Sub-area Origin-Destination (OD) Extraction

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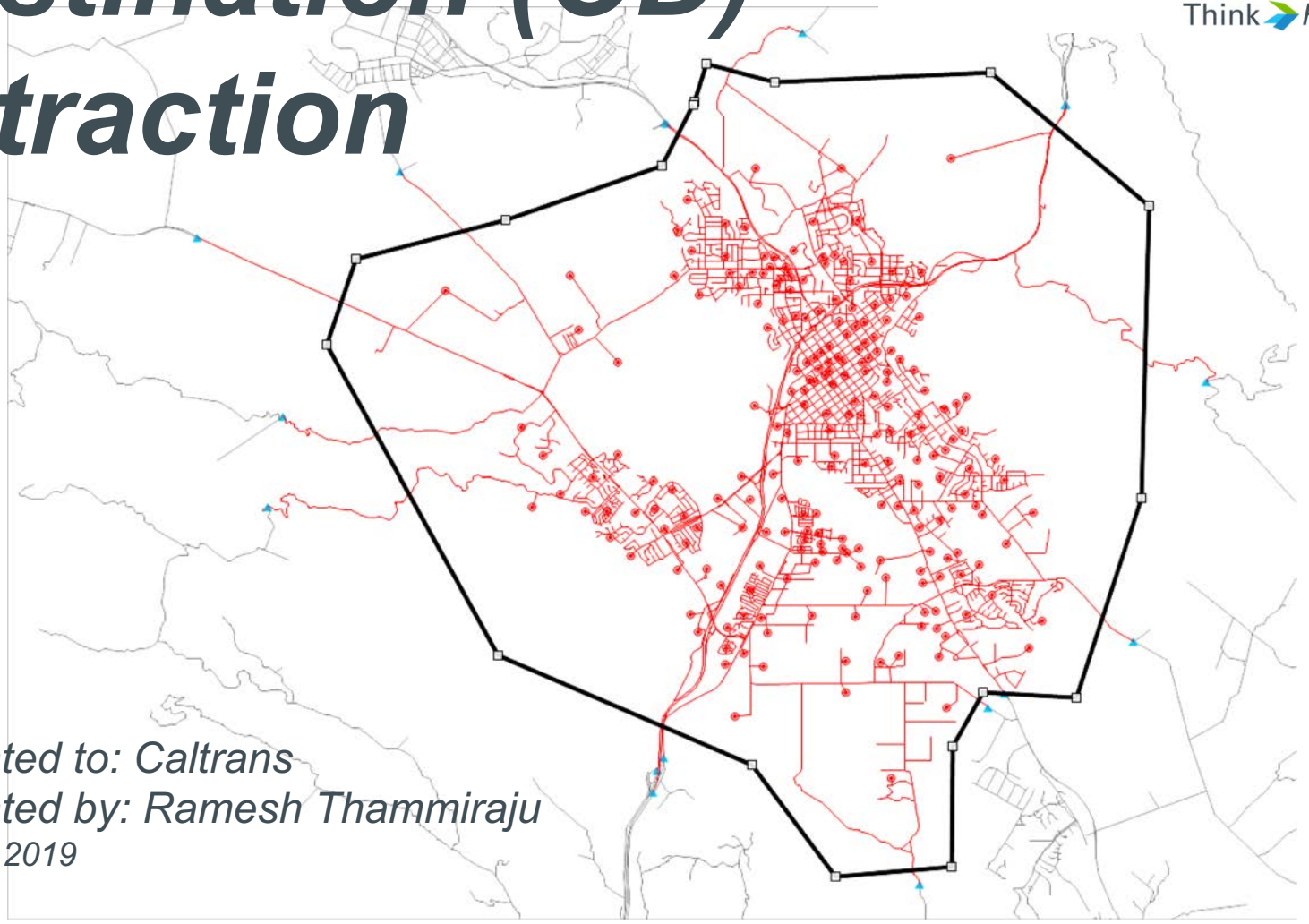
Think Forward



Presented to: Caltrans

Presented by: Ramesh Thammiraju

Jan 15th, 2019

Outline

- **Focus on Sub-area OD Extraction**
- **Concepts**
  - Travel Demand Model (four-step model basics)
  - OD table basics
  - Traffic assignment basics
  - Sub-area OD extraction
- ***Break (10 minute)***
- **Demonstration…**
  - **…of Sub-area extraction procedure**
- **Q & A**

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Agenda

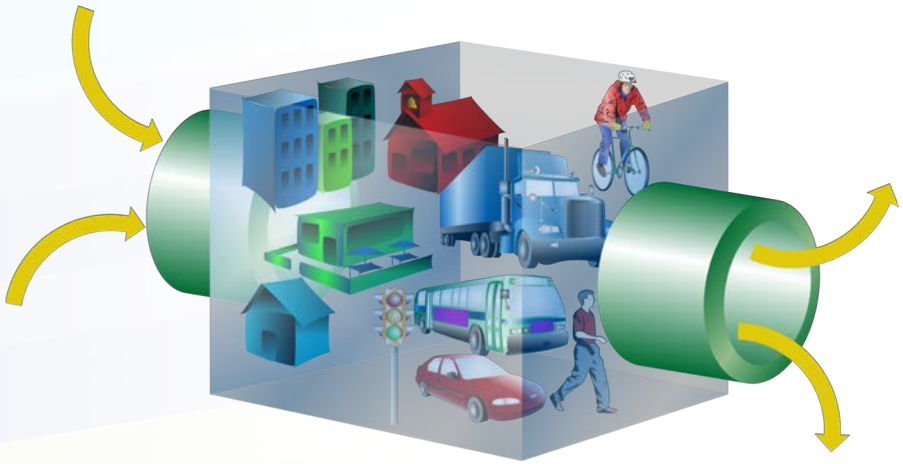
- **8 a.m. - 10 a.m.**
- **Introductions**
- **Sub-area OD Extraction Conceptual discussions**
  - Travel Demand Model (four-step model basics)
  - OD table basics
  - Traffic assignment basics
  - Sub-area OD extraction
- ***Break (10 minute)***
- **10:10 a.m. - Noon**
- **Demonstration…**
  - **…of Sub-area extraction procedure in TransCAD on projector/screen**
- **Q & A**

What is a Travel Model?

- Analysis tool
  - » Series of mathematical programs

Inputs

- Transportation Networks
- Socioeconomic Data
- External Data
- Special Generators
- Model Parameters



Outputs

- VMT
- Traffic Volumes
- Congested Speeds
- Transit Volumes
- Summary Information

** Travel demand model format inputs & outputs are shown above*

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Travel Model

- Calibration, Validation, and Post-Processing

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Calibration & Validation

Real world

Modeled World

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Types of Travel Models

Sketch-Planning Models

Strategic-Planning Models

Trip-Based Models

Activity-Based Models

Order of magnitude estimates; Feasibility

Complex, More detailed

More complex, More detailed, Better sensitivity

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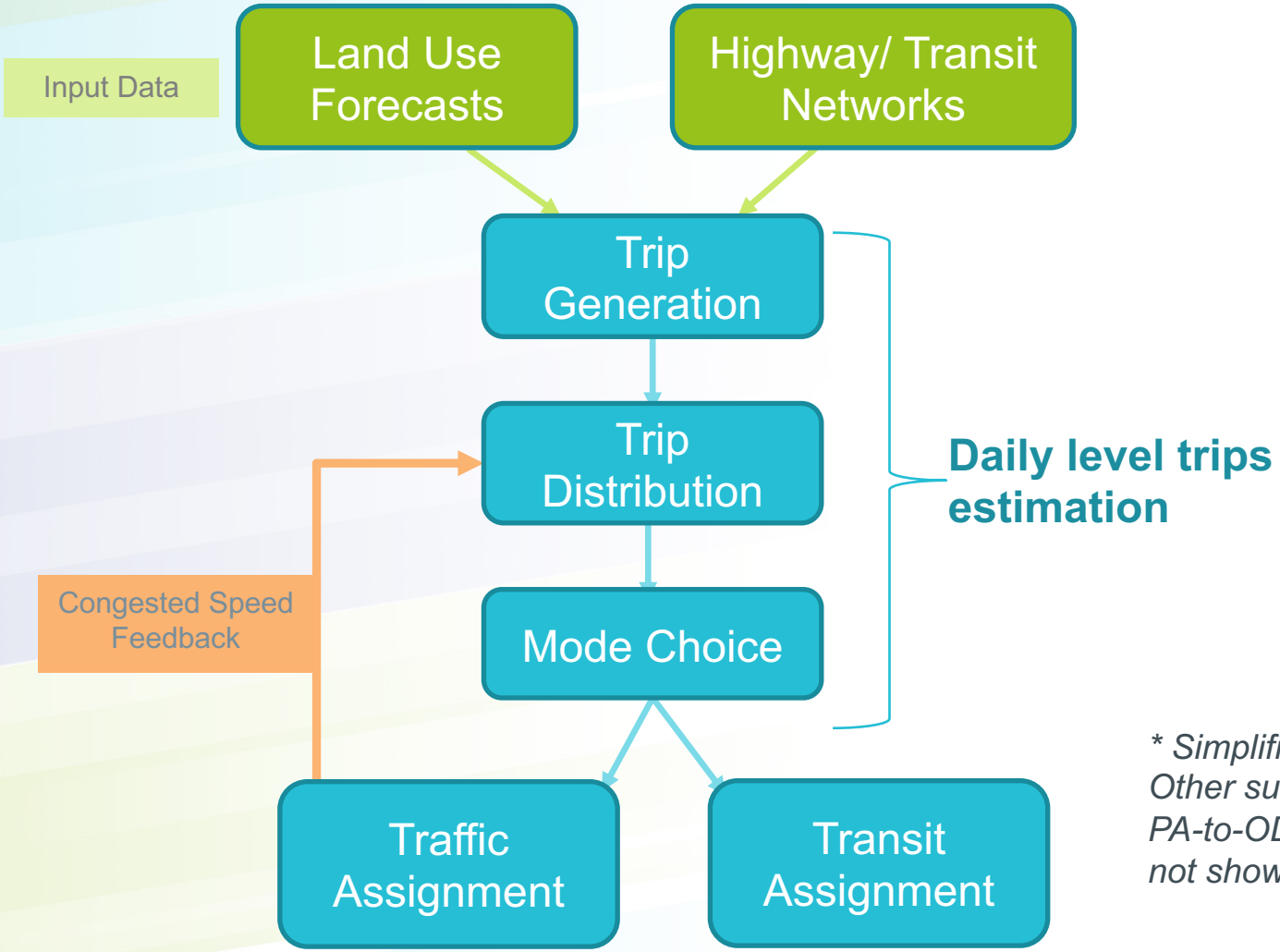
Four Step Model Process



** Simplified representation. Other sub-steps like skimming, PA-to-OD, and other steps are not shown in the figure*

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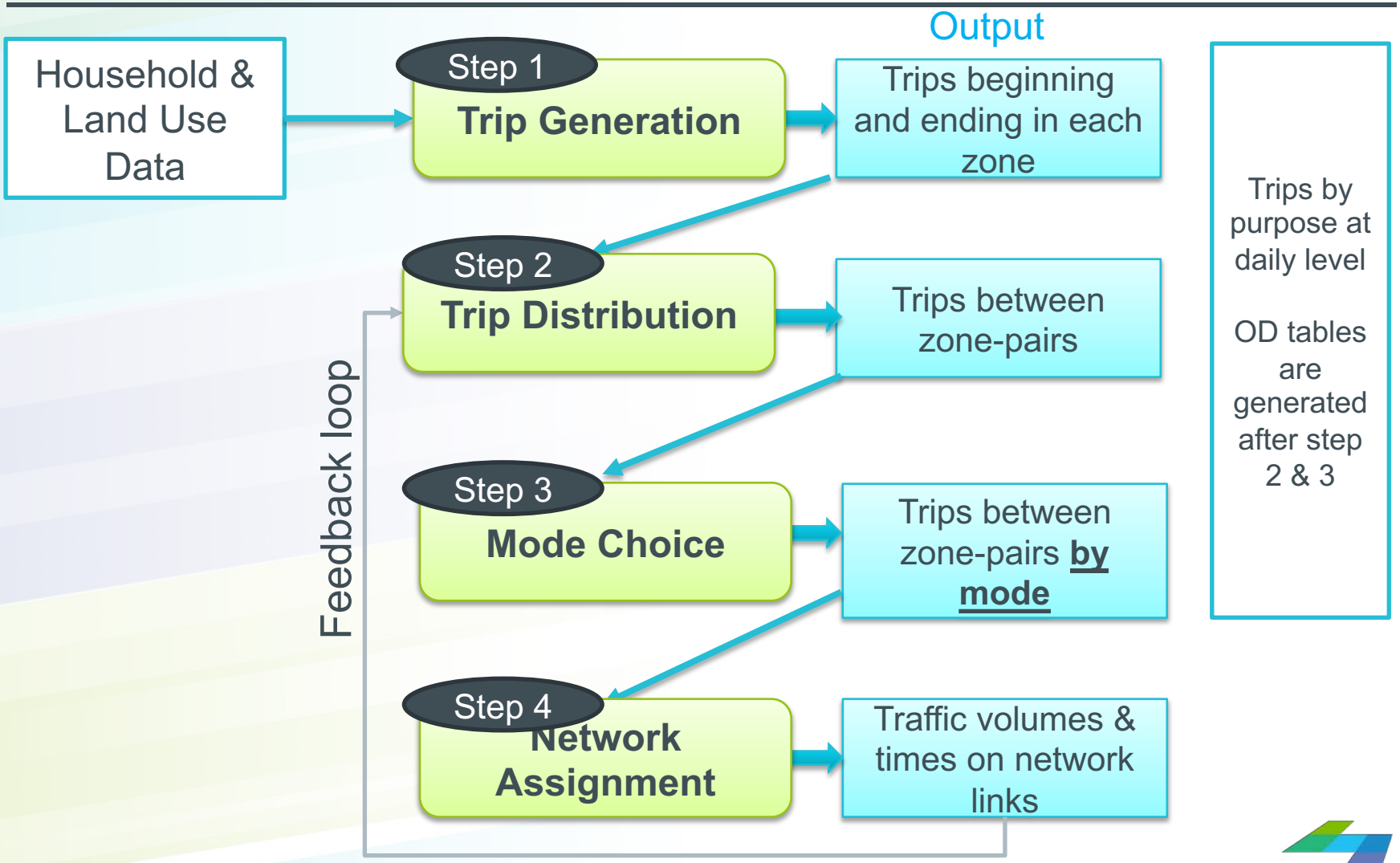
The Four-Step Process



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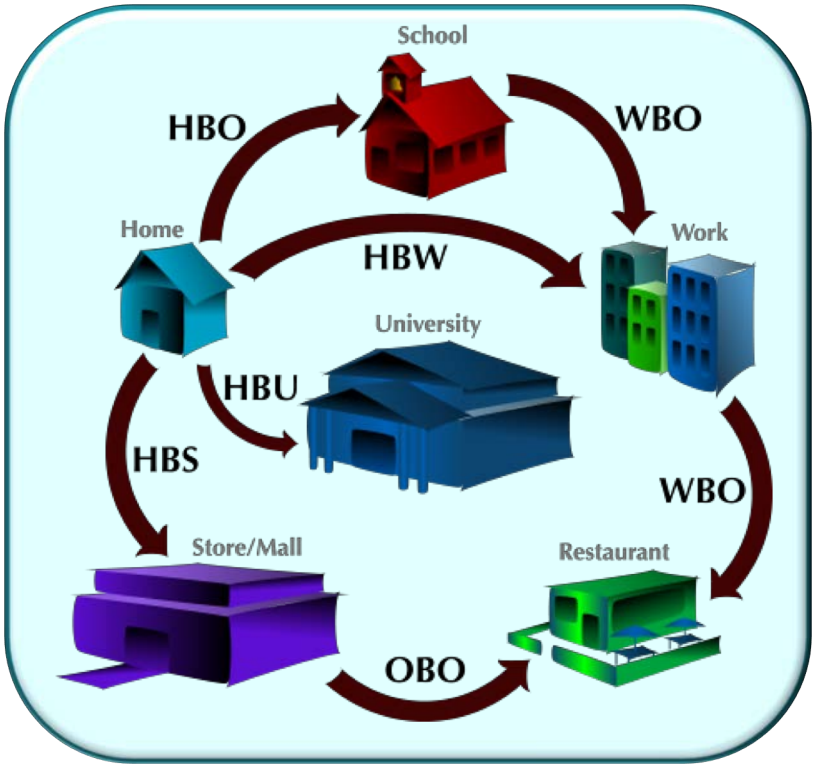
Trip Generation: How Many Trips?

- Based on household survey
- Different trip purposes
- Generate all trips*
  - Walk
  - Bike
  - Transit
  - Auto



** This is different than ITE Trip Generation, which only considers vehicle trips*

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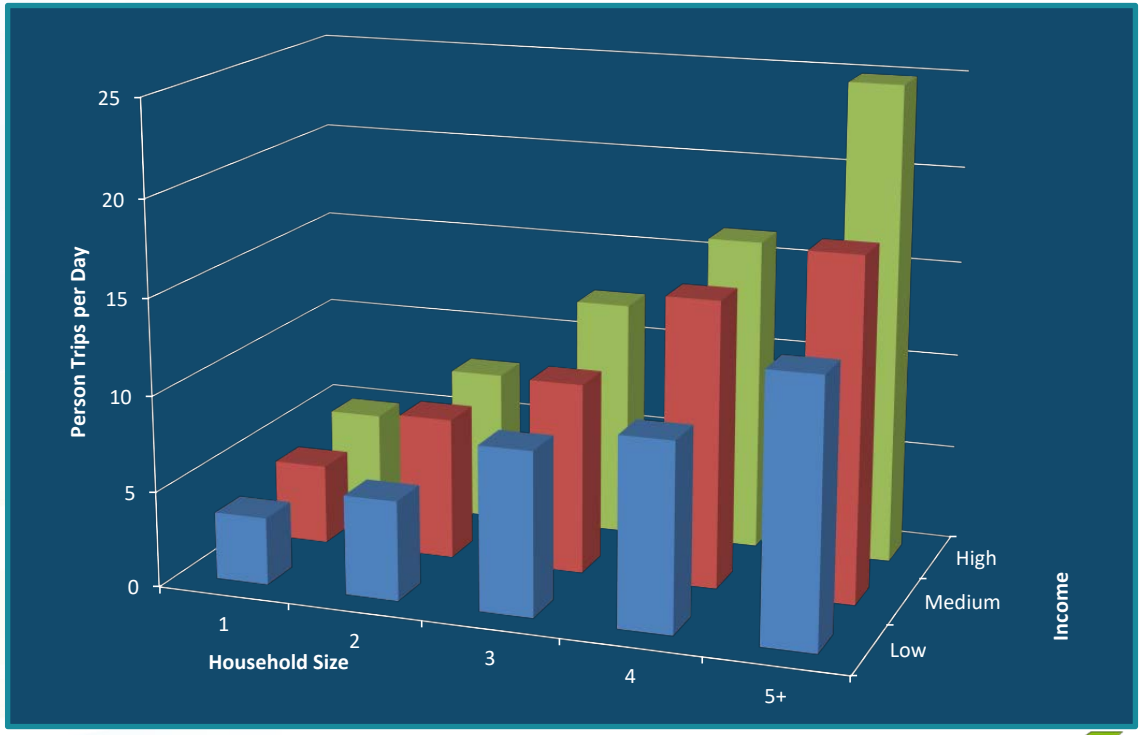
Trip Generation: *How Many Trips?*

- Cross-classified production rates
  - » Household size & income
  - » Household Workers & Income

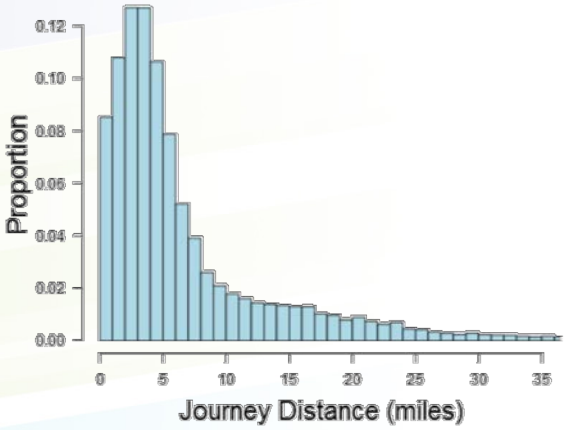


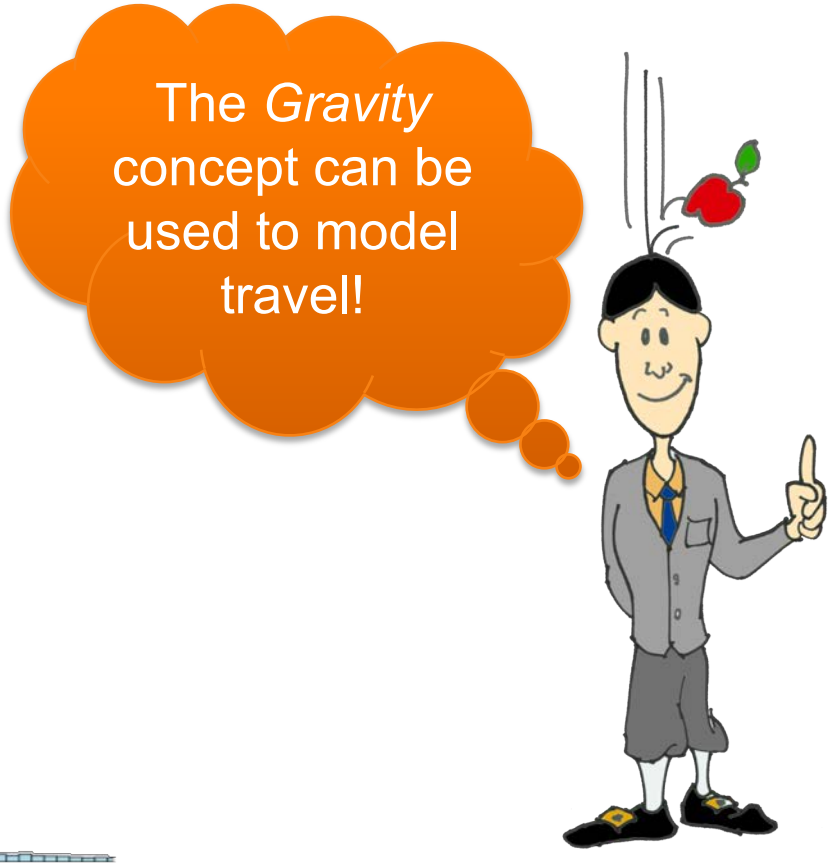
Trip Distribution:

Where will they go?

- Match
  - Productions & attractions

- Survey Data
  - Trip length distributions
  - Subregion to subregion patterns





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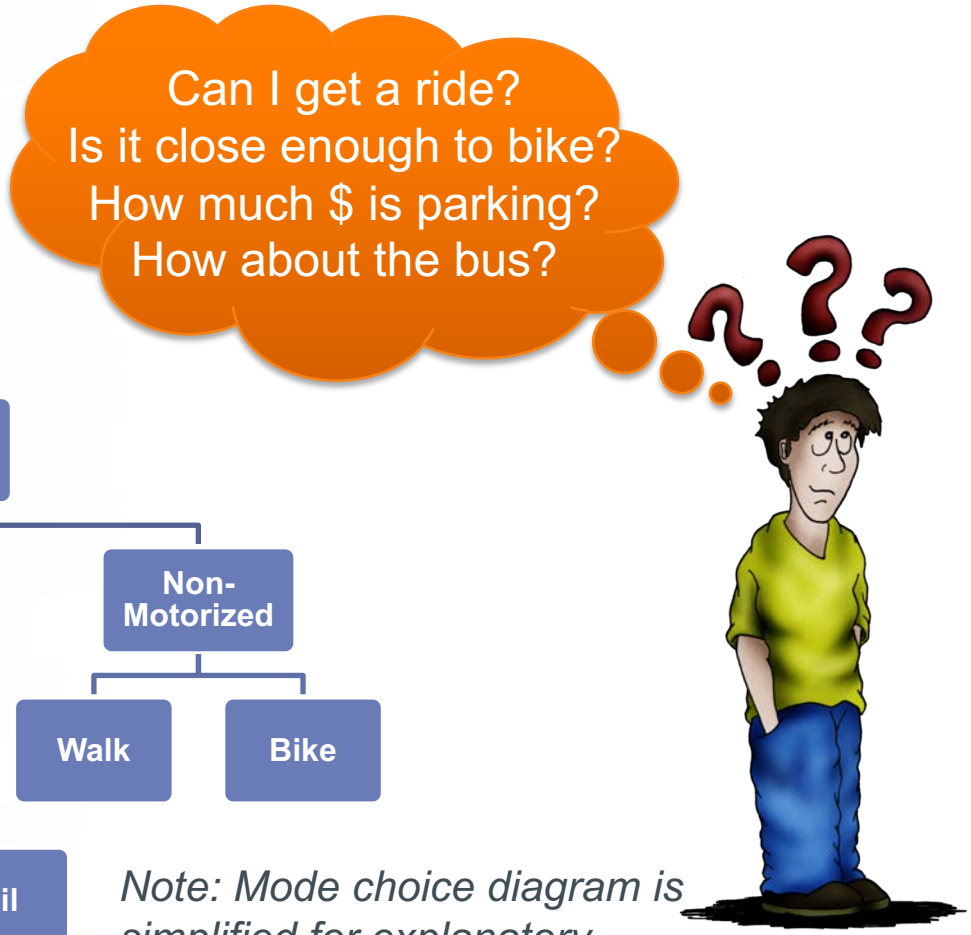
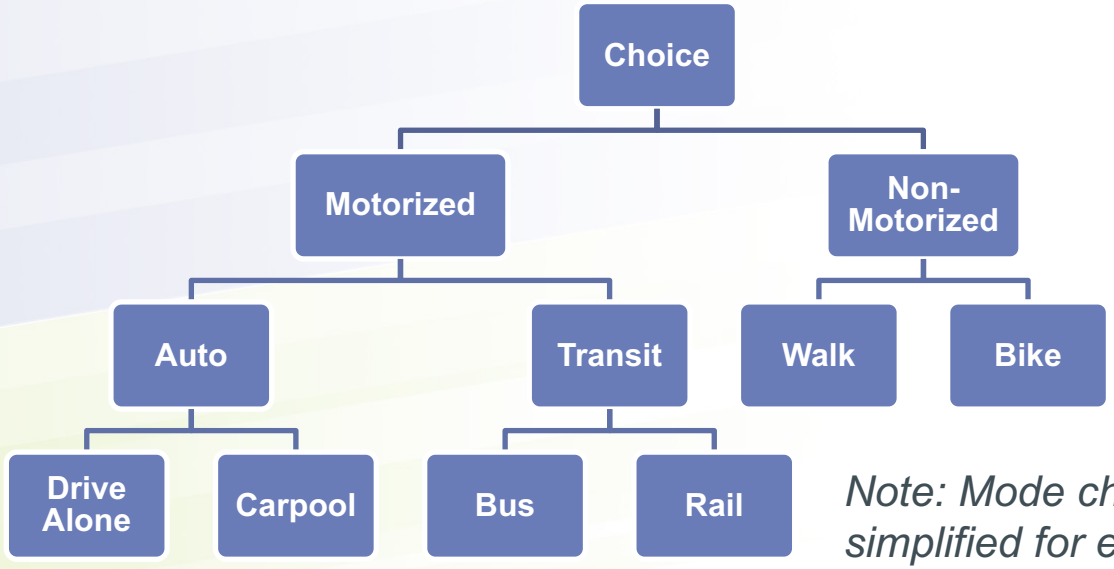
Mode Choice: What Mode?

- Nested Logit Model
  - Consider all modes for each zone pair





Note: Mode choice diagram is simplified for explanatory purposes

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Traffic Assignment:
What Route?

- 4 to 6 time periods (depending on model version)
- Account for localized and peak period congestion

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Network Assignment

- Model sums all trips and assigns trips to the transportation network

Cost.
Time.
Number of paths

Aggregate trips

- Trips by purpose
- External trips

Assign trips to the transportation network

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Traffic Assignment Procedures

- **User Equilibrium (UE) & Stochastic User Equilibrium (SUE)**
- **Iterative process to achieve a convergent solution**
- **No travelers can improve their travel times by shifting routes**
  - SUE assumes travelers do not have perfect information concerning network attributes and/or they perceive travel costs in different ways
  - SUE assignments might produce more realistic results than the deterministic UE model
    - because SUE permits use of less attractive as well as the most-attractive routes.
    - Less-attractive routes will have lower utilization, but will not have zero flow as they do under UE.
    - a large number of iterations should be used for SUE

** There are other traffic assignment procedures as well. Ex: AON, OUE, etc…can be a discussion for a separate session.*

User Equilibrium (UE) vs. Stochastic User Equilibrium (SUE)

UE

de·ter·min·is·tic

/dəˌtərməˈnistik/

adjective

relating to the philosophical doctrine that all events, including human action, are ultimately determined by causes regarded as external to the will.
"a deterministic theory"

SUE

sto·chas·tic

/stəˈkastik/

adjective TECHNICAL

randomly determined; having a random probability distribution or pattern that may be analyzed statistically but may not be predicted precisely.

What is a matrix?

- Data storage format
- Matrix
  - » Can be used to save trips in origin & destination format
  - » Can be used to save other info from any zone to zone.
    - –For example: travel times

Example

ORIGIN \ DESTINATION	1	2	3	4	5	Ti
1	0	0	50	0	0	50
2	0	0	60	0	30	90
3	0	0	0	30	0	30
4	20	0	80	0	20	120
5	0	0	90	10	0	100
Tj	20	0	280	40	50	390

Trip Table in TransCAD Software

- Add screen shot here

Testing Demand Changes

- Evaluate base, interim, and forecast year datasets
- Consider testing large development proposals (e.g., over 200 households or employees)
  - Use the model's trip distribution to compare to traffic study assumptions
  - Cross-check development model runs with ITE-based traffic studies

- Use the model to test very small developments
- Test unreasonable changes to the jobs/housing balance

Testing Roadway Changes

- Test large and medium-scale capacity changes
- Test different roadway alternatives
- Test a comprehensive roadway plan
- Test various corridor configurations

- Test scenarios that do not impact system capacity
- Try to model very small capacity or speed changes
- Rely on the demand model to test interchange configurations

Non-motorized Results

- Focus on potential non-motorized demand
  - E.g., 1, 2, and 5 mile trip bandwidths
  - Identify good places for infrastructure improvements
- Consider non-motorized model results to be a rough estimate
  - The model is only one tool to aid in analysis

- Expect detailed numbers
  - YES: "There is a high demand for a new bike lane in this corridor"
  - NO: "This new bike lane will result in X new bike trips"

Transit Results

- Evaluate major system adjustments
- Test large route changes
- Focus on a system-wide results

- Test fine tuning of route alignments
- Expect detailed forecasts by transit route or transit stop
  - This information is available, but must be interpreted carefully by a transit professional

Traffic Results

- Post process traffic volumes based on counts
- Focus on forecast **growth** rather than values
- Consider corridors as a whole
- Use the model to plan freeways, expressways, and arterials

- Rely on raw model volumes
- Expect detailed collector and intersection forecasts
  - This information is available, but must be interpreted and may require additional post processing

Post Processing: Reconciling to Counts

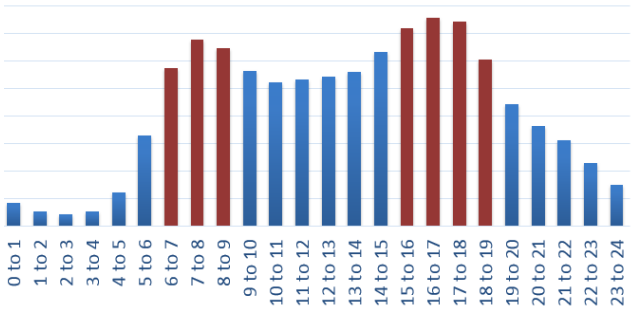
- Is the model too low in the base year?
  - Then the forecast is increased by the same amount
- Is the model too high in the base year?
  - Then the forecast is decreased by the same amount
- Both ***Post Processed*** and ***Raw*** volumes are available for analysis

Post-processing

- To adjust the raw model forecasts

1. » To convert peak period flows to **peak hours flows**

2. » To **adjust** the peak hour flows to account for the differences between the model and counts



Temporal distributions

DELTA

Δ

Model vs. Counts

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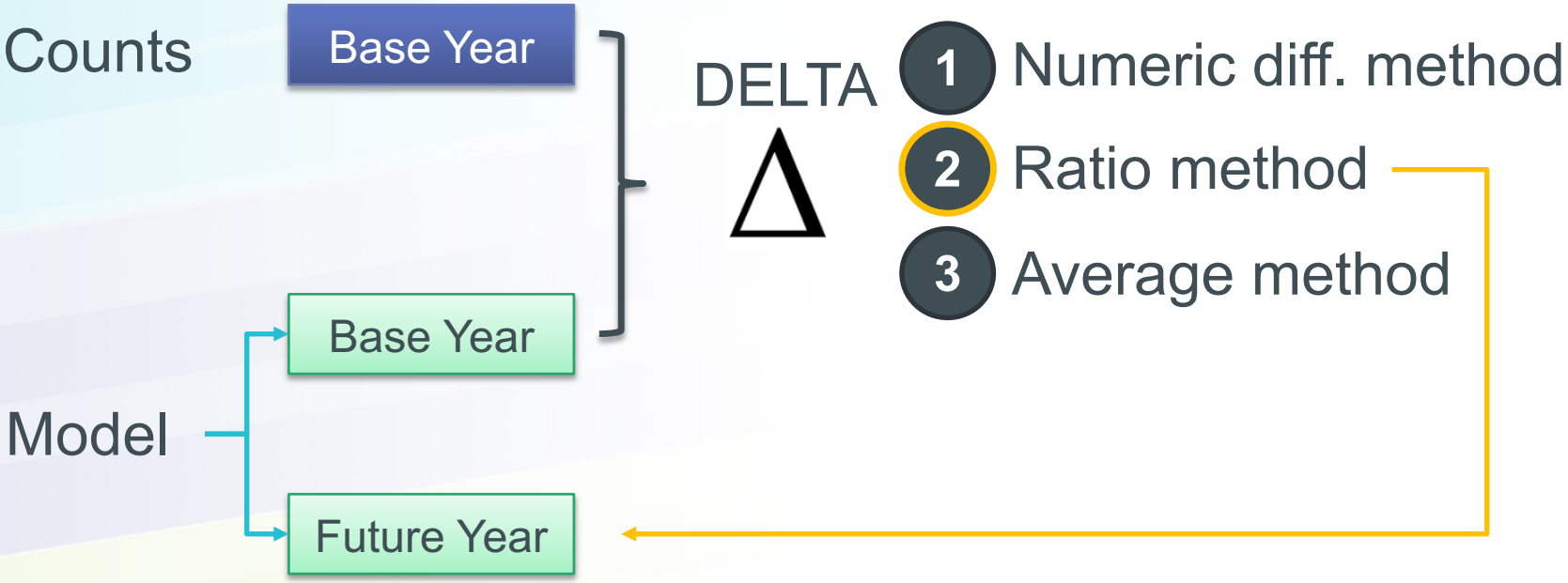
Adjustment Methodology



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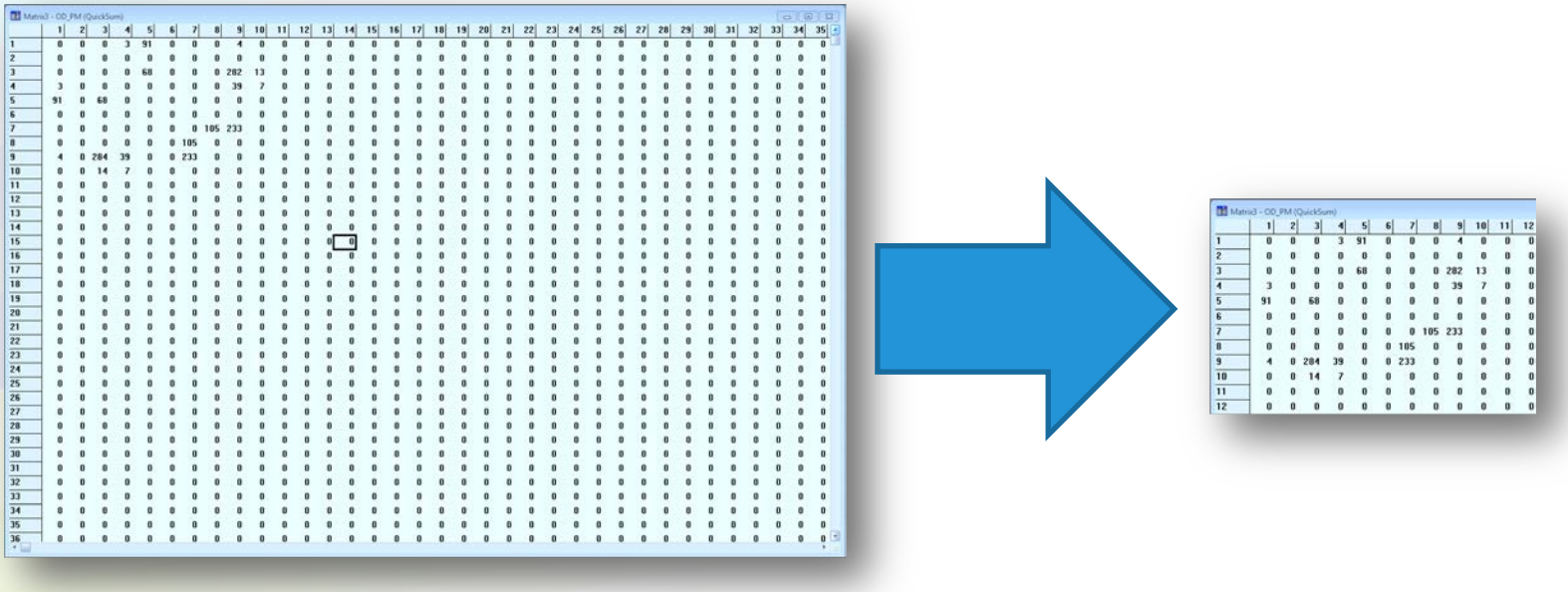
What is sub-area OD extraction?

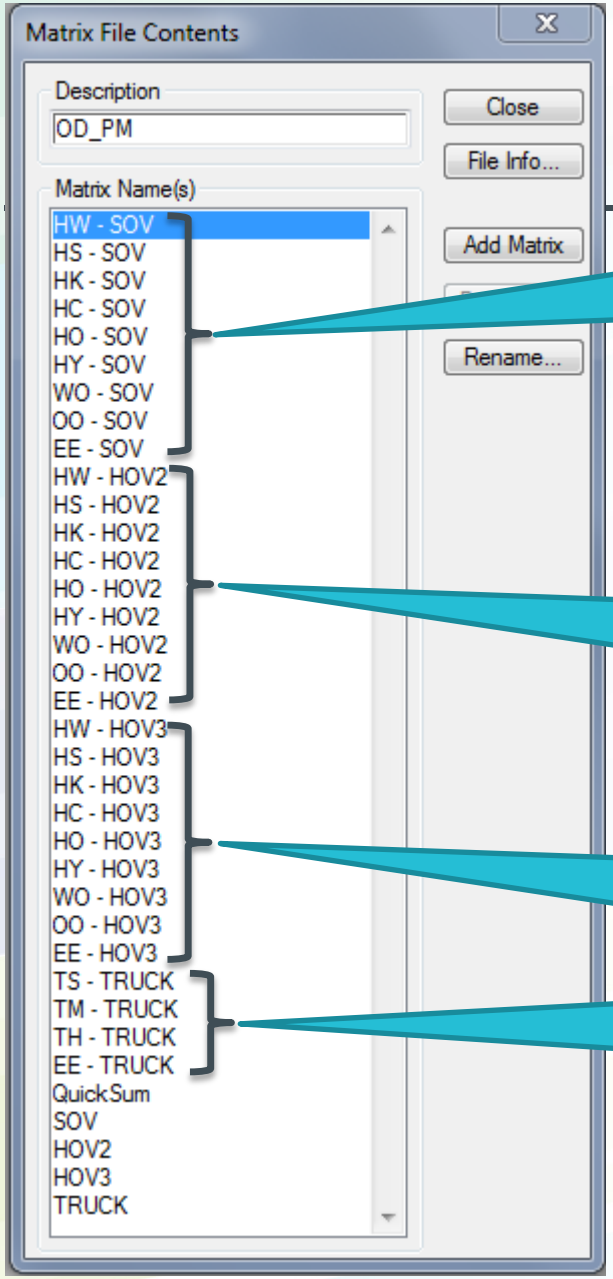
- Shrink or aggregate the trip table
  - » Keep the detail in the area of interest (sub-area)
  - » Aggregate the outer areas to the crossing links



Needed Inputs

- OD Table/Matrix
- Define sub-area & create polygon
- Geographic network database (from full run- which is created from a master network)
  - Links layer and nodes layer
- Exclusion queries
- Field names
- Parameters

SLOCOG Trip Table Details



Single Occupant vehicles

High Occupant vehicles – 2 people

High Occupant vehicles – 3+ people

Trucks

Trip Purposes

1. Home-Work
2. Home-Shop
3. Home-K12
4. Home-College
5. Home-Other
6. Work-Other
7. Other-Other

Truck Types

1. Small
2. Medium
3. Heavy
4. Ext-Ext

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Thank you!

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SLOGOC model reference screenshots

	STAGE	
1	Create Scen Network	Create Scenario Network from Master Network
2	Trip Generation	Compute Trip Productions and Attractions
3	Network Initialization	Network Initialization
4	Network Skimming	Compute Skim Matrix
5	Daily Trip Distribution	Daily Trip Distribution
6	Peak Pr Trip Distribution	Peak Period Trip Distribution
7	Initial Traffic Assignment	AM and MD Peak Period Traffic Assignment
8	Feedback Loop	Running Feedback Loop
9	Final Traffic Assignment	PM and OP Peak Period Traffic Assignment
10	Pk Hr Traffic Assignment	AM and PM Peak Hour Traffic Assignment

eenshots

	PARAMETER	
1	Gravity Model Iterations	10
2	Assignment Iterations Peak Periods	**20**
3	Assignment Convergence	**0.0001**
4	Max Feedback Iteration	3
5	Assignment Iterations Peak Hours	50
6	Through Trips Factor	0.85
7	Truck PCEs	1.0,1.5,2.0
8	HOV3 Occupancies	3.5,3.5,3.5,3.5,3.5,3.5,3.5,3.5,3.5
9	Default Occupancy	1.5
10	Transit Time Factors	1.3,1.3,1.1
11	Walk Speed	3
12	Bike Speed	9
13	Value of Time	0.083,0.083,0.083
14	Max TLD Impedance	250,500,3500
15	AM PR TOD Hours	7,7
16	MD PR TOD Hours	12,12
17	PM PR TOD Hours	16,16
18	OP PR TOD Hours	22,22
19	AM PH TOD Hours	0,0
20	PM PH TOD Hours	2,2
21	MSAT Time Parameters	0.025,0.053,0.053,0.053
22	MSAT Cost Parameters	0.125,0.125,0.125,0.125,0.125
23	Avg HOV3 Veh Occupancy	3.5

SLOCOG GISDK resource code reference

```
macro "variables init" do
    feedback_iteration = 1
    V = null
    V.model_table = model_table

    V.Periods = {"AM", "PM", "MD", "OP"}
    V.SkimClasses = {"DA", "SR2", "SR3", "TrLocal", "TrRegional", "TrExpress", "
    V.HighwayModes = {"DA", "SR2", "SR3"}
    V.TransitModes = {"TrLocal", "TrRegional", "TrExpress"}
    V.MS_Modes = {"DA", "SR2", "SR3", "Transit", "Walk", "Bike"}    // trips spl
    V.OD_Modes = {"SOV", "HOV2", "HOV3", "Transit", "Walk", "Bike"}  // correspo
    V.TAZ_query = "Select * where TAZ <> null"                      // query to
    V.Purposes.HW = {"HW"}
    V.Purposes.HO = {"HS", "HK", "HC", "HO"}
    V.Purposes.NH = {"HY", "WO", "OO", "EE"}
        // use codes for highway modes
    V.UseCodes.SOV  = {1, 4}
    V.UseCodes.HOV2 = {1, 2, 4}
    V.UseCodes.HOV3 = {1, 2, 3, 4}
    V.UseCodes.TH   = {1}
  enditem
```

DBOX_SLOCOG_20130827_new.rsc | Batch Assignment.rsc

```
3400        hov2ExclQry = RunMacro("get exclusion query", period, "HOV2")
3401        hov3ExclQry = RunMacro("get exclusion query", period, "HOV3")
3402        tH_ExclQry  = RunMacro("get exclusion query", period, "TH")
3403
3404        sovExclSet  = {db_link_lyr, link_lyr, "SOV links",  sovExclQry}
3405        hov2ExclSet = {db_link_lyr, link_lyr, "HOV2 links", hov2ExclQry}
3406        hov3ExclSet = {db_link_lyr, link_lyr, "HOV3 links", hov3ExclQry}
3407        tH_ExclSet  = {db_link_lyr, link_lyr, "TH links",   tH_ExclQry}
3408
3409        moveQry = "Select * where Study_Intersection <> null"
3410
3411        Opts = null
3412        Opts.Input.Database = highway_db
3413        Opts.Input.Network = highway_net
3414        Opts.Input.[OD Matrix Currency] = {od_mat, , , }
3415        Opts.Input.[Turning Movement Node Set] = {db_node_lyr, node_lyr, "Study Intersection", moveQry}
3416        Opts.Global.[Critical Query File] = crit_qry_file
3417
3418        if multi_mode then do   // if assignment by mode and purpose, define all modes and purposes
3419                // assignment modes: 1-9 = DA, 10-18 = Truck, 18-27 = HOV2, 28-31 = TRUCK
3420            Opts.Global.[Number of Classes] = 31
3421            Opts.Field.[Vehicle Classes] = RunMacro("array", "from 1 to 31",)
3422            Opts.Field.[Fixed Toll Fields] = RunMacro("array", 31,)
3423            Opts.Global.[Class PCEs] = RunMacro("array", 27, 1) + TruckPCEs + {1}
3424            Opts.Global.[Class VOIs] = RunMacro("array", 31, 1)
3425            Opts.Input.[Exclusion Link Sets] = RunMacro("array", 9, sovExclSet) +   // purposes by SOV
3426                                               RunMacro("array", 9, hov2ExclSet) +  // purposes by HOV2
3427                                               RunMacro("array", 9, hov3ExclSet) +  // purposes by HOV3
3428                                               RunMacro("array", 2, sovExclSet) +   // small/medium trucks
3429                                               RunMacro("array", 2, tH_ExclSet)     // heavy trucks & EE truck
3430          end
3431        else do     // if assignment only by mode
3432            Opts.Global.[Number of Classes] = 4
3433            Opts.Field.[Vehicle Classes] = {33, 34, 35, 36}  // DA, HOV2, HOV3, Truck
3434            Opts.Field.[Fixed Toll Fields] = {,,,}
3435            Opts.Global.[Class PCEs] = {1, 1, 1, 1}
3436            Opts.Global.[Class VOIs] = {1, 1, 1, 1}
3437            Opts.Input.[Exclusion Link Sets] = {sovExclSet,
3438                                               hov2ExclSet,
3439                                               hov3ExclSet,
3440                                               tH_ExclSet}
3441          end
```