a distributed fashion on four Windows 64bit machines. The overall model shell is run from DOS. The EMME components include all network assignment and skimming procedures as well as route type choice (toll vs. non-toll) for trucks, commercial vehicles, external traffic, and special generator (O'Hare airport). The Java components include the core demand model for 10 million residents of the Chicago Metropolitan Region implemented in microsimulation fashion.

The purpose of this User Guide is to describe the modeling system setup, how to run and setup the model, and how to manage the model inputs and the model outputs. Refer to the model specification document for details about model structure, parameters, highway and transit network procedures, etc.

Hardware and Software Prerequisites

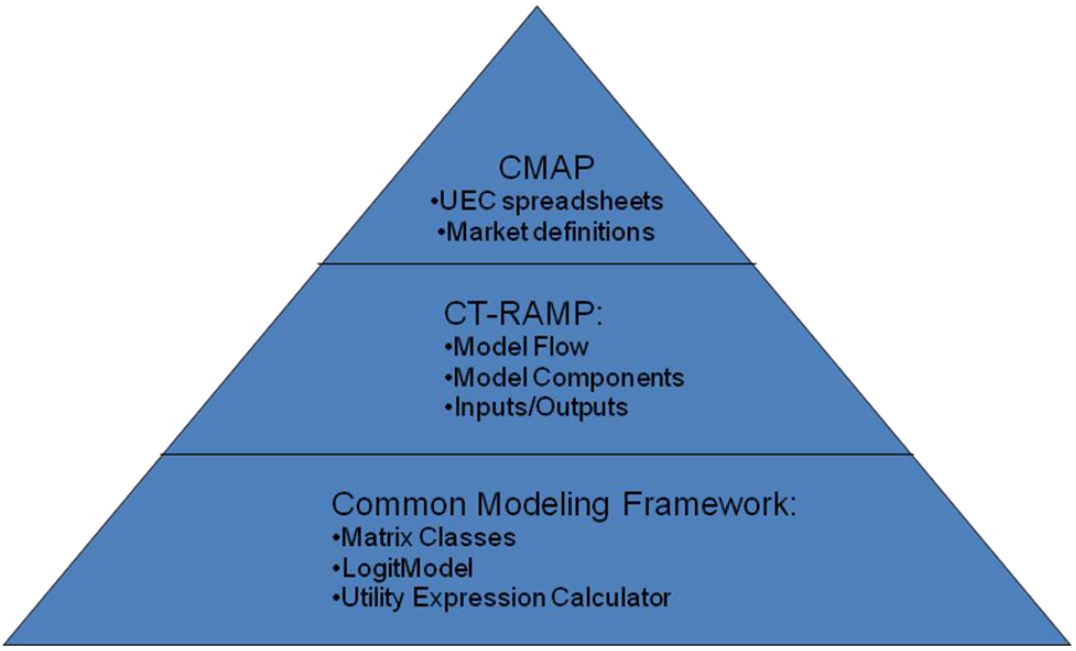
The CMAP ABM requires the following software and hardware configuration:

1) Four 64bit Windows (Server 2008) machines each with >= 144GB of RAM.
2) EMME installed on every machine for running the highway skimming and assignment steps.
3) 64bit Java Development Kit 1.6 or later installed on every machine.
4) 32bit Java Runtime Environment for reading level-of-service matrices from the EMME databanks and writing trip tables for assignment produced by the CT-RAMP model to the EMME databank.

The modeling system requires Java (32bit and 64bit versions), EMME, and the CT-RAMP Java package. The model requires a 64 bit OS in order to take advantage of larger (64-bit) memory addresses. As shown in Figure 2, the CT-RAMP software for the microsimulation components of the model relies on the Common Modeling Framework (CMF), a collection of Java libraries specifically designed for the implementation of disaggregate travel demand models. The CMAP ABM utilizes the CT-RAMP Java package, which contains model logic, choice model structure, and model flow, while utility equations and model inputs and outputs specific to CMAP are contained in Utility Expression Calculator (UEC) files. These Excel-based files open up the models so the model parameters (in particular, all coefficients of choice utilities for each variable), input filenames with all population, employment, land-use, and level-

of-service data, etc can be easily accessed which helps prevent errors and makes the model equations more accessible. The CT-RAMP Java package is included in the CMAP ABM setup.

Figure 1: Disaggregate Travel Demand Model Software Components



Distributed Setup

There are two distributed processes in the CMAP ABM model. The first is the distribution of the EMME highway assignment and skimming steps. The second is the distribution of the core CT-RAMP model calculations.

The EMME skimming and assignment can be done two ways: 1) by starting 8 separate EMME sessions by time-of-day period on one machine or 2) by starting 2 separate EMME sessions by time-of-day period on each of the four machines. Option two, the distributed EMME setup, is made possible by the Microsoft PsExec utility to execute processes remotely[1]. PsExec is a Windows executable that is called from the command line and calls a remote program such as a DOS bat file or EMME by referring to the machine name, program name on the remote machine, and requires a username and password to use for authentication. Details on both setups are provided later in this document.

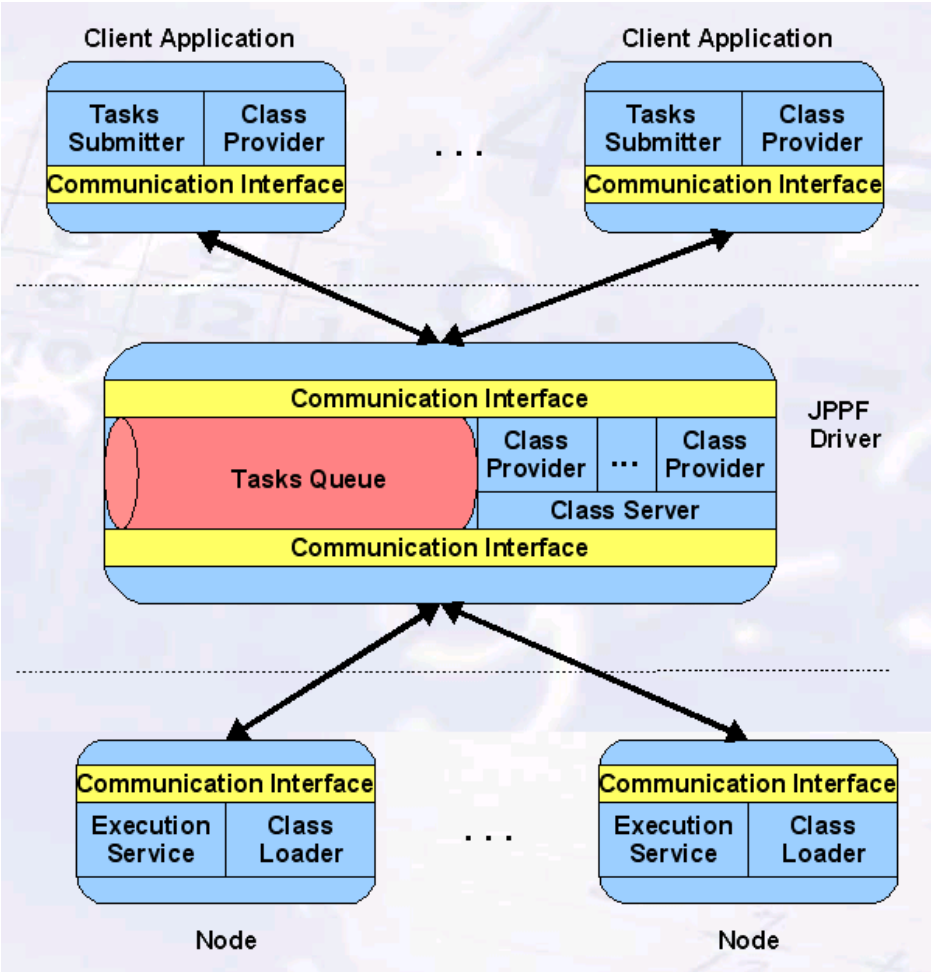
CT-RAMP, the activity-based microsimulation component of the model, is also distributed across the four machines. The approach allows the utilization of one or more computers, each with multiple computing cores, and efficiently balances the computation among the computers. Experience with distributing large-scale CT-RAMP applications in Atlanta and San-Francisco Bay Area regions has shown that the resulted runtime is roughly inversely proportional to the computer power. In addition, the configuration of the cluster of computers is relatively flexible, allowing computers to be easily added or

[1] http://technet.microsoft.com/en-us/sysinternals/bb897553

removed. The model results, whether solved entirely on one computer or cooperatively with many computers, are identical.

CT-RAMP threads the application of activity-based choice models to groups of households taking advantage of the fact that most of the behavioral models are applied for each household independently. Given that CT-RAMP is implemented in Java, it uses the Java Parallel Processing Framework (JPPF), a robust open source library, to manage the distribution of tasks. As illustrated in the Figure below, the JPPF framework consists of 3 main parts: a driver, a set of one or more nodes, and a client. The client is in this case CT-RAMP. The nodes are also additional separate processes, typically one per computer. The driver is a separate server process that is run on one of the cluster machines. The driver is a facilitator that receives tasks from the client application, sends them to node processes, receives results from nodes, and returns those back to the client.

Figure 2: JPPF Framework



Node processes receive tasks of calculations, perform those calculations, and return results. Nodes are configured through a properties file to communicate with the driver process upon their start-up. A

typical configuration might be to set memory equal to 124GB and threads equal to 12 (for a 12 core machine). The majority of parallel computations in the CT-RAMP implementation occur through tasks executed in parallel on nodes.

The driver process uses logic contained in the JPPF framework to balance computational loads across Java Virtual Machines running on the nodes in the cluster. The driver receives tasks from the client application and submits them in bundles to the nodes. The driver also retrieves class files from the client application and passes those to the nodes, as needed by the nodes. Additional nodes can therefore be added by simply editing two properties files and running a Java command.

The client application, which is called by the main DOS model script and configured through a properties file, communicates with the driver as described above. The client application is responsible for creating task objects that can be run in parallel and submitting those to the driver. In the CT-RAMP implementation for CMAP, 3.9 million base year households are split into 1950 tasks of 2000 households each. The tasks are submitted to the driver and the driver assembles the tasks into bundles and submits them to nodes that have notified the driver that they are part of the cluster. As the nodes complete the tasks, the driver receives their results and submits new bundles, while balancing the submission of bundles to keep the nodes uniformly busy.

In addition to the JPPF components, CT-RAMP has a Household Manager and a Matrix Manager process. The Household Manager's purpose is to manage the household and person synthetic population in memory and to provide the JPPF nodes with all household and person related data. The Matrix Manager's purpose is to read the skims into memory and to provide the JPPF nodes with all requested skim values. These Java processes run on the main computer and have substantial memory footprints. To help reduce run time, the synthetic population is only created once in the Household Manager and then left in memory between feedback loops. It is updated with model results each iteration.

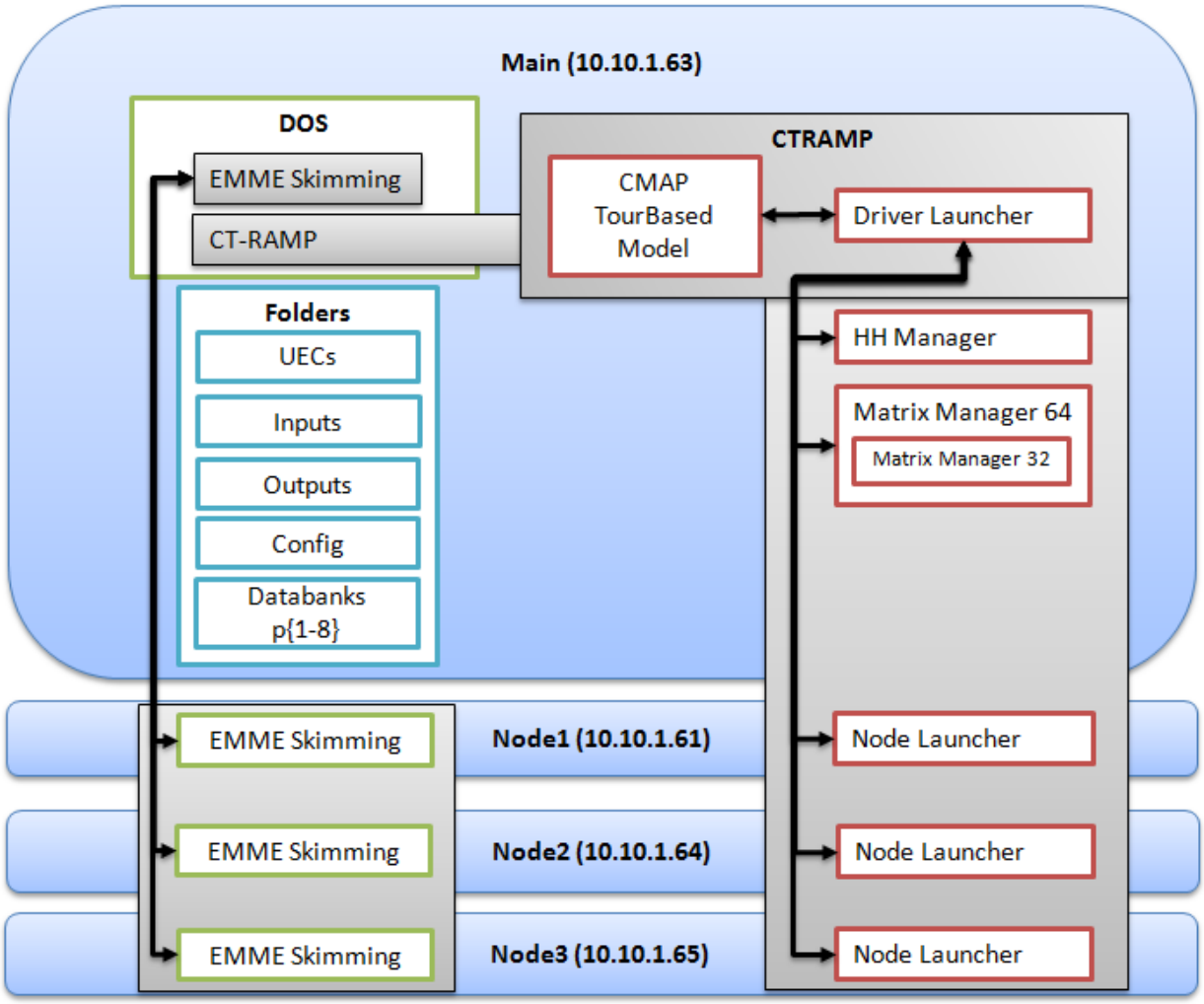
System Setup and Design

The ABM system is implemented with Java, EMME, and DOS. The Java JPPF library handles the distributed/threaded computing for CT-RAMP, whereas DOS and EMME handle the distribution of skimming and assignment. The CMAP system design consists of:

1) A main computer which:
    a. runs the main EMME skimming and assignment processes or manages the distributed EMME skimming and assignment process
    b. runs the main CT-RAMP (CMAPTourBasedModel) Java process
    c. runs the Household Manager Java process
    d. runs the Matrix Manager Java process (including the slave 32bit Java process)
    e. runs the JPPF Driver Launcher processes which is called by CMAPTourBasedModel, and which manages communicating with the nodes

2) Three additional node computers which:
   a. Listen for tasks from the JPPF driver
   b. Run the remote EMME skimming and assignment if desired

Figure 3: CMAP ABM System Design



Running the Model

Running the CMAP ABM requires configuring the secondary, or slave, computers first and then configuring the main computer to execute the model. The Java and slave processes must be started on the three additional computers. In addition, a remote EMME skimming folder must be setup. There is a startup script for each computer that starts all required Java processes on the machine. The remote EMME skimming machines do not require a startup script. The next step is to open and execute the main DOS run script. All the model components on each machine talk to one project directory on the

network. All inputs are read, and all outputs written to this folder, thereby simplifying model setup, inspection, and error detection. For the distributed EMME skimming, all inputs are copied from the project directory to the remote machines before running EMME. Once the skimming is complete, the resulting databank is copied back to the project directory.

Setting Up a Run

To set up a model run, the user has to do the following:

1) Create a project folder containing all input and output files
2) Create remote EMME skimming folders and share these on the network
3) Start JPPF services
4) Configure and Run the Model
5) *Optional:* Configure Run Skimming Remote bat file

Create a Project Folder

1) Create a root folder on the main computer that will house scenarios. For example:
   D:\abm
2) Share the folder on the network.
3) Create a scenario specific project directory inside it. For example:
   D:\abm\cmap\model
4) Unzip the contents of the base year template scenario (CMAPTourBasedModel{dateStamp}.zip) to the project folder created above. This zip file, which is versioned by a date stamp, contains all the required files to setup and run the base year model, except for the databanks. The resulting folders and files in the project directory should be:
   a. config folder – contains configuration files for setting up and running JPPF distributed task processes. Also contains JPPF java code files (jar files).
   b. exec folder – contains the CT-RAMP java jar files with compiled java code as well as the PsExec program, PsKill program, and the MySQL database load script.
   c. inputs folder – contains model input files such as the population and employment data by TAZ, the person and HH population synthesizer files and other model data inputs.
   d. macros - contains EMME macro files and a DOS bat file to remove all emlocki files if needed.
   e. remote – contains DOS bat files used in the distributed EMME skimming process
   f. uecs folder – contains all the model utility expression calculator (UEC) files
   g. outputs folder – will contains the CT-RAMP output files
   h. logFiles folder – will contain the CT-RAMP model run log files
   i. p{1-8} folder – These folders are empty in the zip file. The user needs to copy over an EMME databank for each of the eight time periods. Note that databank p1 and p2 store

the off-peak and peak transit skims respectively. Databanks p3 – p8 can be re-created by simply copying the p1 databank. The skims in databanks p3 – p8 will be updated to be the correct time period when the initial skimming macro is run.

j. cmap.properties - CT-RAMP properties file
k. runCTRAMP.bat – runs CT-RAMP in distributed mode with a specified HH sample rate
l. runCTAMP-SingleProcess.bat – runs CT-RAMP in single process (i.e. non-distributed) mode, which is used for testing and debugging
m. runModel.bat – the overall model run script that calls runCTRAMP.bat and the runSkimming<Initial>.bat files
n. runSkimming.bat – runs EMME on the main machine to generate highway skims for iterations 2+
o. runSkimmingInitial.bat – runs EMME on the main machine to generate initial highway skims for iteration 1
p. runSkimmingRemote.bat – called by runModel.bat to run the remote EMME skimming processes.
q. runCreatePeakTollScenario.bat – optionally run ahead of time to create new EMME scenarios in each databank where the link tolls are factored by a user input factor. This was used to create the toll (pricing) scenario test cases.

5) On each computer, including the main machine, map a network drive to the root folder. This allows for adding/changing model run scenarios without having to re-map network drives. An example of the mapped network drive address is:

    Y:/ = \\cmapmod03\abm\

Create Remote Skimming Folders

1) On each remote machine, create a d:\abm folder.
2) Share the folder on the network.
3) Copy over the contents of the project directory remote folder to each remote abm folder.

Start JPPF Services

After creating the project folder and copying over the template files, the JPPF services can be started on the main machine.

1) If necessary, edit the following properties files in the config folder:
    a. Main Computer DOS Command File - runMain.cmd
        i. set RUNTIME=Y:/cmap/model/ #project directory
        ii. set JAVA_PATH=C:/Program Files/Java/jdk1.6.0_25 #JDK 64bit path
        iii. set JRE32=C:/Program Files (x86)/Java/jre6 #JRE 32bit path
        iv. set HOST_IP=10.10.1.63 #IP of main computer
    b. Node DOS Command File - runNode1.cmd, runNode2.cmd, runNode3.cmd
        i. set RUNTIME=Y:/cmap/model/ #project directory

ii. set JAVA_PATH=C:/Program Files/Java/jdk1.6.0_25 #JDK 64bit path

iii. set JRE32=C:/Program Files (x86)/Java/jre6 #JRE 32bit path

c. JPPF Client Driver Properties File - jppf-clientDistributed.properties

i. driver1.jppf.server.host = 10.10.1.63 #IP of main computer

d. JPPF Driver Properties File - jppf-driver.properties

i. jppf.server.host = 10.10.1.63 #IP of main computer

e. Remote JPPF Node Properties Files - jppf-node1.properties, jppf-node2.properties

i. jppf.server.host = 10.10.1.63 #IP of main computer

ii. processing.threads = 12 #number of cores

iii. other.jvm.options = -Xms124000m –Xmx124000m #memory on node

2) Change directory to the config folder and run the runMain.cmd DOS file to:

a. Start the JPPF Driver Launcher on the main computer

b. Start the HH Manager on the main computer

c. Start the matrix Manager on the main computer

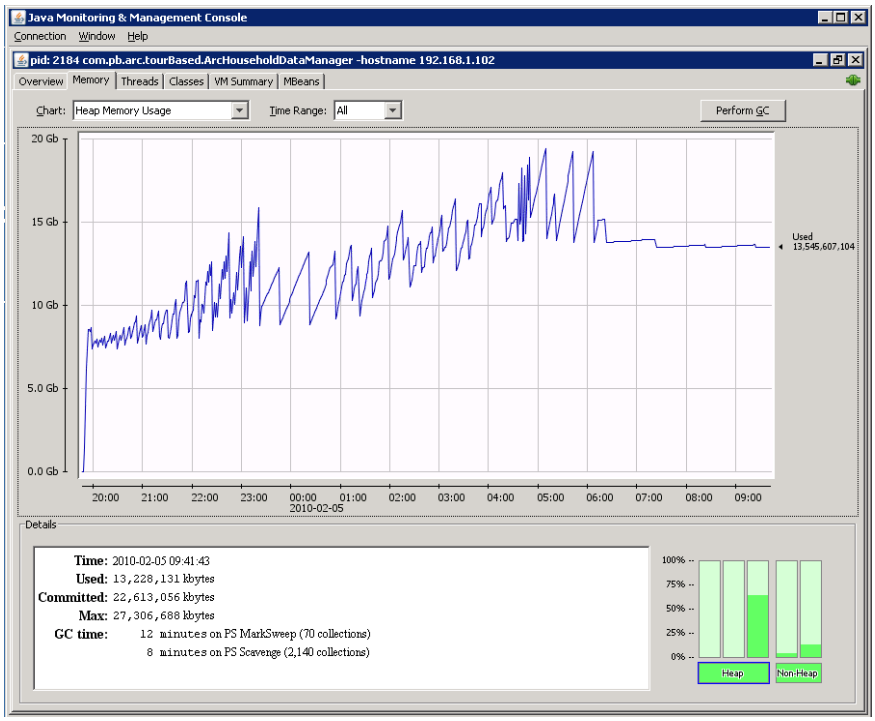
3) Remote desktop to the Node1 computer and run runNode1.cmd to start the Node1 process

4) Remote desktop to the Node2 computer and run runNode2.cmd to start the Node2 process

5) Remote desktop to the Node3 computer and run runNode3.cmd to start the Node3 process

6) *Optional*: Start jConsole sessions to track memory usage of the Java processes. In the config folder is the *runJConsole.cmd* file that starts a JConsole session which requires the user to select a Java process such as the HH manager. Running a JConsole session can be useful for troubleshooting memory problems.

Figure 4: Memory Usage for HH Manager in JConsole



Configure and Run the Model

Having set up the JPPF services, the model can be run via the main DOS run script - runModel.bat. To run this script, do the following:

1) If necessary, edit the following property in the cmap.properties file:
    a. Project.Directory = y:/cmap/model/ #project directory
2) If necessary, edit the following property in the runCTRAMP.bat file:
    a. set RUNTIME = y:/cmap/model/ #project directory
    b. set JAVA_PATH=C:/Program Files/Java/jdk1.6.0_25 #JDK 64bit path
    c. set JRE32=C:/Program Files (x86)/Java/jre6 #JRE 32bit path
3) Start a DOS command window on the main computer by holding shift + right clicking on the project folder in Windows explorer
4) If necessary, edit the following settings in the runMain.bat file:
    a. distributedEMME=1 #distributed skimming
    This is set to 1 to distributed skimming and 0 to do all skimming on the main machine. Setting this to 1 requires configuring the runSkimmingRemote.bat as well.
    b. key_ip=10.10.1.61 #EMME key IP to use
    c. toll_scen= #use toll scenario
    This is set to 1 to skims the toll scenario by time period as opposed to the base time period. This setting relates to the runCreatePeakTollScenario.bat file that was used for the toll scenario runs. This is set to <blank> if the base scenario is used for skimming.
    d. loops=3 #feedback loops to run
    e. runCTRAMP.bat 0.20 #sample rate
    The command line argument to runCTRAMP.bat sets the HH sample rate by iteration. Note that 0.2=20%. The resulting demand matrices will be scaled by 1/<sample rate> before being assigned to the network.
5) If running distributed skimming, configure the runSkimmingRemote.bat file as described below.
6) Run runMain.bat to run the model which runs EMME skimming and CT-RAMP. If running
7) When CT-RAMP is done, it reads the indivTripData_<feedback_iteration>.csv output file and jointTripData_<feedback_iteration>.csv output file to create the demand matrices used for assignment that are written directly to the time period specific databanks.

Before running the model again, the Java services should be re-started. In addition, if the model fails, it's a good idea to kill any Java or EMME processes still running on the main computer. The *killjava.cmd* file located in the config folder can be run on the main computer to kill all running Java processes. The *killjava.cmd* can be used to kill the JPPF nodes running on the slave machines as well. To kill a JPPF node, first remote desktop to the slave machine and then run the *killjava.cmd* file to terminate all Java processes running on the machine. The *deleteLockis.bat* in the macros folder can be used to delete the eight EMME locki files in the p{1-8} folders respectively.

Configure Remote Skimming

The runSkimingRemote.bat file is called by runModel.bat to create eight EMME skimming and assignment processes by time period, six of which will be run on remote machines. The script is called eight times, once for each time period, and does the following:

1) If the skimming time period is to be run remotely, it creates a fake locki file in the project directory p<time period> folder to trick the outer calling DOS process to wait for it to complete before moving on.

2) Via PsKill, kills any remote emme processes that may be running.

3) Copies from the project directory to the appropriate remote skimming folder the inputs, macros, and databank required to run the EMME skimming and assignment procedures on the remote machine.

4) Via PsExec, calls the runSkimming.bat or runSkimmingInitial.bat file on the remote machine to produce the skims.

5) Copies the updated remote databank back to the project directory

6) Deletes the fake project directory p<time period> locki file to let the outer calling DOS process know that the skimming for the time period is done.

If running EMME for the first time on a machine, make sure to accept the EMME license agreement ahead of time since this is assumed in the macro.

In order to run the distributed EMME skimming, the runSkimmingRemote.bat file needs to be configured with the following settings:

1) un – network username used for authenticating on the remote machine

2) pwd – password used for authenticating on the remote machine

3) projDir – project directory , for example: y:\cmap\model\ #include the "\" at the end

4) For each time period:

    a. ip – machine name to run skimming procedures, for example: \\cmapmod00

    b. key_ip – machine IP address to use for EMME license

    c. isMain – Set to 1 to skim on the main (local) machine or set to 0 to skim remotely

    d. copyFiles – Set to 1 to copy inputs and macros to the remote machine or set to 0 to not copy files to the remote machine. This needs to be set to 1 for one, and only one, of the

time periods per each machine to ensure each machine has the necessary files to run the EMME skimming procedures.

EMME Macro Settings

The highway skimming and assignment procedures as well as route type choice for non-core traffic components (trucks, commercials, externals, and airport ground access) are done with EMME. The settings are specified in the macros. The macros are described below. Note that the runSkimming.bat and runSkimmingInitial.bat call these macros with the appropriate command line arguments that are specific to each global iteration:

1) TOD_tables.mac – creates time of day period specific matrices for highway assignment, including the initial version of the auto trip matrices that will be further created by CT-RAMP (to generate starting sets of skims for each period). This macro is run once for each time-of-day period before the first global iteration. The command line argument are:
    a. Time period code, such as 1 for p1
2) extraclass.mac – creates extra attributes for CT_RAMP_skim macro. This macro is only run once for each time-of-day period before the first global iteration when running the initial skimming. It has no command line arguments.
3) CT_RAMP_skim.mac – toll road choice (for non CT-RAMP user classes) and skimming macro. Implements binary choice between toll and non-toll users and all necessary highway skimming procedures. Can be applied independently to generate starting skims and/or explore pricing scenarios. When applied to support CT-RAMP, auto trip tables mf101-mf106 are generated by CT-RAMP, Truck trip tables mf107-mf110, external autos mf111-mf116 and passenger autos to airports mf121-mf126 are split by this macro (between toll and non-toll users). This macro is run 4 times (internal iterations) for each global iteration (to equilibrate non-core traffic components). The command line arguments are:
    a. 0 = initialize split matrices mf131-mf174 (only for first global iteration), 1 = start with the previous set
    b. MSA factor for averaging matrices (0.0 = no update, 1.0 = full update)
    c. 0 = skip final assignment, 1 = implement final assignment (for last global iteration)
    d. base network scenario for assignment (p1-8)
    e. number of assignment iterations (normally set to 10, 20, 30, 40 by internal iterations)
    f. 0 = include auto split (for initial skims), 1 = exclude (when applied with CT-RAMP)
4) Toll_scenario.mac – creates a new toll (pricing) scenario from a base scenario. This was used to create the toll scenario test cases. The command line arguments are:
    a. Baseline scenario, such as 3
    b. Pricing scenario, such as 1
    c. Toll multiplier, such as 5

CT-RAMP Model Run Properties

The CT-RAMP properties file defines the properties specified to run the main CMAPTourBasedModel CT-RAMP Java process. Most of the CT-RAMP settings should not be changed when running a new scenario. The settings that are likely to change with a new scenario are:

1) Project directory
2) Population Synthesizer Household File
3) Population Synthesizer Person File
4) Population Synthesizer Sample Percents
5) Population Synthesizer Sample Seed

In addition, the following settings may need to be changed if a new model setup is configured:

1) Run Model – Matrix Server Address
2) Run Model – Household Server Address

What follows is an exhaustive list of all the CT-RAMP settings in the CMAP ABM properties file.

General Inputs

1) Project Directory – The project directory. This should be set to the location of the project directory (i.e. the directory that contains the runModel.bat file).
2) Debug – Trace Household ID List – HH IDs separated by a comma to write debug results for. Ensure these HHs are in the sampled HHs if a sample rate < 1.0 is used.
3) Taz Data – Location of the TAZ data input file
4) Taz Walk Shares – Location of the TAZ walk shares (none, short, and long) input file
5) Zone Accessibilities – Location of the TAZ-based accessibility measures input file (note this would be calculated on-the-fly in a full ABM implementation).

Result Files and Database

6) Results – Write Data to Files – Write CT-RAMP output files to CSV files. This is required for writing the trip matrices to the EMME databanks. See the Model Outputs section for details.
7) Results – Write Data to Database – Writes CT-RAMP output tables to a SQLite database. This is default to FALSE and may not complete successfully due to memory limitations.

8) Results – <Model Name> - Specifies the location of output CSV files. See the Model Outputs section for details.

Result Matrices

1) Results – Write Trip Matrices– T/F to write the trip matrices to databanks

2) Results – Trips Matrices – LowVOTUpperBound – Max person value-of-time in order to classify their trips as low income in the output trip matrices.

3) Results – Trip Matrices – Num Zones – Number of zones in the output trip matrices.

4) Results – Trip Matrices – Databanks – Location of the time period databanks

5) Results – TimePeriodUpperBounds – Time period code upper bound for time periods 1 – 8

6) Results – Trips Matrices – Numbers – Matrix numbers to write to each databank. The order and number of these matrices cannot be changed without changes to the code.

7) Results – Trips Matrices – Names – Matrix names for each matrix number above.

Run Model IP and Port Settings

8) Run Matrix Server Separate – This runs the CT-RAMP matrix server in is a separate Java process.

9) Run Model – Matrix Server Address – IP address of the CT-RAMP matrix server. This needs to be set to the actual IP address, not localhost or 127.0.0.1 as this confuses JPPF.

10) Run Model – Matrix Server Port – Port of the CT-RAMP matrix server.

11) Run Model – Household Server Address – IP address of the CT-RAMP household data server. This needs to be set to the actual IP address, not localhost or 127.0.0.1 as this confuses JPPF.

12) Run Model – Household Server Port – Port of the CT-RAMP household server.

Models to Run

The Models to Run section (RunModel.*) defines which CT-RAMP models to run. By default, all models are run except for the Population Synthesizer. These models correspond to CT-RAMP UECs stored in the uecs folder. Refer to the CMAP ABM Model Specification document for details on the individual models (more than 20 choice submodels with multiple segments by travel purpose and/or person type within most of them).

UEC Files

The UEC Files section (UecFile.*) defines the location of the UEC input files in the uecs folder. There are a number of other UEC files specified in the properties file as well. These are:

13) Stop.depart.arrive.proportions – lookup table for stop depart time period by tour purpose, is inbound stop, time period, and trip index on tour

14) TourDepartureAndDuration.AlternativeList.InputFile – alternative file

15) IndividualNonMandatoryTourFrequency.AlternativesList.InputFile – alternatives file

16) IndividualNonMandatoryTour.FrequencyExtension.ProbabilityFile – lookup table for individual non-mandatory tour frequency by person type, is mandatory tour, is joint tour, and non-mandatory tour type

17) UsualWorkAndSchoolLocationChoice.SizeCoefficients.InputFile – usual work and school location choice size term coefficients input file

18) UsualWorkAndSchoolLocationChoice.AlternativesList.InputFile – alternatives file

19) StopDestinationChoice.SizeCoefficients.InputFile – stop destination choice size term coefficients input file

20) StopPurposeLookup.Proportions – lookup table for stop purpose by tour purpose, is inbound stop, departure range start and end hour, and person type

21) CBDParkingAlternatives.file – CBD parking zone alternatives file

Distributed Value of Time Settings

22) Household Manager – Min Value of Time, MaxValueOfTime, MeanValueOfTime.Values, MeanValueOfTime.Income.Limits, Mean.ValueOfTime.Multiplier.Mu, ValueOfTime.Lognormal.Sigma, HH.ValueOfTime.Multiplier.Under18 – Settings to calculate the person value of time. Refer to the CMAP ABM Model Specification document for details on the calculation.

Distributed Model Run Settings

23) Distributed Task Packet Size – The size of packages to distribute and process in CT-RAMP.

24) Initialization Packet Size – The initialization packet size for distributing tasks in CT-RAMP.

25) Number Initialization Packets – The number of initialization packets in CT-RAMP

Population Synthesizer Inputs

26) Population Synthesizer Household File – Location of the HH population synthesizer file

27) Population Synthesizer Person File – Location of the person population synthesizer file

28) Population Synthesizer Work Occupation Code Files – The crosswalk from PUMS Industry Census codes to CMAP worker occupancy classes.

Usual Work and School Location Choice Model Settings

29) Usual Work and School Location Choice – Run Flag - Work – Run the usual work location model

30) Usual Work and School Location Choice – Run Flag - University – Run the usual university location model

31) Usual Work and School Location Choice – Run Flag - School – Run the usual school location model

32) Usual Work and School Location Choice – Shadow Pricing – Max Iterations – the maximum number of show pricing iterations for the run.

33) Usual Work and School Location Choice Shadow Pricing Input File – The input file to use for re-start with shadow pricing if desired. This file would have been calculated from previous model run and has the same format as the output shadow pricing file. The default is to comment out this property.

Sample of Alternatives Sample Size Settings

34) Usual Work and School Location Choice Sample of Alts – Sample Size – The number of alternatives. The default is 30.

35) Joint Tour Location Choice Sample of Alts – Sample Size – The number of alternatives. The default is 30.

36) Individual Non Mandatory Tour Location Choice Sample of Alts – Sample Size – The number of alternatives. The default is 30

37) At Work Subtour Location Choice Sample of Alts – Sample Size – The number of alternatives. The default is 30.

38) Stop Location Choice Sample of Alts – Sample Size – The number of alternatives. The default is 30.

Departure Time Model Settings

39) The departTime.* properties in the properties file specify the tour departure and duration model UEC data pages for each activity.

CT-RAMP Output Files

40) CT-RAMP Output – Write to Disk – T/F to write the output files described below. See the Model Outputs section for details on each file (Households, Persons, and Tours).

Exec Folder

The Exec folder contains the following Java code files used by the model:

1) cmap.jar – the CMAP specific Java code that is the entry point for running the model. It requires the jar files specified below

2) ctrampIf.jar – the CT-RAMP Java code

3) synpop.jar – population synthesizer Java code

4) common-base.jar – PB's common modeling framework Java code

5) jxl.jar – J Excel Java code for reading Excel files

6) log4j-1.2.9.jar – Log4J Java code for logging

7) ssj.jar – University of Montreal stochastic simulation Java code

The Exec folder also contains the Microsoft PsExec.exe program for remote execution, the Microsoft PsKill.exe program for remote process termination, and the cmap_abm.sql script to load the output tables into a MySQL database, as described in the Model Outputs section.

Model Inputs

Inputs to the CMAP ABM are stored in the following folders: uecs, inputs, and p{1-8}.

UECs Folder

The uecs folder stores all CT-RAMP Utility Expression Calculator (UEC) files and choice model alternatives files. The files are summarized in the table below. Many of the UEC files, such as the Destination Choice UEC, contain multiple models. In addition, the complete definition of one destination choice model is actually spread across multiple files – DestinationChoice.xls, DestinationChoiceAlternatives.csv, DestinationChoiceAlternativeSample.xls, and DestinationChoiceSizeCoefficients.csv. Refer to the CMAP ABM Model Specification for a description of each CT-RAMP model.

Table 1: CT-RAMP Model Input Files

File Name	Description
AtWorkSubtourFrequency.xls	At work subtour frequency model UEC
AutoOwnership.xls	Auto ownership model UEC
AutoDependecy.xls	Auxiliary auto dependency model called by auto ownership model
cbd_parking_zones.csv	CBD parking zone alternatives
CoordinatedDailyActivityPattern.xls	Coordinated daily activity pattern model UEC

File Name	Description
DepartureTimeAndDurationAlternatives.csv	Tour departure time and duration models alternatives
DestinationChoice.xls	Destination choice model UECs (mandatory, maintenance, discretionary, at work subtours)
DestinationChoiceAlternatives.csv	Destination choice models alternatives (including 3 market segments by walk access to transit within each TAZ)
DestinationChoiceAlternativeSample.xls	Destination choice model sample of alternatives UECs
DestinationChoiceSizeCoefficients.csv	Destination choice models size term coefficients
FreeParkingEligibility.xls	Household free parking eligibility model UEC
IndividualMandatoryTourFrequency.xls	Individual mandatory tour frequency model UEC
IndividualNonMandatoryTourFrequency.xls	Individual non-mandatory tour frequency model UEC
IndividualNonMandatoryTourFrequency Alternatives.csv	Individual non-mandatory tour frequency alternatives by activity part one
IndividualNonMandatoryTourFrequencyExtension Probabilities.csv	Individual non-mandatory tour frequency alternatives part two
JointTours.xls	Joint tour frequency, party composition, person participation model UECs
ModeChoice.xls	Tour mode choice model UECs (mandatory, non-mandatory, at work subtour)
Parklocation.xls	Parking location choice model UEC (mandatory, non-mandatory)
stopDepartArriveProportions.csv	Stop departure time-of-day proportions
StopDestinationChoice.xls	Stop destination choice model UECs (mandatory, maintenance, discretionary, at work subtour)
StopDestinationChoiceAlternativeSample.xls	Stop destination choice model UECs sample of alternatives
StopDestinationChoiceCoefficients.csv	Stop destination choice models size term coefficients
StopFrequency.xls	Stop frequency model UECs (mandatory, maintenance, discretionary, at work subtour)
StopPurposeLookup.csv	Stop purpose shares by primary tour purpose, direction, time-of-day, and person type
TourDepartureAndDuration.xls	Tour departure time and duration model UECs (mandatory, joint non-mandatory, individual non-mandatory, at work subtour)
TripDepartHourPercents.csv	Trip depart time hour percents by tour purpose, inbound/outbound, tour hour and trip index
TripModeChoice.xls	Trip mode choice model UECs (mandatory, non-mandatory, work subtour)

Inputs Folder

The Inputs folder stores various inputs such as zonal land use data, the synthetic population, time-of-day factors for EMME, zonal accessibility measures, etc. Some of these inputs are expected to change for each new scenario/alternative. Each input file is described in detail below.

Table 2: Inputs Folder Input Files

File Name	Description
EMME	
Directional.splits	PA to OD directional factors by time period
Kzone.mtx	Kzone park and ride lot matrix
Tod_factors.p{1-8}	Time period trip table factors for each trip matrix by time period
Tod_flags.in	Zone flags for trip table fractioning
TOD_OCC_INC_NON_WORK.p{1-8}	Time period distribution by occupancy and income for HBO and NHB
tollsys.flag	Toll facility link flag used by extraclass.mac
CT-RAMP	
Accessibility.csv	Zonal accessibility measures (which would be calculated on-the-fly in a full ABM implementation)
ForecastHHFile.csv	Synthesized household population file
ForecastPersonFile.csv	Synthesized person population file
totalpctwkt.csv	Percent of zone with no walk transit access, with short walk to transit access, and with long walk to transit access
workerOccupationCodes.csv	Crosswalk from Census Industry codes to CMAP ABM employment categories
ZoneData.csv	Zonal level data such as population, employment by employment type, parking costs, area type, etc
ModesNames.csv	Mode code to Mode name lookup for MySQL database script

Accessibilites.csv – Zonal accessibility measures

Table 3: Accessibility Measures File Fields

Field	Description
taz	TAZ
autoPeakRetail	Peak Auto Retail accessibility
autoPeakTotal	Peak Auto Total accessibility
autoOffPeakRetail	Off-Peak Auto Retail accessibility

autoOffPeakTotal	Off-Peak Auto Total accessibility
transitPeakRetail	Peak Transit Retail accessibility
transitPeakTotal	Peak Transit Total accessibility
transitOffPeakRetail	Off-Peak Transit Retail accessibility
transitOffPeakTotal	Off-Peak Transit Total accessibility
nonMotorizedRetail	Non-motorized retail accessibility
nonMotorizedTotal	Non-motorized total accessibility
access17	Transit accessibilities to all non-mandatory activity locations
access18	Non-motorized accessibilities to all non-mandatory activity locations

ForecastHHFile.csv – Synthetic Population Household File

This file contains the synthesized household population for the model year. See the 2000 PUMS documentation for details on the possible values for the fields.

Table 4: Synthesized Household File Fields

Field	Description
HHID	Household ID
TAZ	TAZ
SERIALNO	Housing/Group Quarters (GQ)Unit Serial Number
PUMA5	Public Use Microdata Area Code (PUMA)
HINC	Household Total Income in 1999
PERSONS	Number of person records following this housing record
HHT	Household/Family Type
UNITTYPE	Type of unit
NOC	Number of own children under 18 years in household
BLDGSZ	Size of Building
TENURE	Home Ownership
hinccat1	HH annual income (4 categories)
hinccat2	HH annual income (9 1-digit categories)
hhagecat	age of householder (1--under 65, 2--65+)
hsizecat	household size category (1--1,2--2,3--3,4--4,5--5+)
hsizecat6	household size category (1--1,2--2,3--3,4--4,5--5,6--6+)
hfamily	HH is nonfamily(1) or family(2)
hunittype	Type of group quarters household (0--non-GQ, 1--inst. GQ, 2--noninst GQ, 3--empty housing unit)
hNOCcat	Presence of own children age 00-17 (0-none, 1-1 or more)
hNCcat6	Number children age 00-17 in household (0-0,1-1,2-2,3-3,4-4,5-5+)

hwrkrcat	Number in HH employed PT or FT (0--0,1--1,2--2,3--3+)
hwrkcat5	Number in HH employed PT or FT (0--0,1--1,2--2,3--3,4--4+)
h0005	Number in HH age under 6
h0611	Number in HH age 6-11
h1215	Number in HH age 12-15
h1617	Number in HH age 16-17
h1824	Number in HH age 18-24
h2534	Number in HH age 25-34
h3549	Number in HH age 35-49
h5064	Number in HH age 50-64
h6579	Number in HH age 65-79
h80up	Number in HH age 80+
hworkers	Number in HH employed PT or FT
hwork_f	Num in HH with ptype=1 (FT worker age 16+)
hwork_p	Num in HH with ptype=2 (PT worker nonstudent age 16+)
huniv	Num in HH with ptype=3 (university student)
hnwork	Num in HH with ptype=4 (nonworker nonstudent age 16-64)
hretire	Num in HH with ptype=5 (nonworker nonstudent age 65+)
hpresch	Num in HH with ptype=8 (under age 6)
hschpred	Num in HH with ptype=7 (age 6-15)
hschdriv	Num in HH with ptype=6 (age 16-19 student ; not FT wrkr or univ stud)
htypdwel	Type of dwelling unit: 1-detached SF / 2-attached / 3-mobile home
hownrent	own or rent dwelling
hadnwst	Number in HH not-employed students age 16+ (PUMS P.ESR in {3,6} and P.GRADE>0)
hadwpst	Number in HH employed students age 16+ (PUMS P.ESR in {1,2,4,5} and P.GRADE>0)
hadkids	Number adult children in HH (padkid=1)
bucketBin	Number of subgroups into which each PUMA's HHs of a single category are grouped
originalPUMA	Original PUMA
WIF	Workers in family
VEHICL	Number of Vehicles Available

ForecastPersonFile.csv - Synthetic Population Person File

This file contains the synthesized person population for the model year. See the 2000 PUMS documentation for details on the possible values for the fields.

Table 5: Synthesized Person File Fields

Field	Description
HHID	Household ID
PERID	Person ID
AGE	Age
RELATE	Relationship
ESR	Employment Status Recode
GRADE	School Enrollment: Grade Level Attending
PNUM	Person Sequence Number
PAUG	Augmented Person Flag
DDP	Data-defined Person Flag
SEX	Sex
WEEKS	Weeks Worked in 1999
HOURS	Hours Worked Per Week in 1999
RACE1	Race Recode 1
HISPAN	Hispanic or Latino Origin
MSP	Married, Spouse Present Recode
POVERTY	Person ’s Poverty Status
EARNS	Person ’s Total Earnings in 1999
pagecat	Age category (10 1-digit categories)
pemploy	Employment status (1-employed FT, 2-employed PT, 3-not employed, 4-under age 16)
pstudent	1-primary or secondary student age 3+; 2-post-secondary student; 3-age under 3 or not a student (from PUMS P.GRADE)
phispan	hispanic: 1-not hispanic, 2-hispanic (PUMS min(P.HISPAN,2))
ptype	Person type (8 categories)
padkid	young adult age 18-24 in family household with older adult age 35-64 in HH: 1-yes, 2-no
EDUC	Education attainment in years
INDCEN	Industry Census code

totalpctwkt.csv - Percent short walk and long walk access by zone

Table 6: Percent Short and Long Walk Access Fields

Field	Description
TAZ	TAZ
SHRT	Percent zone short transit walk accessible (1/3 mi)
LONG	Percent zone long transit walk accessible (2/3 mi)

workerOccupationCodes.csv – Census Industry to Employment Categories

Table 7: Worker Occupation Code Fields

Field	Description
IndCenMin	Census person industry code range minimum
IndCenMax	Census person industry code range maximum
workerOccupation	CMAP ABM employment category

ZoneData.csv – Zone data

Table 8: Zone Data Fields

Field	Description
Zone	Zone
Construc	Construction Employment
Manufac	Manufacturing Employment
TCU	TCU (Transportation, Communication, Utilities)
Wholesl	Wholesale Employment
Retail	Retail Employment
FIRE	Fire Employment
Service	Service Employment
Private	Total Private Employment
Govt	Government Employment
Emp	Total Employment
Pop	Population
Hshld	Households
Univ	University Enrollment
Acres	Area (acres)
OtherEmp	Other employment
District	District code
Parktot	Total parking spaces
Parklng	Long term parking spaces

Propfree	Proportion free parking
Parkrate	Parking rate ($)
areatype	Area type
County	County code
CBD FLAG	CBD Flag
Highschool	High school code
Gradeschool	Grade school code
naics11	NAICS employment category employment
naics21	NAICS employment category employment
naics22	NAICS employment category employment
naics23	NAICS employment category employment
naics31_33	NAICS employment category employment
naics42	NAICS employment category employment
naics44_45	NAICS employment category employment
naics48_49	NAICS employment category employment
naics51	NAICS employment category employment
naics52	NAICS employment category employment
naics53	NAICS employment category employment
naics54	NAICS employment category employment
naics55	NAICS employment category employment
naics56	NAICS employment category employment
naics61	NAICS employment category employment
naics62	NAICS employment category employment
naics71	NAICS employment category employment
naics72	NAICS employment category employment
naics81	NAICS employment category employment
naics92	NAICS employment category employment
naics99	NAICS employment category employment
k8_enroll	School enrollment
Highschool_enroll	High school enrollment
small_coll	Small college enrollment
lg_college	Large college enrollment
B_hhden	Buffered household density
B_empden	Buffered employment density
Pef	Walkability measure for the zone
Ring	Area ring code

ModeNames.csv – Mode code to name lookup table

Table 9: Mode Name Fields for Loading Outputs into Database

Field	Description
CODE	Mode code (alternative number)
NAME	Mode name

P{1-8} Folders

The p{1-8} folders each contain one EMME databank for the named time period. The databank is used for skimming and assignment as well as binary route type choice (between toll and non-toll users) for all traffic components not handled by the core CT-RAMP model (trucks and commercial vehicles by type, externals, and auto trips to and from the O'Hare airport). The matrix numbers are the same across databanks. The time periods are defined in the first table below. The second table defines the highway matrices and the third table the transit matrices.

Table 10: Time Period Databanks

TOD Period	Time-Of-Day	Highway Skims	Transit Skims
1	8pm-6am	p1	p1 (offpeak)
2	6am-7am	p2	p2 (peak)
3	7am-9am	p3	
4	9am-10am	p4	
5	10am-2pm	p5	
6	2pm-4pm	p6	
7	4pm-6pm	p7	
8	6pm-8pm	p8	

Highway Skims

Table 11: Highway Skims

Variable		Matrix Number by Highway Mode					
		SOV (SV1**)		HOV2 (HV2**)		HOV3+ (HV3**)	
		Non-Toll (*n*)	Toll (*t*)	Non-Toll (*n*)	Toll (*t*)	Non-Toll (*n*)	Toll (*t*)
Congested time	**(**1c)**	175	180	185	190	195	200
Toll	**(**2t)**	176	181	186	191	196	201

Variable		Matrix Number by Highway Mode					
		SOV (SV1**)		HOV2 (HV2**)		HOV3+ (HV3**)	
		Non-Toll (*n*)	Toll (*t*)	Non-Toll (*n*)	Toll (*t*)	Non-Toll (*n*)	Toll (*t*)
Distance	**(**3d)**	177	182	187	192	197	202
Toll distance	**(**4m)**	178	183	188	193	198	203
Free-flow time	**(**5f)**	179	184	189	194	199	204

Transit Skims

Table 12: Transit Skims

Variable		Matrix Number by Transit Mode and Sub-Mode					
		Bus (B**)		Metro (M**)		Rail (R**)	
		Walk (*W*)	Auto (*A*)	Walk (*W*)	Auto (*A*)	Walk (*W*)	Auto (*A*)
In-vehicle time	**(**ivt)**	351 (bus)	361 (bus)	371 (metro)	381 (metro)	391 (rail)	401 (rail)
In-vehicle time (bus)	**(**ivtb)**	352 (zero)	362 (zero)	372 (bus)	382 (bus)	392 (bus)	402 (bus)
In-vehicle time (metro)	**(**ivtm)**	353 (zero)	363 (zero)	373 (zero)	383 (zero)	393 (metro)	403 (metro)
Walk time	**(**walk)**	354	364	374	384	394	404
Fare, cents	**(**fare)**	355	365	375	385	395	405
First Wait time	**(**fwai)**	356	366	376	386	396	406
Number of boardings	**(**xfer)**	357	367	377	387	397	407
Transfer Wait time	**(**xwai)**	358	368	378	388	398	408

Variable		Matrix Number by Transit Mode and Sub-Mode					
		Bus (B**)		Metro (M**)		Rail (R**)	
		Walk (*W*)	Auto (*A*)	Walk (*W*)	Auto (*A*)	Walk (*W*)	Auto (*A*)
Drive access parking cost, cents	**(**park)**	359 (zero)	369	379 (zero)	389	399 (zero)	409
Drive access auto time	**(**auto)**	360 (zero)	370	380 (zero)	390	400 (zero)	410

Model Outputs

The core outputs of the CMAP ABM are summarized in the following table. The outputs are grouped into three sections – EMME, CSV Files, and Trip Matrices. In addition to the skims created and described above, the EMME outputs are matrices created by the EMME macros that remain in EMME. These are non-CT-RAMP matrices such as trucks, external model trips and airport trips. The CSV output files are the ABM model outputs and are described in more detail below. The Trip Matrices are also output by CT-RAMP and are written into the databanks.

Table 13: Model Output Files

Output	Description
EMME	
Mf135-142	Truck demand matrices by toll/non-toll and class (commercial, light truck, medium truck, heavy truck)
Mf143-154	External demand matrices by toll/non-toll and class (SOV1 low inc., SOV1 high inc., HOV2 low inc., HOV2 high inc., HOV3 low inc., HOV3 high inc.)
Mf155-166	Airport demand matrices by toll/non-toll and class (SOV1 low inc., SOV1 high inc., HOV2 low inc., HOV2 high inc., HOV3 low inc., HOV3 high inc.)
CSV Files	
hh_Data_{loop}.csv	household attribution results
personData_{loop}.csv	person attribution results
ShadowPricing_{shadowPricingIteration}.csv	shadow pricing results
wsLocResults_{loop}.csv	usual work and school location choice results

aoResults.csv	auto ownership results
cdapResults.csv	CDAP model results
indivTourData_{loop}.csv	individual tour records
jointTourData_{loop}.csv	joint tour records
indivTripData_{loop}.csv	individual trip records
jointTripData_{loop}.csv	joint trip records
Trip Matrices written to Each p{1-8} Databank	
Mf123	SOV1n1 - SOV non-toll, low income trips
Mf124	SOV1tl – SOV toll, low income trips
Mf125	SOV1nh – SOV non-toll, high income trips
Mf126	SOV1th – SOV toll, high income trips
Mf127	HOV2nl – HOV2 non-toll, low income trips
Mf128	HOV2tl – HOV2 toll, low income trips
Mf129	HOV2nh – HOV2 non-toll, high income trips
Mf130	HOV2th – HOV2 toll, high income trips
Mf131	HOV3nl – HOV 3+ non-toll, low income trips
Mf132	HOV3tl – HOV 3+ toll, low income trips
Mf133	HOV3nh – HOV 3+ non-toll, high income trips
Mf134	HOV3th – HOV 3+ toll, high income trips

CSV Files

1) Household attribution results – hh_Data_{loop}.csv

The household data file for each feedback loop has the following fields:

Table 14: Household Output File Fields

Field	Description
hh_id	Household ID
taz	Origin TAZ
walk_subzone	Walk subzone
income	HH income
autos	Autos
jtf_choice	Joint tour frequency choice
size	HH size
workers	Number of workers in HH
auto_suff	Auto sufficiency

2) Person attribution results – personData_{loop}.csv

The person data file for each feedback loop has the following fields:

Table 15: Person Output File Fields

Field	Description
hh_id	Household ID
person_id	Person ID
person_num	person number in HH
age	Age
gender	Gender
type	person type (worker, student, etc)
value_of_time	value of time
fp_choice	free parking choice
activity_pattern	activity pattern
imf_choice	individual mandatory tour freq choice
inmf_choice	individual non-mandatory tour freq choice

3) Shadow pricing result files – ShadowPricing_{shadowPricingIteration}.csv

Each iteration of the shadow pricing results for each taz and subzone by destination choice size term class are written to this file.

4) Usual work and school location choice results – wsLocResults_{loop}.csv

The usual work and school location choice results table consists of the following fields:

Table 16: Usual Work and School Location Choice Output File Fields

Field	Description
HHID	household ID
HomeTAZ	Home TAZ
HomeSubZone	Home subzone
PersonID	Person ID
PersonNum	Person number in HH
PersonWorkOcc	Worker occupancy code
PersonType	Person type
PersonAge	Age
EmploymentCategory	employment category
StudentCategory	student category

WorkLocation	work TAZ location
WorkSubZone	work subzone
SchoolLocation	school TAZ location
SchoolSubZone	school subzone

Table 17: Person Type Codes

Person Type Code	Description
1	Full-time worker
2	Part-time worker
3	Non-worker
4	Retired
5	University Student
6	Student of driving age
7	Student of non-driving age
8	Child too young for school

5) Auto ownership results – aoResults.csv

Table 18: Auto Ownership Output File Fields

Field	Description
hhid	Household ID
ao	Number of autos

6) Coordinated Daily Activity Pattern (CDAP) results – cdapResults.csv

The results of the CDAP model are written to this file.

Table 19: CDAP Output File Fields

Field	Description
HHID	household ID
PersonID	Person ID
PersonNum	Person number in HH
PersonType	Person type
ActivityString	Daily activity pattern (M = mandatory, N = non-mandatory, H = at home)

7) Individual tour records – indivTourData_{loop}.csv

Individual tours for each CT-RAMP feedback loop are written to this file.

Table 20: Individual Tours Output File Fields

Field	Description
hh_id	Household ID
person_id	Person ID
person_num	Person number in household
person_type	Numeric identifier of person type
tour_id	Tour number for each person (e.g. 0 = first tour made by a person, 1 = second tour, etc)
tour_category	tour category
tour_purpose	purpose of tour
orig_taz	tour origin taz location
orig_walk_segment	tour origin subzone
dest_taz	tour destination taz location
dest_walk_segment	tour destination subzone
depart_period	tour depart period
Arrive_period	tour arrival period
tour_mode	mode of tour
atWork_freq	number of at work subtours made
num_ob_stops	number of outbound stops on tour
num_ib_stops	number of inbound stops made on tour
util_1	utility for mode 1
util_2	utility for mode 2
…	
util_26	utility for mode 26
prob_1	probability of mode 1
prob_2	probability of mode 2
…	
prob_26	probability of mode 26

Table 21: Trip/Tour Mode Codes

Trip/Tour Mode Code	Description
1	Drive alone free
2	Drive alone pay
3	Shared ride 2 free
4	Shared ride 2 pay
5	Shared ride 3+ free
6	Shared ride 3+ pay
7	Walk
8	Bike
9	Walk to local transit
10	Walk to premium transit
11	Drive to local transit
12	Drive to premium transit
13	Taxi
14	School bus

8) Joint tour records – jointTourData_{loop}.csv

Joint tours for each CT-RAMP feedback loop are written to this file.

Table 22: Joint Tours Output File Fields

Field	Description
hh_id	Household ID
tour_id	Tour ID
tour_category	tour category (joint non-mandatory)
tour_purpose	purpose of tour
tour_composition	tour composition
tour_participants	household participants on tour (e.g. 1 2 4 = persons 1, 2, and 4 in the household)
orig_taz	tour origin taz location
orig_walk_segment	tour origin subzone
dest_taz	tour destination taz location
dest_walk_segment	tour destination subzone
depart_period	tour depart period
arrive_period	tour arrival period
tour_mode	mode of tour

num_ob_stops	number of outbound stops on tour
num_ib_stops	number of inbound stops made on tour
util_1	utility for mode 1
util_2	utility for mode 2
…	
util_26	utility for mode 26
prob_1	probability of mode 1
prob_2	probability of mode 2
…	
prob_26	probability of mode 26

9) Individual trip records – indivTripData_{loop}.csv

Individual trips for each CT-RAMP feedback loop are written to this file.

Table 23: Individual Trips Output File Fields

Field	Description
hh_id	Household ID
person_id	Person ID
person_num	Person number
tour_id	Tour ID
stop_id	Stop ID
inbound	Is Inbound Trip
tour_purpose	Tour Purpose
orig_purpose	Origin purpose
dest_purpose	Destination purpose
orig_taz	Origin TAZ
orig_walk_segment	Origin walk market segment
dest_taz	Destination TAZ
dest_walk_segment	Destination walk market segment
parking_taz	Parking TAZ used
stop_period	Stop period
trip_mode	Trip Mode
tour_mode	Tour mode
tour_category	Tour category

10) Joint trip records – jointTripData_{loop}.csv

Joint trips for each CT-RAMP feedback loop are written to this file.

Table 24: Joint Trips Output File Fields

Field	Description
hh_id	Household ID
tour_id	Tour ID
stop_id	Stop ID
inbound	Is Inbound Trip
tour_purpose	Tour Purpose
orig_purpose	Origin purpose
dest_purpose	Destination purpose
orig_taz	Origin TAZ
orig_walk_segment	Origin walk market segment
dest_taz	Destination TAZ
dest_walk_segment	Destination walk market segment
parking_taz	Parking TAZ used
stop_period	Stop period
trip_mode	Trip Mode
Num_part	Number of participants on tour
tour_mode	Tour mode
tour_category	Tour category

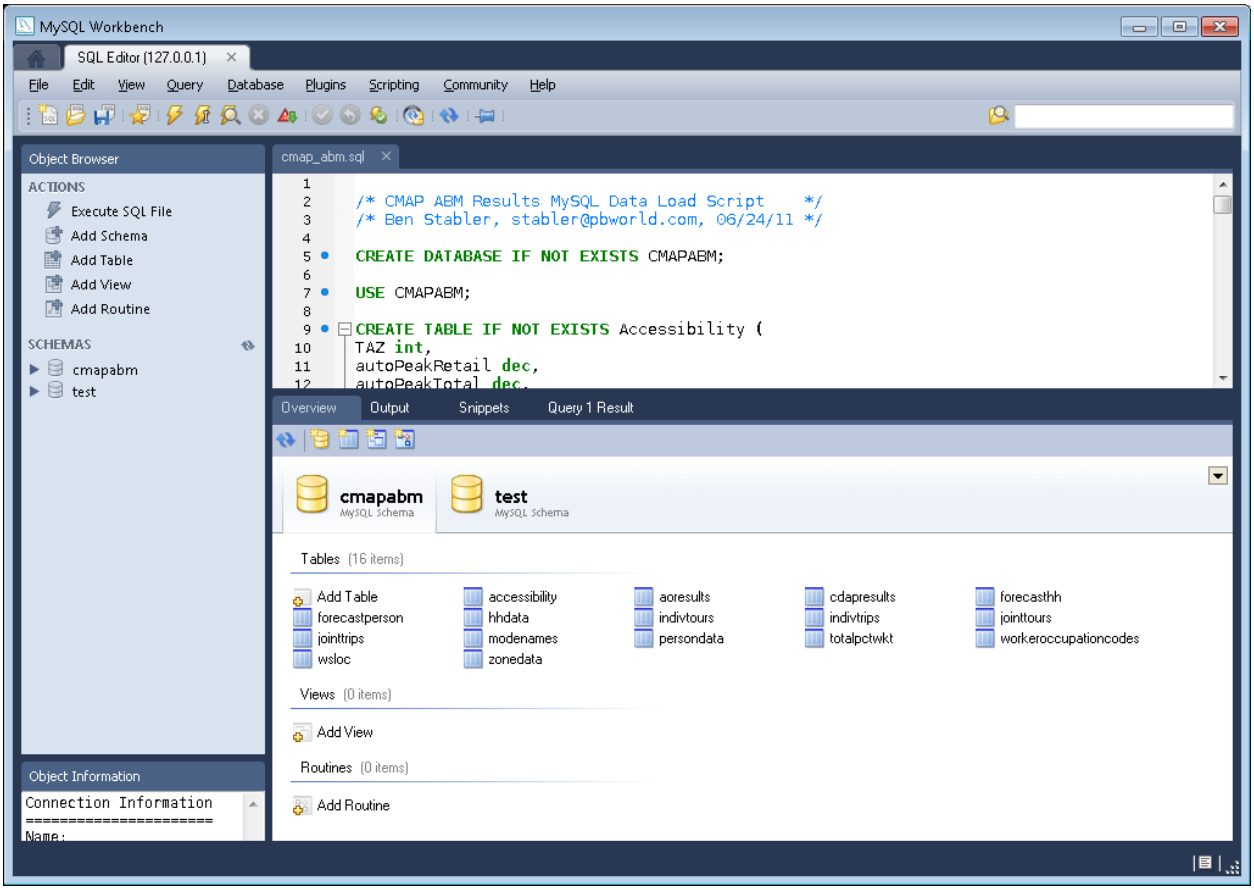
MySQL

The resulting CT-RAMP output files plus the input synthetic population and zone data files can be loaded into a MySQL database with the cmap_abm.sql script in the exec folder. To run the script, do the following:

1) Edit the LOAD DATA LOCAL FILE commands to reference the project directory folder.

2) Run the script with MySQL Workbench. The script will create a new database called CMAPABM with 16 tables, as shown below. The tables are the same tables described in the inputs and outputs sections above.

Figure 5: MySQL CMAPABM Database



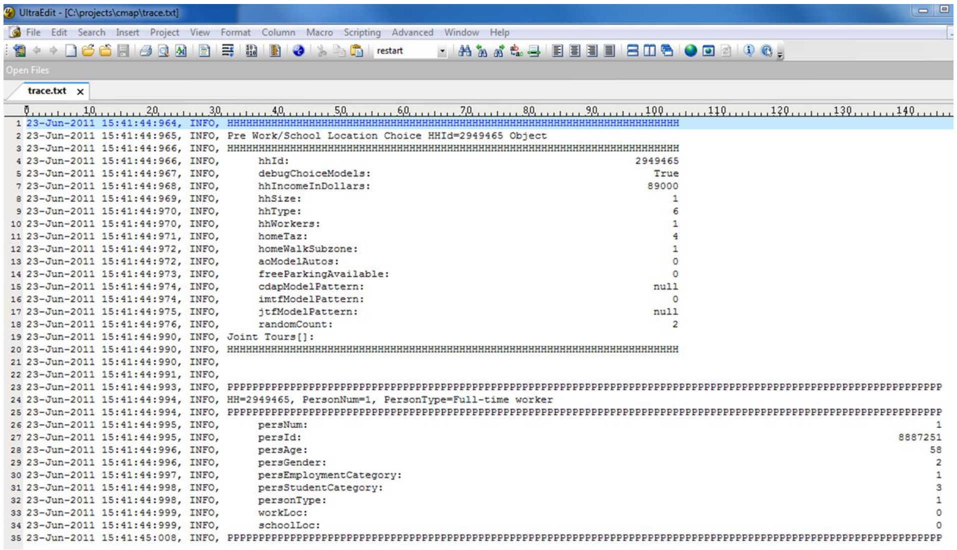
Model Logging/Trace Results

CT-RAMP writes a series of log files to the logFiles folder during a model run. These log files are extremely useful for understanding the model as well as for debugging a model run. The main log file is the event.log file and it is the starting point for reviewing the logs. In addition to event.log, the event_hh.log logs the household data manager work, event_mtx.log logs the matrix data manager work, and event-node<X>.log logs the work on each remote node. There are also model component specific log files for each node such as event-node1-ao.log for the auto ownership model being run on remote machine node 1.

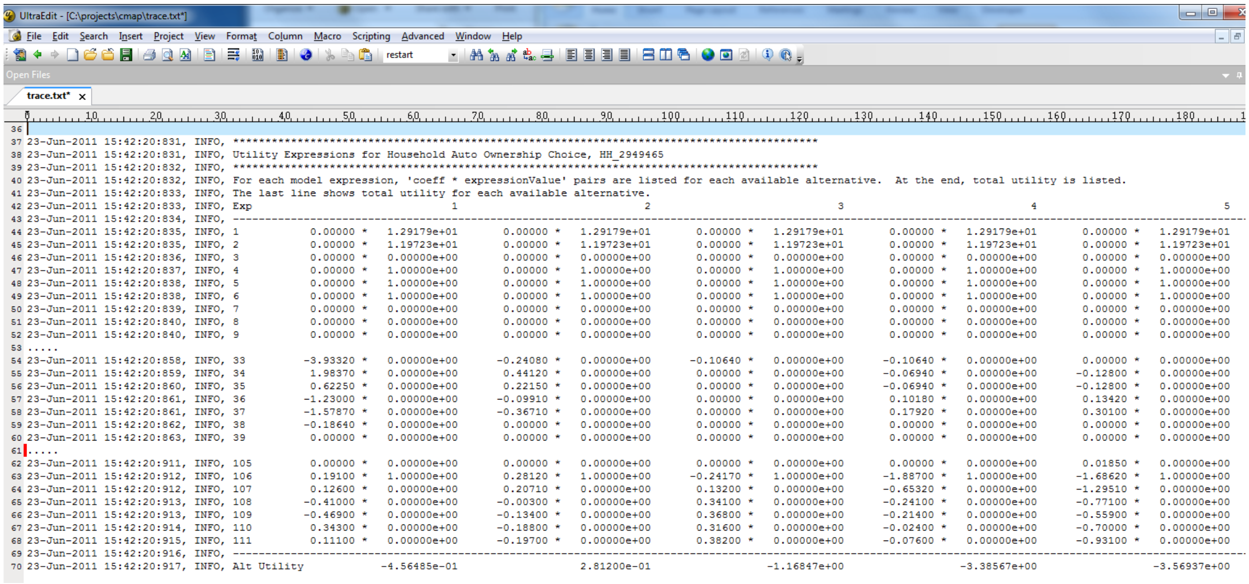
In addition to writing log files, CT-RAMP can trace model calculations for a user specified household. To trace results for household 2949465 for example, set Debug.Trace.HouseholdIdList = 2949465 in the cmap.properties file. This tells CT-RAMP to basically write out all calculations for every person in household 2949465, including the results of the UEC calculations for each model. Figure 6 below contains a sample of the household trace results. The first screenshot shows a sample of the trace

results for the household and person number 1 in the household. As is shown below, key attributes of the household and person are traced such as the household income, size, number of workers, home TAZ, person age, person employment category (worker, retired, etc). As is shown in the second screenshot, which is the auto ownership model trace for household 2949465, the value of the coefficient for each alternative times the value of each expression is logged. The 111 expressions and five alternatives (0, 1, 2, 3, 4+ autos) traced correspond exactly with the expressions and alternatives in the auto ownership UEC file, which makes tracing and debugging easier.

Figure 6: Household Trace Results



```
23-Jun-2011 15:41:44:964, INFO, HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
23-Jun-2011 15:41:44:965, INFO, Pre Work/School Location Choice HHId=2949465 Object
23-Jun-2011 15:41:44:966, INFO, HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
23-Jun-2011 15:41:44:966, INFO,      hhId:                                                       2949465
23-Jun-2011 15:41:44:967, INFO,      debugChoiceModels:                                             True
23-Jun-2011 15:41:44:968, INFO,      hhIncomeInDollars:                                            89000
23-Jun-2011 15:41:44:969, INFO,      hhSize:                                                           1
23-Jun-2011 15:41:44:970, INFO,      hhType:                                                           6
23-Jun-2011 15:41:44:970, INFO,      hhWorkers:                                                        1
23-Jun-2011 15:41:44:971, INFO,      homeTaz:                                                          4
23-Jun-2011 15:41:44:972, INFO,      homeWalkSubzone:                                                  1
23-Jun-2011 15:41:44:972, INFO,      aoModelAutos:                                                     0
23-Jun-2011 15:41:44:973, INFO,      freeParkingAvailable:                                             0
23-Jun-2011 15:41:44:974, INFO,      cdapModelPattern:                                              null
23-Jun-2011 15:41:44:974, INFO,      imtfModelPattern:                                                 0
23-Jun-2011 15:41:44:975, INFO,      jtfModelPattern:                                               null
23-Jun-2011 15:41:44:976, INFO,      randomCount:                                                      2
23-Jun-2011 15:41:44:990, INFO, Joint Tours[]:
23-Jun-2011 15:41:44:990, INFO, HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
23-Jun-2011 15:41:44:990, INFO,
23-Jun-2011 15:41:44:991, INFO,
23-Jun-2011 15:41:44:993, INFO, PPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPP
23-Jun-2011 15:41:44:994, INFO, HH=2949465, PersonNum=1, PersonType=Full-time worker
23-Jun-2011 15:41:44:994, INFO, PPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPP
23-Jun-2011 15:41:44:995, INFO,      persNum:                                                                                                    1
23-Jun-2011 15:41:44:995, INFO,      persId:                                                                                               8887251
23-Jun-2011 15:41:44:996, INFO,      persAge:                                                                                                   58
23-Jun-2011 15:41:44:996, INFO,      persGender:                                                                                                 2
23-Jun-2011 15:41:44:997, INFO,      persEmploymentCategory:                                                                                     1
23-Jun-2011 15:41:44:998, INFO,      persStudentCategory:                                                                                        3
23-Jun-2011 15:41:44:998, INFO,      personType:                                                                                                 1
23-Jun-2011 15:41:44:999, INFO,      workLoc:                                                                                                    0
23-Jun-2011 15:41:44:999, INFO,      schoolLoc:                                                                                                  0
23-Jun-2011 15:41:45:008, INFO, PPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPP
```



```
23-Jun-2011 15:42:20:831, INFO, *******************************************************************************************
23-Jun-2011 15:42:20:831, INFO, Utility Expressions for Household Auto Ownership Choice, HH_2949465
23-Jun-2011 15:42:20:832, INFO, *******************************************************************************************
23-Jun-2011 15:42:20:832, INFO, For each model expression, 'coeff * expressionValue' pairs are listed for each available alternative.  At the end, total utility is listed.
23-Jun-2011 15:42:20:833, INFO, The last line shows total utility for each available alternative.
23-Jun-2011 15:42:20:833, INFO, Exp                               1                             2                             3                             4                             5
23-Jun-2011 15:42:20:834, INFO, -------------------------------------------------------------------------------------------------------------------------------------------------------------
23-Jun-2011 15:42:20:835, INFO, 1           0.00000 *   1.29179e+01       0.00000 *   1.29179e+01       0.00000 *   1.29179e+01       0.00000 *   1.29179e+01       0.00000 *   1.29179e+01
23-Jun-2011 15:42:20:835, INFO, 2           0.00000 *   1.19723e+01       0.00000 *   1.19723e+01       0.00000 *   1.19723e+01       0.00000 *   1.19723e+01       0.00000 *   1.19723e+01
23-Jun-2011 15:42:20:836, INFO, 3           0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00
23-Jun-2011 15:42:20:837, INFO, 4           0.00000 *   1.00000e+00       0.00000 *   1.00000e+00       0.00000 *   1.00000e+00       0.00000 *   1.00000e+00       0.00000 *   1.00000e+00
23-Jun-2011 15:42:20:838, INFO, 5           0.00000 *   1.00000e+00       0.00000 *   1.00000e+00       0.00000 *   1.00000e+00       0.00000 *   1.00000e+00       0.00000 *   1.00000e+00
23-Jun-2011 15:42:20:838, INFO, 6           0.00000 *   1.00000e+00       0.00000 *   1.00000e+00       0.00000 *   1.00000e+00       0.00000 *   1.00000e+00       0.00000 *   1.00000e+00
23-Jun-2011 15:42:20:839, INFO, 7           0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00
23-Jun-2011 15:42:20:840, INFO, 8           0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00
23-Jun-2011 15:42:20:840, INFO, 9           0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00
.....
23-Jun-2011 15:42:20:858, INFO, 33         -3.93320 *   0.00000e+00      -0.24080 *   0.00000e+00      -0.10640 *   0.00000e+00      -0.10640 *   0.00000e+00       0.00000 *   0.00000e+00
23-Jun-2011 15:42:20:859, INFO, 34          1.98370 *   0.00000e+00       0.44120 *   0.00000e+00       0.00000 *   0.00000e+00      -0.06940 *   0.00000e+00      -0.12800 *   0.00000e+00
23-Jun-2011 15:42:20:860, INFO, 35          0.62250 *   0.00000e+00       0.22150 *   0.00000e+00       0.00000 *   0.00000e+00      -0.06940 *   0.00000e+00      -0.12800 *   0.00000e+00
23-Jun-2011 15:42:20:861, INFO, 36         -1.23000 *   0.00000e+00      -0.09910 *   0.00000e+00       0.00000 *   0.00000e+00       0.10180 *   0.00000e+00       0.13420 *   0.00000e+00
23-Jun-2011 15:42:20:861, INFO, 37         -1.57870 *   0.00000e+00      -0.36710 *   0.00000e+00       0.00000 *   0.00000e+00       0.17920 *   0.00000e+00       0.30100 *   0.00000e+00
23-Jun-2011 15:42:20:862, INFO, 38         -0.18640 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00
23-Jun-2011 15:42:20:863, INFO, 39          0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00
.....
23-Jun-2011 15:42:20:911, INFO, 105         0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.00000 *   0.00000e+00       0.01850 *   0.00000e+00
23-Jun-2011 15:42:20:912, INFO, 106         0.19100 *   1.00000e+00       0.28120 *   1.00000e+00      -0.24170 *   1.00000e+00      -1.88700 *   1.00000e+00      -1.68620 *   1.00000e+00
23-Jun-2011 15:42:20:912, INFO, 107         0.12600 *   0.00000e+00       0.20710 *   0.00000e+00       0.13200 *   0.00000e+00      -0.65320 *   0.00000e+00      -1.29510 *   0.00000e+00
23-Jun-2011 15:42:20:913, INFO, 108        -0.41000 *   0.00000e+00      -0.00300 *   0.00000e+00       0.34100 *   0.00000e+00      -0.24100 *   0.00000e+00      -0.77100 *   0.00000e+00
23-Jun-2011 15:42:20:913, INFO, 109        -0.46900 *   0.00000e+00      -0.13400 *   0.00000e+00       0.36800 *   0.00000e+00      -0.21400 *   0.00000e+00      -0.55900 *   0.00000e+00
23-Jun-2011 15:42:20:914, INFO, 110         0.34300 *   0.00000e+00      -0.18800 *   0.00000e+00       0.31600 *   0.00000e+00      -0.02400 *   0.00000e+00      -0.70000 *   0.00000e+00
23-Jun-2011 15:42:20:915, INFO, 111         0.11100 *   0.00000e+00      -0.19700 *   0.00000e+00       0.38200 *   0.00000e+00      -0.07600 *   0.00000e+00      -0.93100 *   0.00000e+00
23-Jun-2011 15:42:20:916, INFO, -------------------------------------------------------------------------------------------------------------------------------------------------------------
23-Jun-2011 15:42:20:917, INFO, Alt Utility            -4.56485e-01                   2.81200e-01                  -1.16847e+00                  -3.38567e+00                  -3.56937e+00
```