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Gen3 Model Development Project

Travel Forecasting Subcommittee Meeting

September 23, 2022

IN PARTNERSHIP WITH

BASELINE MOBILITY

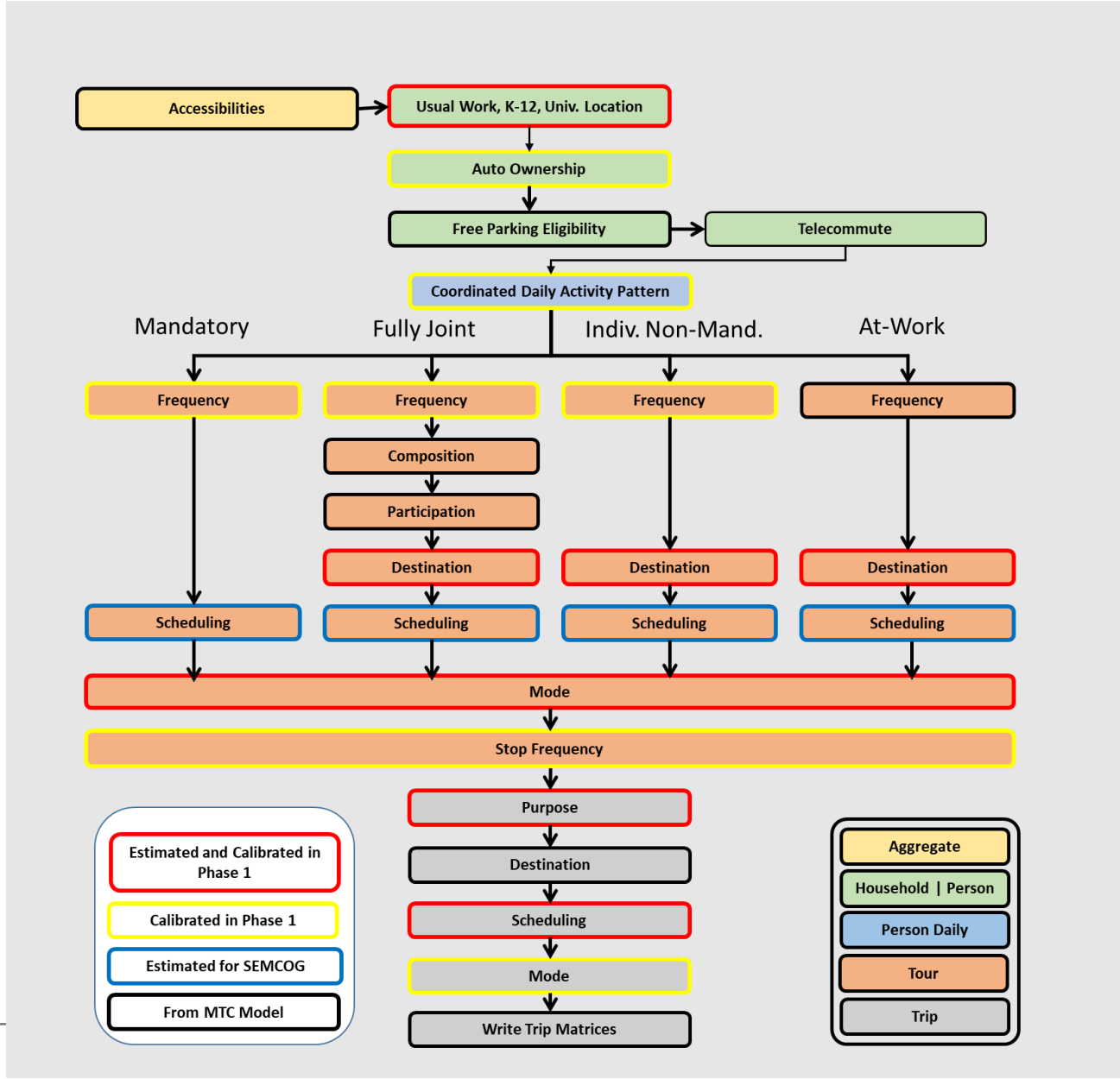
Metropolitan Washington Council of Governments

Discussion Topics

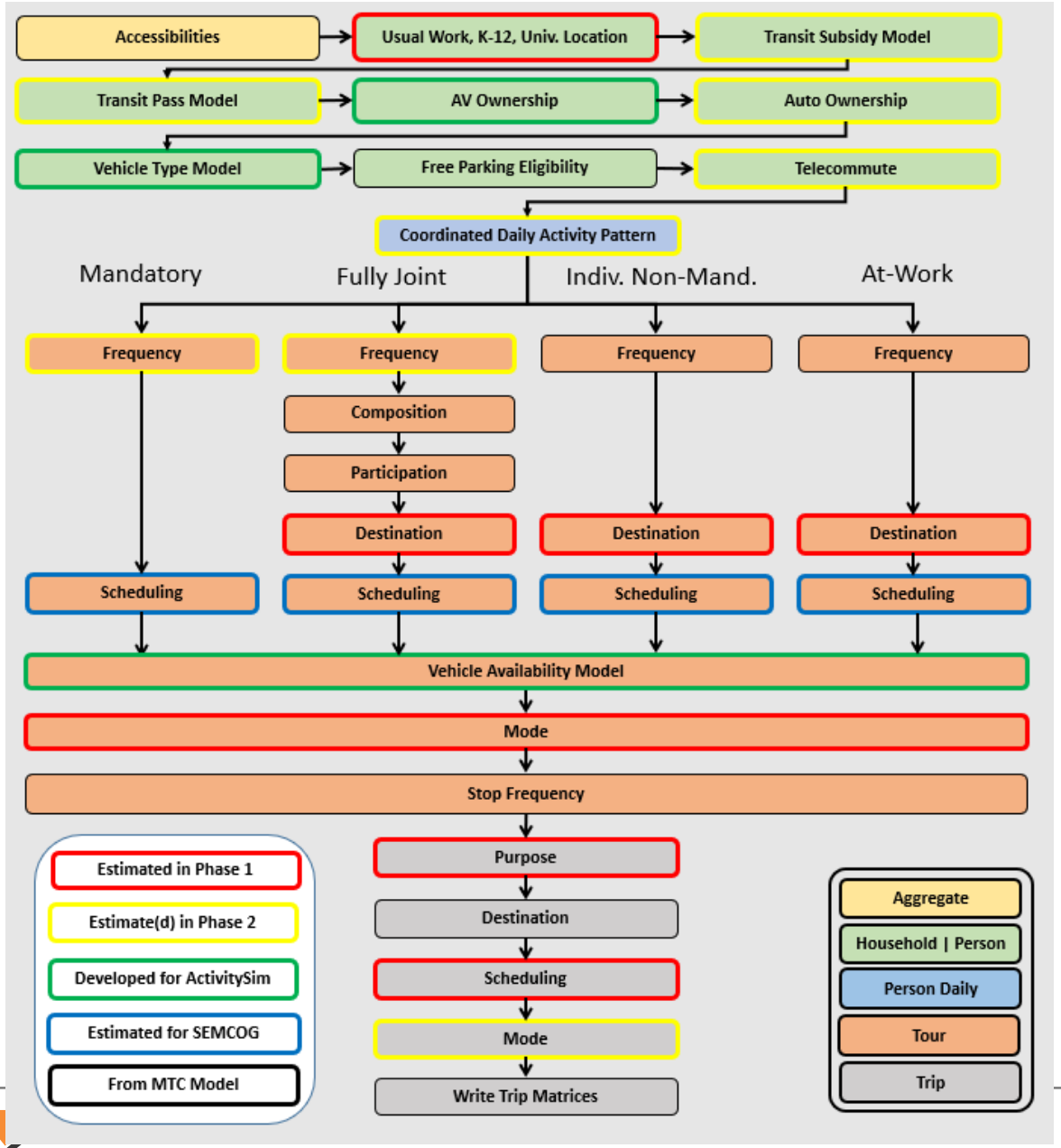
- Phase 2 model estimation update
- Phase 2 implementation update
  - PT skim updates
  - Vehicle type model implementation
  - GitHub issue updates
  - Other updates
- Phase 2 calibration and schedule update

Phase 2 Model Estimation

Models Estimated and Calibrated in Phase 1



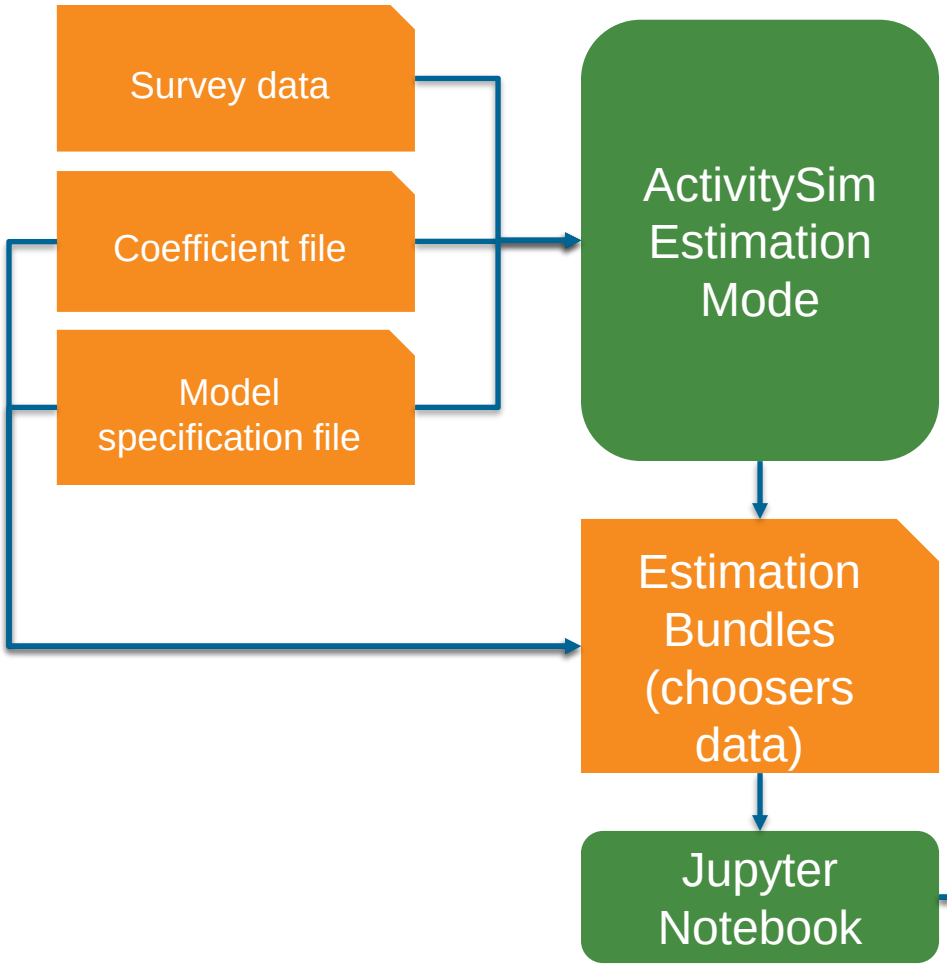
Models Estimated in Phase 2



New in Phase 2

- Transit subsidy model
- Transit pass ownership model
- AV ownership model
- Vehicle type choice model
- Vehicle availability model

Estimation process



www.python.org

https://larch.newman.me/

Scipy.org

Status Update on Model Estimation (MWCOG)

- Auto ownership model
  - Model estimation complete, implemented
  - Documentation is underway
- Coordinated Daily Activity Pattern Model
  - Model estimation in progress
  - Problem in estimation mode discovered, subset of coefficients (interaction terms for 3, 4, and 5 person households) cannot be estimated until fixed; will transfer existing coefficients for now
- Mandatory Tour Frequency Model
  - Model estimation mostly complete
- Non-Mandatory Tour Frequency Model
  - Problem in estimation mode discovered, cannot be estimated until fixed
  - We will continue to use MTC/ARC version in Gen3 Phase 2

Status Update on Model Estimation (RSG)

- Telecommute Frequency Model
  - Model estimation complete
  - Documentation is underway
- Transit Subsidy Model
  - Model estimation complete
  - Documentation is underway
- Trip Mode Choice Model
  - Model estimation complete
  - Documentation underway
  - Mostly reasonable IVT coefficients, but a significant number of out-of-vehicle time coefficients had to be held to similar ratios as estimated in tour mode choice models
- Transit Pass Ownership Model
  - Investigating potential use of 2019 State of the Commute Survey for model estimation

Trip Mode Choice Model Estimation

Coefficients

Variable	Work	University	School	Maintenance	Discretionary
Tour IVT	-0.025	-0.01	-0.01	-0.0213	-0.0213
In-vehicle time	-0.0426	-0.0516	-0.017	-0.0359	-0.0399
Cost	-0.00063	-0.00516	-0.00154	-0.00039	-0.00199
First wait	-0.0634	-0.0769	-0.0253	-0.0539	-0.0644
Transfer wait	-0.0651	-0.0789	-0.026	-0.0632	-0.0877
Walk time	-0.0779	-0.0385	-0.0311	-0.0625	-0.0695
Walk mode time	-0.0779	-0.0385	-0.0311	-0.0822	-0.0914
Transfer walk time	-0.0852	-0.0944	-0.026	-0.0718	-0.0798
Bike mode time	-0.0625	-0.0759	-0.025	-0.088	-0.0978
Drive-transit time	-0.129	-0.0939	-0.0309	-0.0718	0

Trip Mode Choice Model Estimation

Relationships

	Work	University	School	Maintenance	Discretionary
Trip IVT/Tour IVT	1.7	5.2	1.7	1.7	1.9
Value of time	$ 40.77	$ 6.00	$ 6.62	$ 55.52	$ 12.03
First wait/IVT	1.5	1.5	1.5	1.5	1.6
Transfer wait/IVT	1.5	1.5	1.5	1.8	2.2
Walk time/IVT	1.8	0.7	1.8	1.7	1.7
Walk mode time/IVT	1.8	0.7	1.8	2.3	2.3
Transfer walk time/IVT	2.0	1.8	1.5	2.0	2.0
Bike mode time/IVT	1.5	1.5	1.5	2.5	2.5
Drive-transit time/IVT	3.0	1.8	1.8	2.0	0.0

Phase 2 Implementation Update

Switching to PT Multipathing

- COG staff replaced the PT best-pathing processes with PT multipathing in the Gen3 Model.
  - PT is designed as a multi-path builder.
  - Switching to PT multipathing significantly reduces model runtime.
- COG staff found a hyperpath issue in PT multipathing:
  - The multiple “hyperpaths” created by the multi-path builder for certain transit mode(s) do not always use the mode(s) of interest.
- COG staff proposed a partial solution.
  - Hyperpath issue for commuter rail path building: Completely fixed
  - Hyperpath issue for Bus + Metrorail path building: Partially fixed
- Bentley acknowledged that there is currently no perfect solution to the hyperpath issue in PT.
  - Bentley will explore a long-term solution in the PT algorithm.
  - Bentley agreed our decision to move forward with the partial solution.
- RSG will use the PT skims from the current PT multipathing implementation in the subsequent work.

Github Issues Addressed

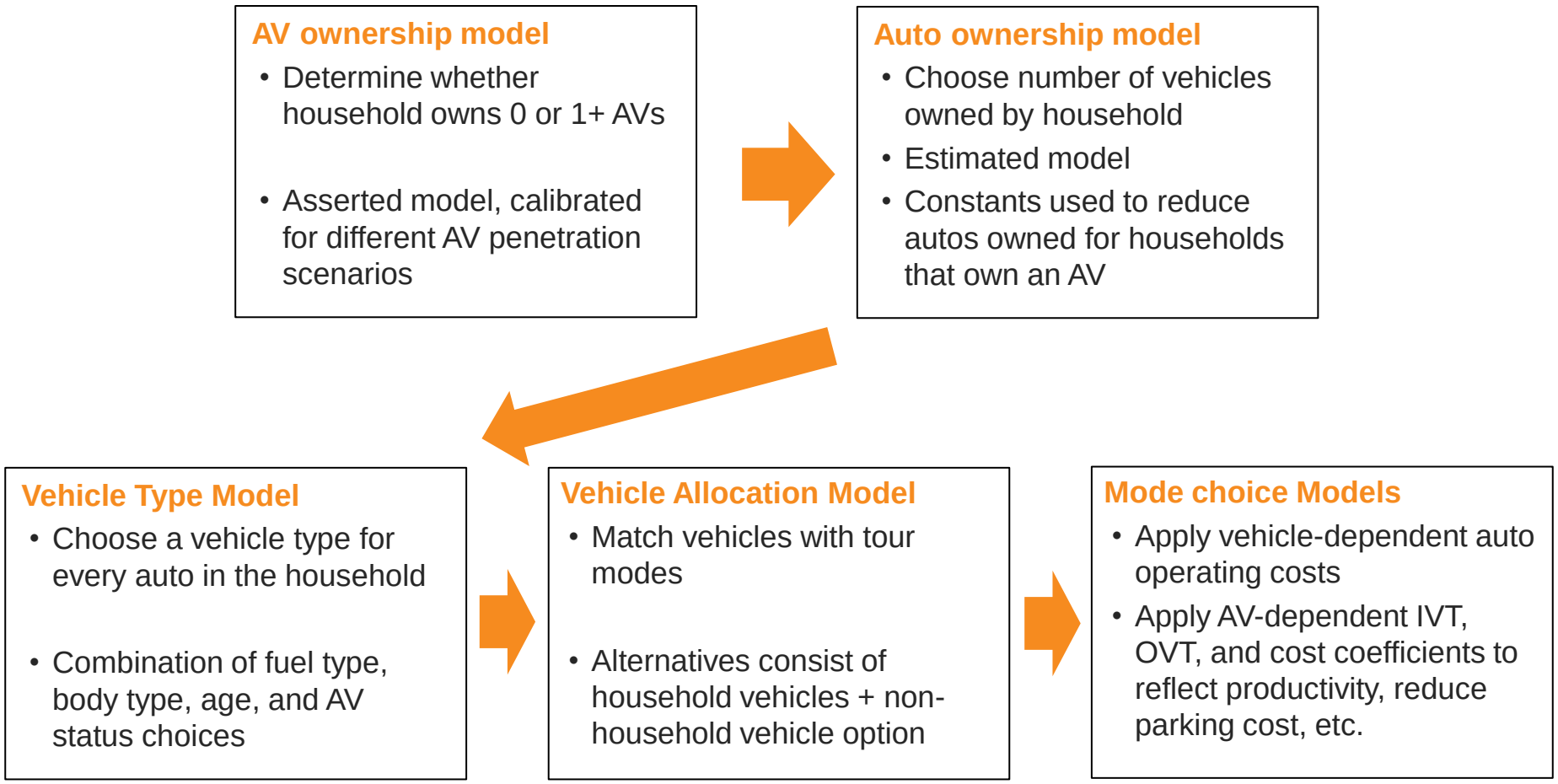
- Updated input scripts to remove hard-coded values
- Test Run with updated version of ActivitySim (v1.1)
- Fixed issue in batch file that caused ABM visualizer and LineSum to Fail
- Performance warning in ActivitySim

Visualizer Issues Addressed

- The base map was replaced
- The NT1 and NT2 time periods were combined as NT

Vehicle Type Model Overview

Vehicle Type and Vehicle Allocation Model Flow with AV Extension



Vehicle Type Model: Vehicle Type Data

	A	B	C	D	E	F	G	H	I
1	body_type	fuel_type	vehicle_year	NumMakes	NumModels	MPG	Range	NewPrice	auto_operating_cost
2	Car	Gas	2017	39	738	24	0	32926.61346	0.13
3	Car	Gas	2016	39	734	23.7	0	33383.61537	0.13
4	Car	Gas	2015	39	740	23.4	0	33369.12233	0.13
5	Car	Gas	2014	41	717	23.2	0	32571.33539	0.13
6	Car	Gas	2013	40	702	23.1	0	32976.62731	0.13
7	Car	Gas	2012	42	668	22.4	0	32959.56219	0.13
8	Car	Gas	2011	42	617	21.7	0	34409.88113	0.14
9	Car	Gas	2010	44	641	21.5	0	35279.71318	0.14
10	Car	Gas	2009	45	637	21	0	35638.52401	0.14
11	Car	Gas	2008	46	649	20.5	0	35745.78309	0.15
12	Car	Gas	2007	43	594	20.3	0	37613.76774	0.15
13	Car	Gas	2006	43	595	20.2	0	38581.65596	0.15
14	Car	Gas	2005	41	661	20.4	0	37537.36453	0.15
15	Car	Gas	2004	43	628	20.6	0	37988.14511	0.15
16	Car	Gas	2003	42	573	20.5	0	37597.37624	0.15
17	Car	Gas	2002	42	543	20.8	0	37380.8733	0.14
18	Car	Gas	2001	39	505	21	0	37361.09207	0.14

- Model was estimated using data from 2017 NHTS
- Supplemented with U.S. Environmental Protection Agency's (EPA's) fuel economy testing database
  - Fuel economy rating, electric vehicle range, number of makes and models of vehicles available for sale in the US in each vehicle type category

Vehicle Type Model: Utility Expressions Subset

Snippet of some terms in the utility expression file

	A	B	C	D
1	Label	Description	Expression	Coefficient
2	util_ln_nmods	number of models available	@np.log(1 + df.NumModels)	coef_ln_nmods
3	util_ln_nmakes	number of makes available	@np.log(1 + df.NumMakes)	coef_ln_nmakes
4	util_mpg	miles per gallon (or equivalent)	@df.MPG	coef_mpg
5	util_crange	Range for BEV (mi)	@df.Range	coef_crange
6	util_crangeltwk	range less than average round trip distance to work	@np.where((df.Range < df.avg_hh_dist_to_work * 2) & (df.fuel_type=='BEV'), 1, 0)	coef_crangeltwk
7	util_ln_chpc_ev	ln(1+number of chargers per capita in MSA/state)	@np.log(1+CHARGERS_PER_CAP)	coef_ln_chpc_ev
8	util_cprice0	New Purchase Price (2017$) Segmented by Income	((income < 25000) & (income > -1)) * NewPrice	coef_cprice0
9	util_cprice25	New Purchase Price (2017$) Segmented by Income	((income < 50000) & (income >= 25000)) * NewPrice	coef_cprice25
10	util_cprice50	New Purchase Price (2017$) Segmented by Income	((income < 100000) & (income >=50000)) * NewPrice	coef_cprice50
11	util_van_van	Household already owns a Van -- Van	(num_hh_Van > 0) & (body_type == 'Van')	coef_van_van
12	util_van_suv	Household already owns a Van -- SUV	(num_hh_Van > 0) & (body_type == 'SUV')	coef_van_suv
13	util_van_pu	Household already owns a Van -- Pickup	(num_hh_Van > 0) & (body_type == 'Pickup')	coef_van_pu
14	util_van_mc	Household already owns a Van -- Motorcycle	(num_hh_Van > 0) & (body_type == 'Motorcycle')	coef_van_mc
15	util_van_suv	Household already owns an SUV -- Van (symmetrical with above)	(num_hh_SUV > 0) & (body_type == 'Van')	coef_van_suv
16	util_van	Van ASC	(body_type == 'Van')	coef_van
17	util_suv	SUV ASC	(body_type == 'SUV')	coef_suv
18	util_sfo_van	SF and San Jose - Van	@(CBSA == 'SFO') * (df.body_type == 'Van')	coef_sfo_van
19	util_sfo_suv	SF and San Jose - SUV	@(CBSA == 'SFO') * (df.body_type == 'SUV')	coef_sfo_suv
20	util_sfo_pu	SF and San Jose - Pickup	@(CBSA == 'SFO') * (df.body_type == 'Pickup')	coef_sfo_pu

Vehicle type model variables include household attributes, person attributes, vehicle attributes (body type, age, fuel type) charging infrastructure, vehicle costs

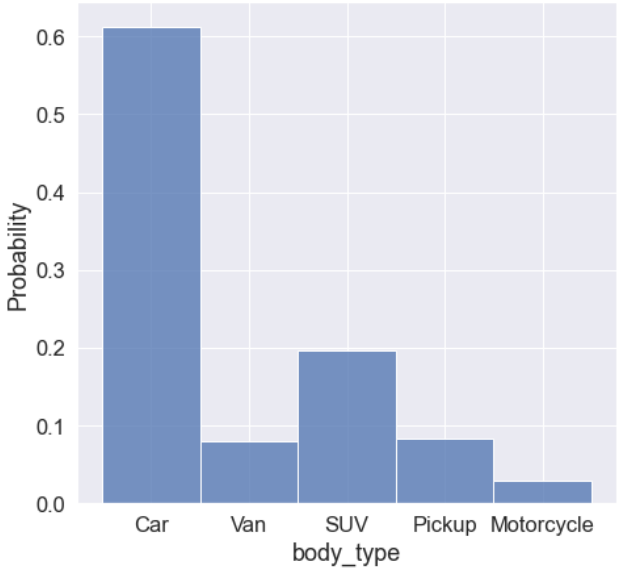
Vehicle Type Model: Output

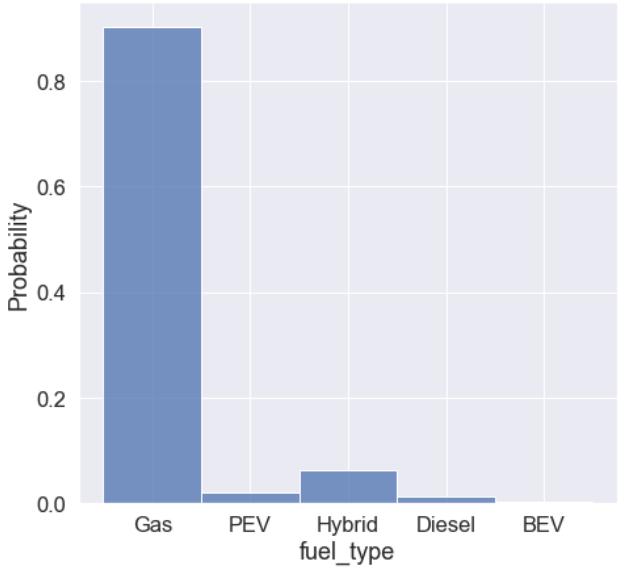
final_vehicles.csv

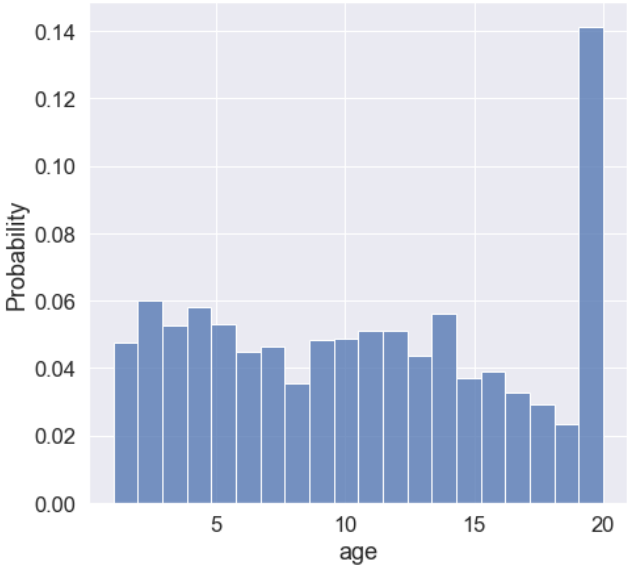
	A	B	C	D	E	F	G
1	vehicle_id	household_id	vehicle_num	vehicle_type	auto_operating_cost	Range	MPG
2	9828751	982875	1	Car_12_Gas	0.15	0	20.2
3	13120521	1312052	1	Car_2_Gas	0.13	0	23.7
4	13120522	1312052	2	Car_20_Gas	0.14	0	21.3
5	17402091	1740209	1	Van_4_PEV	0.1	0	0
6	17402092	1740209	2	SUV_14_Gas	0.18	0	16.6
7	13190021	1319002	1	SUV_20_Gas	0.17	0	17.4
8	13190022	1319002	2	Pickup_2_Gas	0.16	0	18.5
9	15274261	1527426	1	Car_3_Hybrid	0.08	0	35.5
10	15274262	1527426	2	Car_20_Gas	0.14	0	21.3
11	15274263	1527426	3	Car_11_Gas	0.15	0	20.3
12	7134881	713488	1	SUV_20_Gas	0.17	0	17.4
13	7134882	713488	2	Car_19_Gas	0.14	0	21.2
14	23169201	2316920	1	Car_19_Gas	0.14	0	21.2
15	23169202	2316920	2	Car_1_Gas	0.13	0	24
16	23169203	2316920	3	Car_13_Gas	0.15	0	20.4
17	9213581	921358	1	Car_13_Gas	0.15	0	20.4
18	9213582	921358	2	Car_8_Gas	0.14	0	21.5
19	19624501	1962450	1	Car_5_Gas	0.13	0	23.1
20	19624502	1962450	2	SUV_4_Gas	0.15	0	20.3
21	19624503	1962450	3	Van_13_Gas	0.18	0	16.4

A vehicle table with one record for each vehicle owned by every household in the synthetic population

Vehicle Type Model: Output Distributions







Vehicle Allocation Model

Want to select a vehicle that will be used for each tour and auto mode (DA, S2, S3+)

Runs before tour mode choice.

- Setup the example to have 5 alternatives:
  - 4 possible household vehicles (max from auto ownership model)
  - 1 for a non-household vehicle (for non-auto owning households and for ride-hail modes)
- Need to run the model once for each occupancy level
- Tour file is output with one vehicle allocated for each occupancy level

Vehicle Allocation Model: Utility Expressions Subset

	A	B	C	D	E	F	G	H
1	Label	Description	Expression	veh_num1	veh_num2	veh_num3	veh_num4	non_hh_veh
2	#	Availability Conditions						
3	util_alt1_unavail	Household does not own vehicle	veh_num1.isna() | (veh_num1 == '')	coef_unavail	0	0	0	0
4	util_alt2_unavail	Household does not own vehicle	veh_num2.isna() | (veh_num2 == '')	0	coef_unavail	0	0	0
5	util_alt3_unavail	Household does not own vehicle	veh_num3.isna() | (veh_num3 == '')	0	0	coef_unavail	0	0
6	util_alt4_unavail	Household does not own vehicle	veh_num4.isna() | (veh_num4 == '')	0	0	0	coef_unavail	0
7	#	BEV Range						
8	util_dstgtrng1	Round trip tour distance > BEV range	@np.where((df.tot_tour_dist > df.Range_1) & (df.fuel_type_1 == 'BEV'), 1, 0)	coef_dstgtrng	0	0	0	0
9	util_dstgtrng2	Round trip tour distance > BEV range	@np.where((df.tot_tour_dist > df.Range_2) & (df.fuel_type_2 == 'BEV'), 1, 0)	0	coef_dstgtrng	0	0	0
10	util_dstgtrng3	Round trip tour distance > BEV range	@np.where((df.tot_tour_dist > df.Range_3) & (df.fuel_type_3 == 'BEV'), 1, 0)	0	0	coef_dstgtrng	0	0
11	util_dstgtrng4	Round trip tour distance > BEV range	@np.where((df.tot_tour_dist > df.Range_4) & (df.fuel_type_4 == 'BEV'), 1, 0)	0	0	0	coef_dstgtrng	0
12	#	Vehicles & Driver interactions						
13	util_vehltdr_nh	Vehicles < Drivers -- Non-Household Vehicle	hh_veh_lt_drivers	0	0	0	0	coef_vehltdr_nh
14	util_vehltdr_nh	Vehicles > Drivers -- Non-Household Vehicle	hh_veh_gt_drivers	0	0	0	0	coef_vehgtdr_nh
15	util_vehltdr_van1	Vehicles > Drivers -- Van alt 1	hh_veh_gt_drivers * (body_type_1 == 'Van')	coef_vehltdr_van	0	0	0	0
16	util_vehltdr_van2	Vehicles > Drivers -- Van alt 2	hh_veh_gt_drivers * (body_type_2 == 'Van')	0	coef_vehltdr_van	0	0	0
17	util_vehltdr_van3	Vehicles > Drivers -- Van alt 3	hh_veh_gt_drivers * (body_type_3 == 'Van')	0	0	coef_vehltdr_van	0	0
18	util_vehltdr_van4	Vehicles > Drivers -- Van alt 4	hh_veh_gt_drivers * (body_type_4 == 'Van')	0	0	0	coef_vehltdr_van	0
19	#	Occupancy interactions						
20	util_maxocc_van1	Maximum Occupancy -- Van alt 1	@occup * (df.body_type_1 == 'Van')	coef_maxocc_van	0	0	0	0
21	util_maxocc_van2	Maximum Occupancy -- Van alt 2	@occup * (df.body_type_2 == 'Van')	0	coef_maxocc_van	0	0	0
22	util_maxocc_van3	Maximum Occupancy -- Van alt 3	@occup * (df.body_type_3 == 'Van')	0	0	coef_maxocc_van	0	0
23	#	Alternative Specific Constants						
24	util_non_hh	Non-Household Vehicle Constant	1	0	0	0	0	coef_non_hh
25	util_van1	Van ASC alt 1	(body_type_1 == 'Van')	coef_van	0	0	0	0
26	util_van2	Van ASC alt 2	(body_type_2 == 'Van')	0	coef_van	0	0	0
27	util_van3	Van ASC alt 3	(body_type_3 == 'Van')	0	0	coef_van	0	0
28	util_van4	Van ASC alt 4	(body_type_4 == 'Van')	0	0	0	coef_van	0
29	util_suv1	SUV ASC alt 1	(body_type_1 == 'SUV')	coef_suv	0	0	0	0

- Estimated from NHTS data
- Alternatives constructed from vehicles owned by household
- Variables include ratio of vehicles to drivers, tour distance, vehicle characteristics

Vehicle Allocation Model: Output

- Final tours table includes the vehicle allocation for each occupancy level
  - *Bodytype_age_fueltype*
- Occupancy numbers are taken directly from the *OCCUPANCY_LEVELS* configuration settings
- Zero auto households will always select the non-household vehicle option

final_tours.csv

	A	B	C	D
1	tour_id	vehicle_occup_1	vehicle_occup_2	vehicle_occup_3.5
2	3827799	non_hh_veh	non_hh_veh	non_hh_veh
3	3867733	Car_9_Gas	Car_9_Gas	Car_9_Gas
4	3875277	non_hh_veh	non_hh_veh	non_hh_veh
5	4162195	Car_12_Gas	Car_12_Gas	Car_12_Gas
6	5616465	Car_16_Gas	Car_16_Gas	Car_16_Gas
7	16038903	Car_20_Gas	Car_20_Gas	Car_20_Gas
8	36354780	SUV_15_Gas	Pickup_20_Gas	SUV_15_Gas
9	36354781	SUV_15_Gas	Pickup_20_Gas	SUV_15_Gas
10	36354813	SUV_15_Gas	SUV_15_Gas	SUV_15_Gas
11	36354854	SUV_15_Gas	SUV_15_Gas	SUV_15_Gas
12	36354855	Pickup_20_Gas	SUV_15_Gas	SUV_15_Gas
13	48309478	Car_14_Gas	SUV_15_Gas	SUV_15_Gas
14	48309519	Car_14_Gas	SUV_15_Gas	SUV_15_Gas
15	48309560	Car_14_Gas	SUV_15_Gas	SUV_15_Gas
16	48309593	SUV_18_Gas	Car_14_Gas	SUV_15_Gas
17	48309594	Car_14_Gas	SUV_15_Gas	SUV_15_Gas
18	60437360	Car_12_Gas	Car_12_Gas	Car_12_Gas
19	71860247	Car_13_Gas	Car_13_Gas	Car_8_Gas
20	73330466	SUV_8_Gas	Car_4_Gas	Car_4_Gas
21	73597909	SUV_9_Gas	SUV_9_Gas	SUV_9_Gas
22	74512783	Car_12_Gas	Car_12_Gas	Van_19_Gas
23	76591729	Car_16_Gas	Car_16_Gas	SUV_20_Gas
24	76904600	Car_12_Gas	Car_12_Gas	Car_12_Gas
25	79909408	Car_13_Gas	Car_20_Gas	Car_13_Gas
26	79909449	Car_13_Gas	Car_20_Gas	Car_13_Gas
27	92446257	SUV_12_Gas	SUV_12_Gas	SUV_12_Gas
28	98204182	SUV_4_Gas	Pickup_11_Gas	Pickup_11_Gas
29	98204223	SUV_4_Gas	SUV_4_Gas	SUV_4_Gas
30	98204256	Motorcycle_13_Gas	SUV_4_Gas	SUV_4_Gas
31	107386706	Van_15_Gas	Car_20_Gas	Car_13_Gas

Tour Mode Choice Modifications

- Preprocessor selects the auto operating costs from the vehicles table for each occupancy level
- Correct auto operating cost is used for each mode
  - SOV, drive transit → occupancy 1
  - SR2 → occupancy 2
  - SR3p → occupancy 3.5
- The selected vehicle is added as a new column after tour mode choice is run
- Atwork subtours use the auto operating costs of the parent tour vehicle
- Non-household vehicles use the previous *costPerMile* constant

final_tours.csv

	A	S	T	U	V	W
1	tour_id	vehicle_occup_1	vehicle_occup_2	vehicle_occup_3.5	tour_mode	selected_vehicle
2	3827799	non_hh_veh	non_hh_veh	non_hh_veh	WALK_HVY	
3	3867733	Car_9_Gas	Car_9_Gas	Car_9_Gas	DRIVEALONEFREE	Car_9_Gas
4	3875277	non_hh_veh	non_hh_veh	non_hh_veh	WALK_HVY	
5	4162195	Car_12_Gas	Car_12_Gas	Car_12_Gas	DRIVEALONEFREE	Car_12_Gas
6	5616465	Car_16_Gas	Car_16_Gas	Car_16_Gas	DRIVEALONEFREE	Car_16_Gas
7	16038903	Car_20_Gas	Car_20_Gas	Car_20_Gas	SHARED3FREE	Car_20_Gas
8	36354780	SUV_15_Gas	Pickup_20_Gas	SUV_15_Gas	SHARED2FREE	Pickup_20_Gas
9	36354781	SUV_15_Gas	Pickup_20_Gas	SUV_15_Gas	DRIVEALONEFREE	SUV_15_Gas
10	36354813	SUV_15_Gas	SUV_15_Gas	SUV_15_Gas	DRIVEALONEFREE	SUV_15_Gas
11	36354854	SUV_15_Gas	SUV_15_Gas	SUV_15_Gas	SHARED3FREE	SUV_15_Gas
12	36354855	Pickup_20_Gas	SUV_15_Gas	SUV_15_Gas	SHARED2FREE	SUV_15_Gas
13	48309478	Car_14_Gas	SUV_15_Gas	SUV_15_Gas	DRIVEALONEFREE	Car_14_Gas
14	48309519	Car_14_Gas	SUV_15_Gas	SUV_15_Gas	DRIVEALONEFREE	Car_14_Gas
15	48309560	Car_14_Gas	SUV_15_Gas	SUV_15_Gas	SHARED2FREE	SUV_15_Gas
16	48309593	SUV_18_Gas	Car_14_Gas	SUV_15_Gas	SHARED3FREE	SUV_15_Gas
17	48309594	Car_14_Gas	SUV_15_Gas	SUV_15_Gas	SHARED3FREE	SUV_15_Gas
18	60437360	Car_12_Gas	Car_12_Gas	Car_12_Gas	DRIVEALONEFREE	Car_12_Gas
19	71860247	Car_13_Gas	Car_13_Gas	Car_8_Gas	WALK	
20	73330466	SUV_8_Gas	Car_4_Gas	Car_4_Gas	DRIVEALONEFREE	SUV_8_Gas
21	73597909	SUV_9_Gas	SUV_9_Gas	SUV_9_Gas	DRIVEALONEFREE	SUV_9_Gas

Extend Vehicle Table For Future Years

BodyType	FuelType	ModelYear	BT-FT-Year	NumMakes	NumModels	MPG	Range	charge240	co2gpm	NewPurchasePrice2017USD	Depreciated Value (Year Specific)	AV
Car	PEV	2020	Car-PEV-2020	13	28	30.5	0.0	3.4	160.4	0.0	0.0	0
Car	PEV	2021	Car-PEV-2021	12	32	27.6	0.0	3.7	168.0	0.0	0.0	0
Car	PEV	2022	Car-PEV-2022	9	18	34.6						0
Car	PEV	2023	Car-PEV-2023	10	20	36.7						0
Car	PEV	2024	Car-PEV-2024	11	21	38.8						0
Car	PEV	2025	Car-PEV-2025	11	22	41.0						0
Car	PEV	2026	Car-PEV-2026	12	24	43.2						0
Car	PEV	2027	Car-PEV-2027	13	25	45.5						0
Car	PEV	2028	Car-PEV-2028	14	26	47.7						0
Car	PEV	2029	Car-PEV-2029	14	28	50.0						0
Car	PEV	2030	Car-PEV-2030	15	29	52.3						0
Car_AV	PEV	2020	Car_AV-PEV-2020	13	28	30.5	0.0	3.4	160.4	0.0	0.0	1
Car_AV	PEV	2021	Car_AV-PEV-2021	12	32	27.6	0.0	3.7	168.0	0.0	0.0	1
Car_AV	PEV	2022	Car_AV-PEV-2022	9	18	34.6						1
Car_AV	PEV	2023	Car_AV-PEV-2023	10	20	36.7						1
Car_AV	PEV	2024	Car_AV-PEV-2024	11	21	38.8						1
Car_AV	PEV	2025	Car_AV-PEV-2025	11	22	41.0						1
Car_AV	PEV	2026	Car_AV-PEV-2026	12	24	43.2						1
Car_AV	PEV	2027	Car_AV-PEV-2027	13	25	45.5						1
Car_AV	PEV	2028	Car_AV-PEV-2028	14	26	47.7						1
Car_AV	PEV	2029	Car_AV-PEV-2029	14	28	50.0						1
Car_AV	PEV	2030	Car_AV-PEV-2030	15	29	52.3						1

New AV Body Types

- Body type and Fuel type attributes must be defined for future years (up to max forecast year)
- AV-Body Type combinations must be added, with indicator field

AV Ownership Model

The following model is from DaySim and has been implemented in ActivitySim

Variable	Coefficient
AV_Constant	Calibrated for different penetration Rates
AV_HHIncomeUnder50KCoefficient	-1.0
AV_HHIncomeOver100KCoefficient	1.0
AV_HHHeadUnder35Coefficient	0.5
AV_HHHeadOver65Coefficient	-1.0
AV_CoefficientPerHourCommuteTime	0.25

Then the variable will be used to influence number of cars owned in the auto ownership model

	Parameters				
Variable	Cars 0	Cars 1	Cars 2	Cars 3	Cars 4+
util_asc		1.17	-0.709	-2.88	-4.57
util_auto_time_saving_per_worker		0.837	0.957	0.957	0.957
util_children_16_17_per_driver		0.00	-2.42	-4.18	-5.50
util_density		-0.00730	-0.00730	-0.00730	-0.00730
…		…	…	…	…
util_AV_owned	-999	0	-0.22314	-0.69315	-999

Or turn off?

AV influence on mode choice

- If an AV is selected as the vehicle choice for tour mode choice, a set of “modifier” parameters will be turned on in the pre-processor
  - In-vehicle time perception for auto (0.8, due to increased productivity in self-driving vehicles)
  - Parking cost (~0, due to sending self-driving car to remote parking or home)
  - Terminal time (~0, due to curbside drop-off and pick-up)

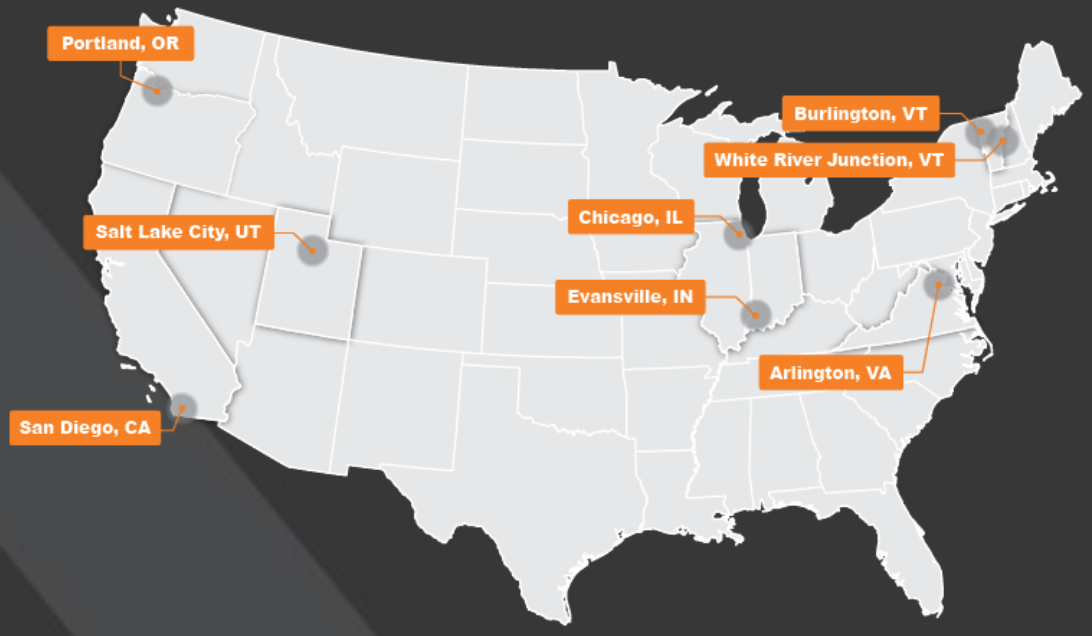
Phase 2 Next Steps

Preparing County-level Calibration Targets for Work Location Choice

- 2011-2015 Census Journey-to-work Flows at County level used as starting point
- ActivitySim constrained by workers at residence end and employment at destination end
  - Workers by residence county matches census data well
  - Employment data includes workers who work from home and workers who in-commute
  - Method used to factor observed data and model size terms to account for these workers
  - County-county targets are being compared to ActivitySim to determine whether county-county constants needed to improve match

Next steps with updated schedule

- Complete model estimation and implement all estimated models (end of September)
- Complete extension of vehicle type model to consider AVs (end of October)
- Model calibration (now through November)
- Model validation (November through January)
- Sensitivity testing (February through May)
- Documentation and training (February through June)



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