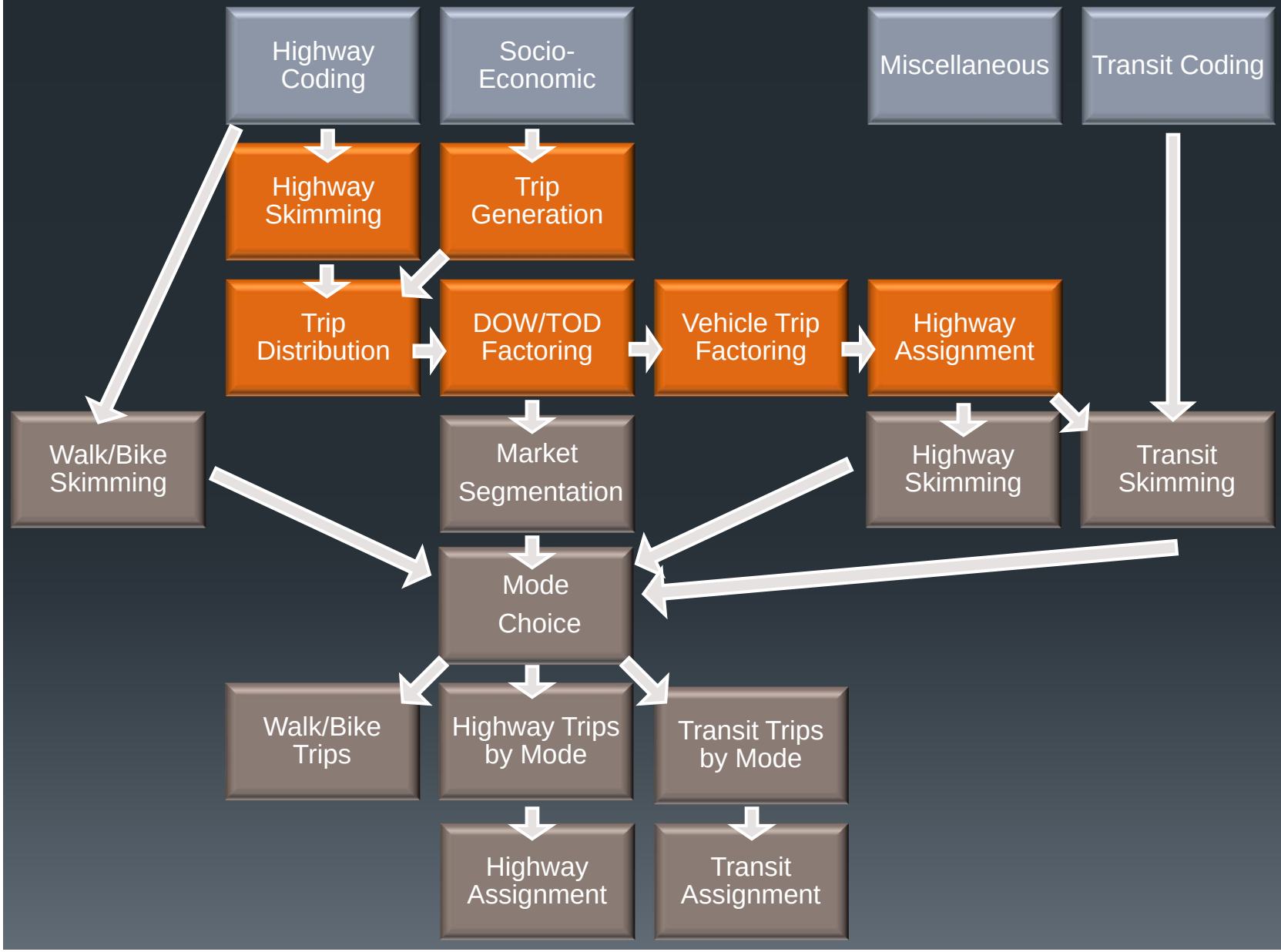
Des Moines Transit Modeling

Midwest Traffic *(and Transit)* Model Users Group

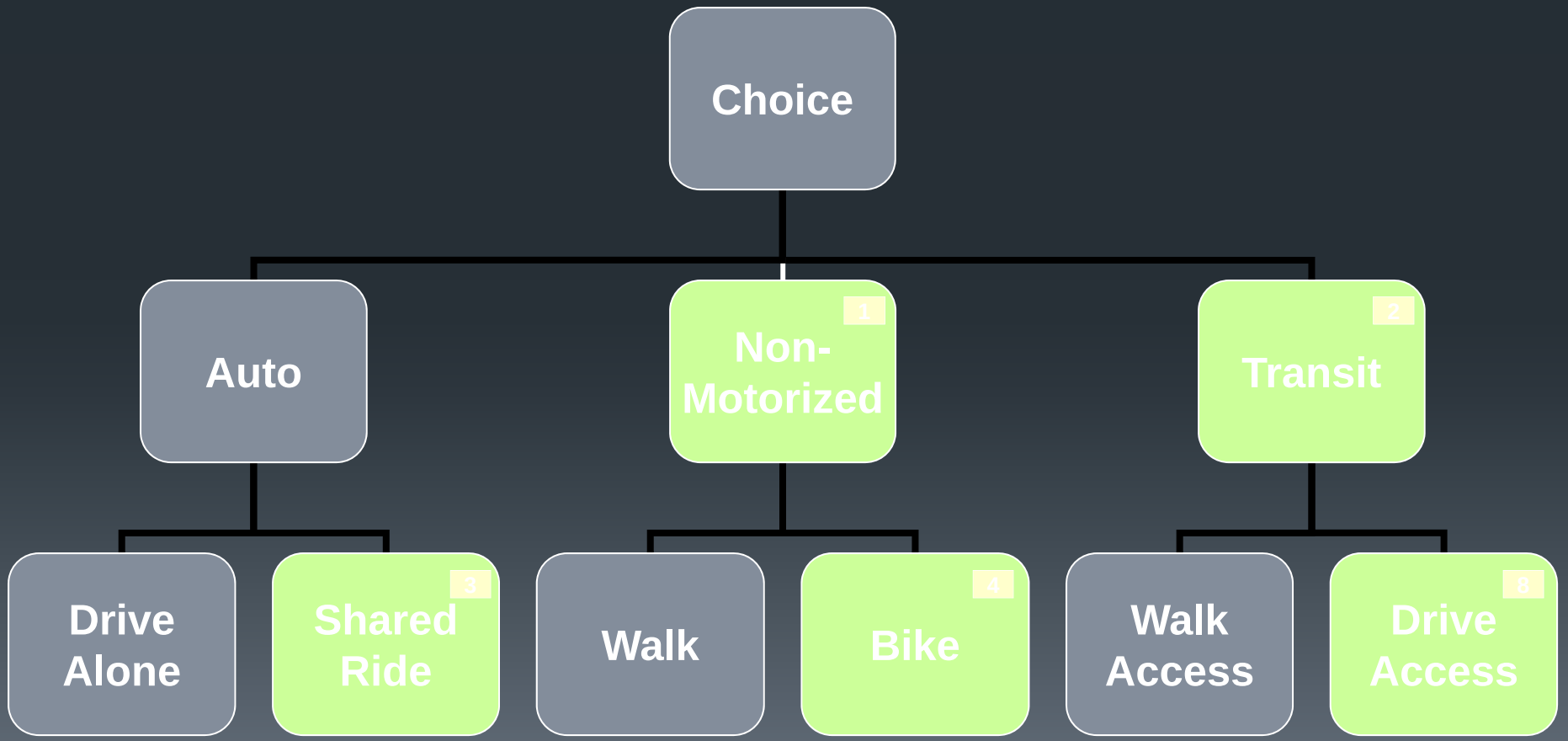
April 9th, 2014

DMAMPO Modeling Process

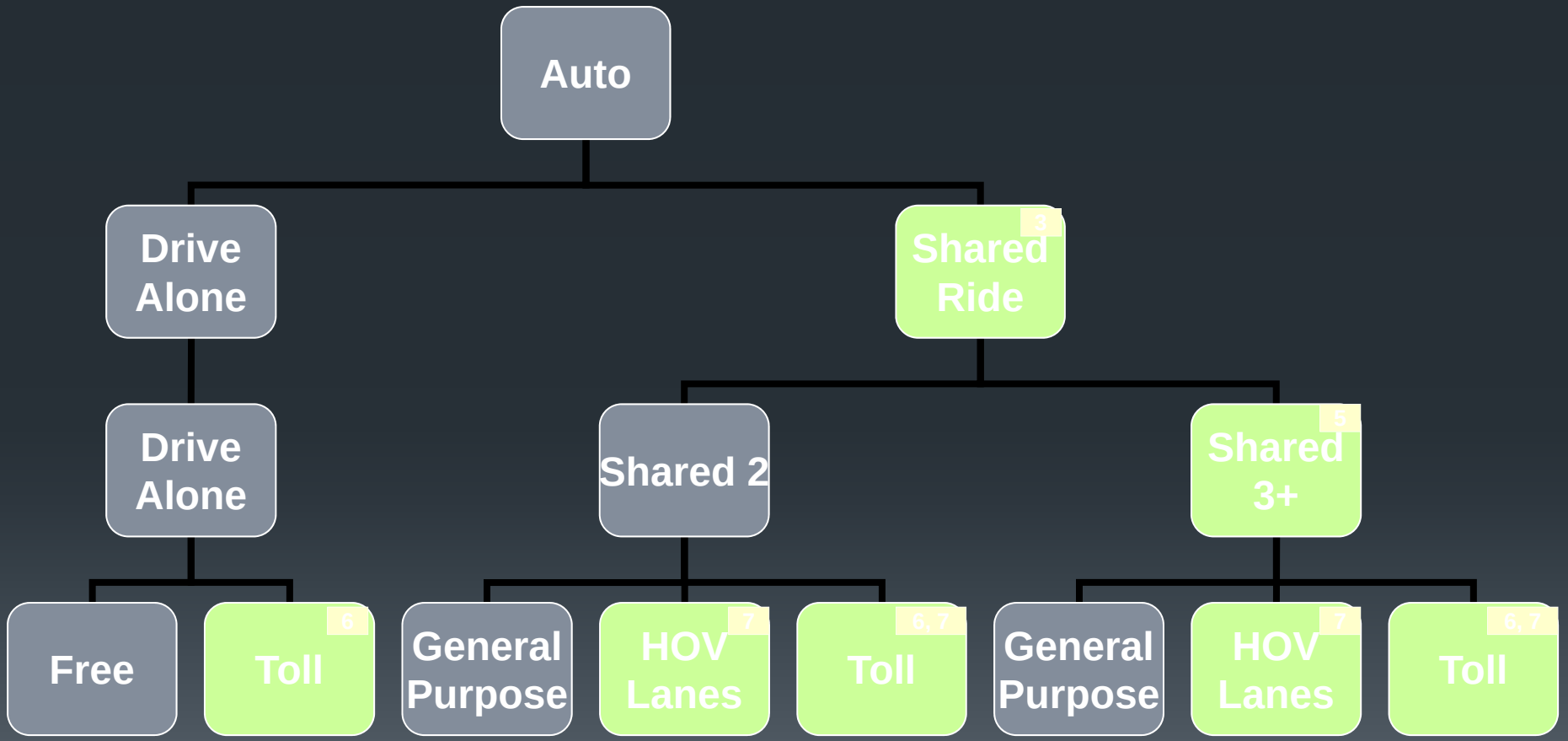


Mode Choice Function

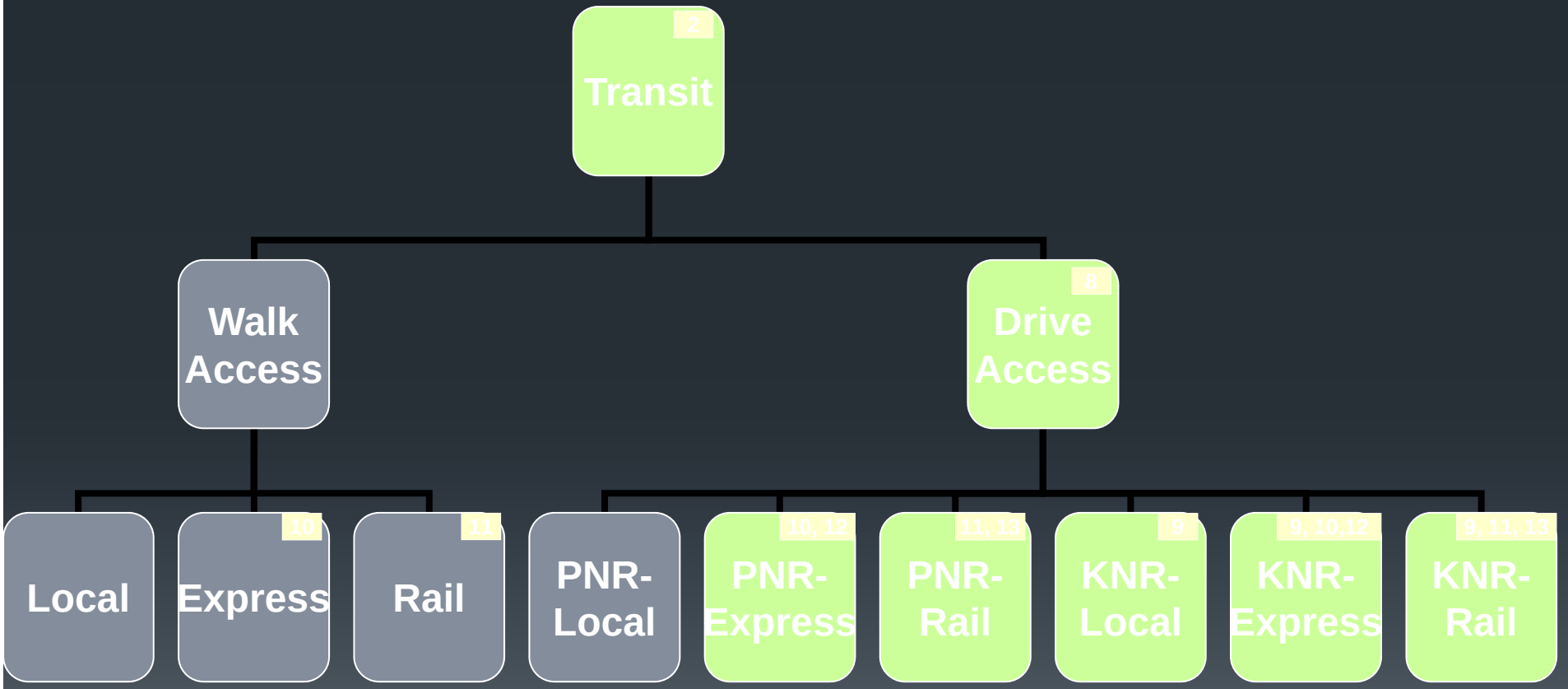
- Allocate person trips to modes based on utility of each mode and trip-maker and trip characteristics



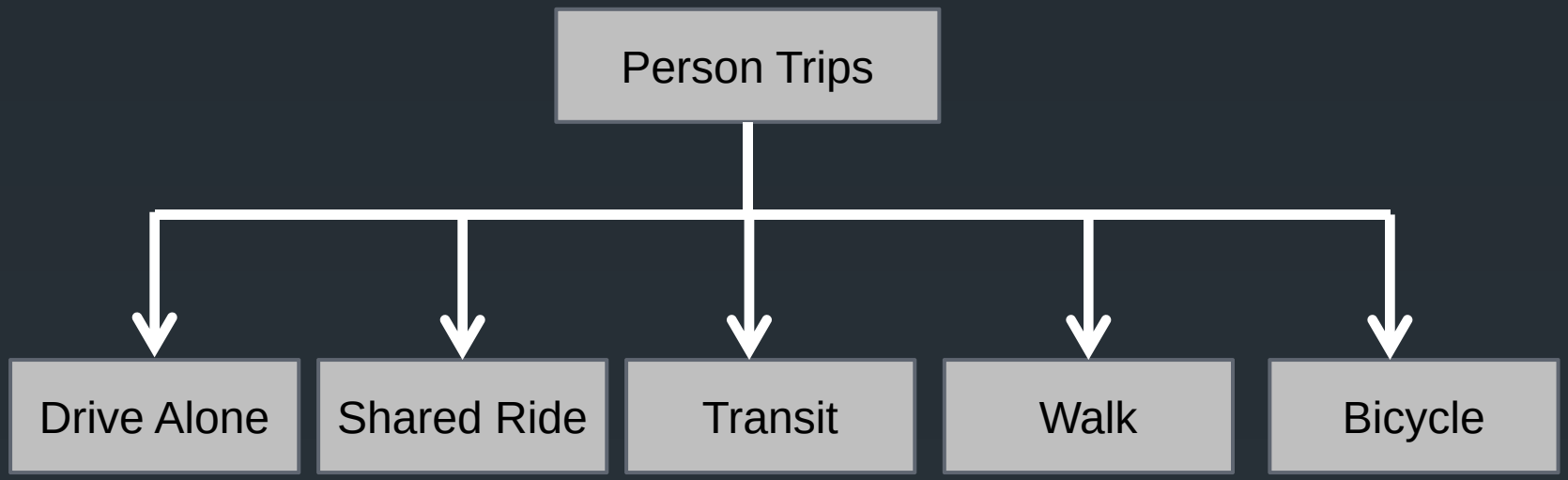
Mode Choice Function



Mode Choice Function



Des Moines Mode Choice Structure



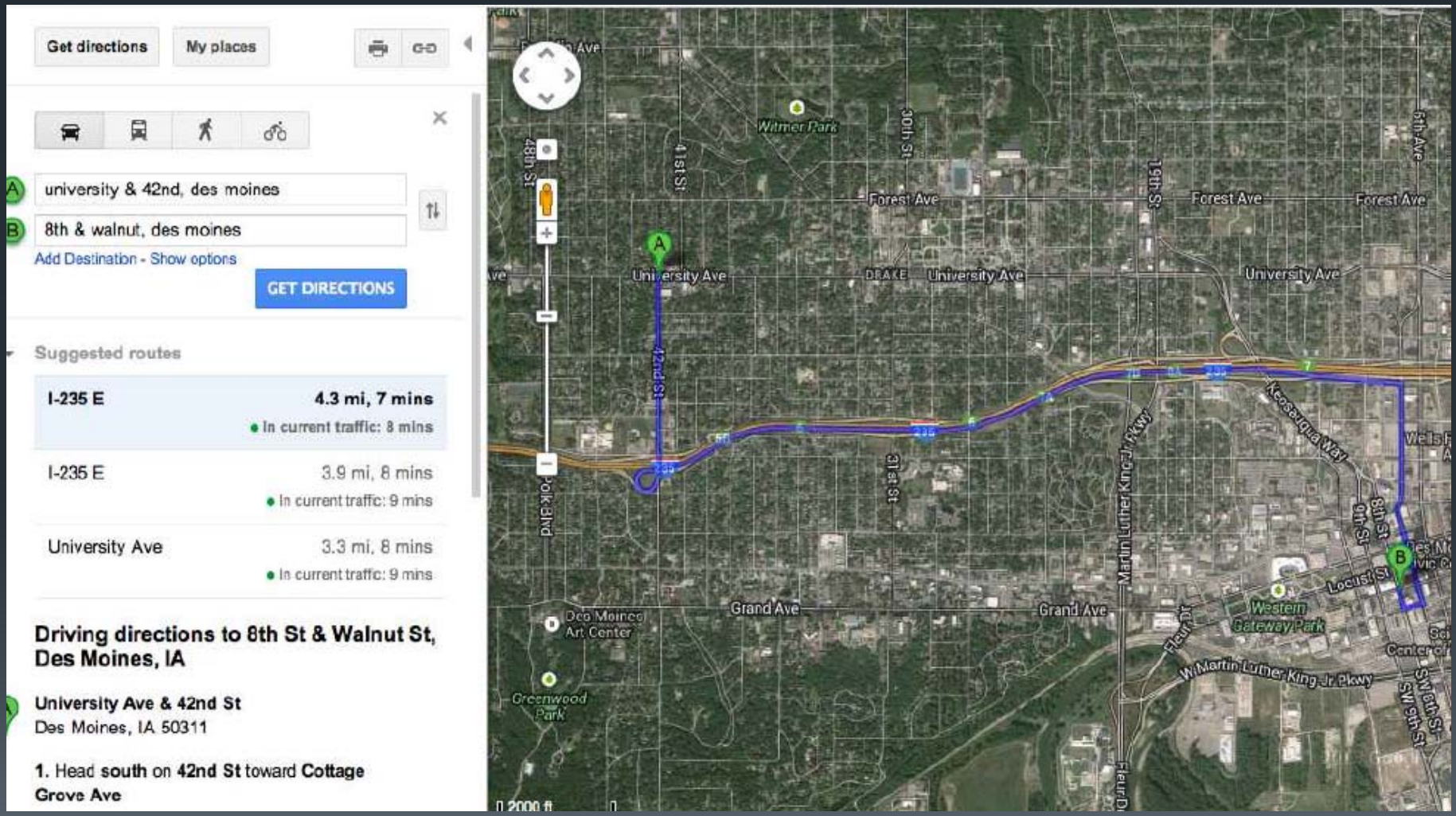
Reasons for Mode Choice Modeling

- Evaluating the feasibility of a major transit investment (new mode?)
- Providing performance measures for choosing corridors, station locations, and alignments for transit improvements
- Evaluating the effectiveness of transit oriented development strategies and other methods of reducing auto travel
- Determining the traffic volume reductions of transit improvements
- Getting federal funding for transit projects (FTA New Starts)
- Determining toll road and HOV lane usage
- Driving transportation modelers insane

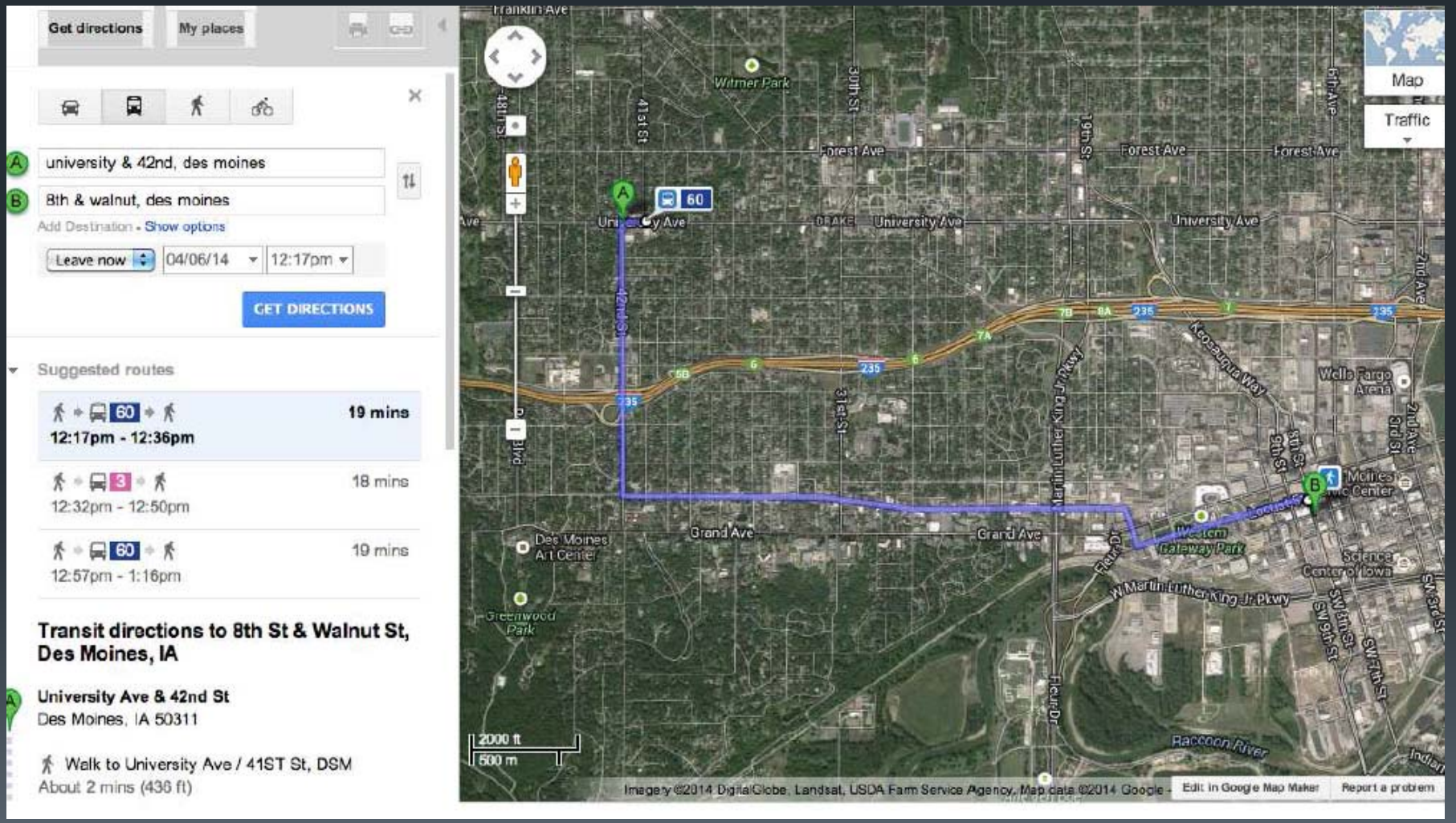
Assumptions

- Trip makers know the times and costs of each mode and choose modes accordingly
- Modes have “unincluded” attributes that can’t be quantified but influence mode use
- Unincluded attributes are reflected through the use of mode constants that vary by trip purpose and market segment

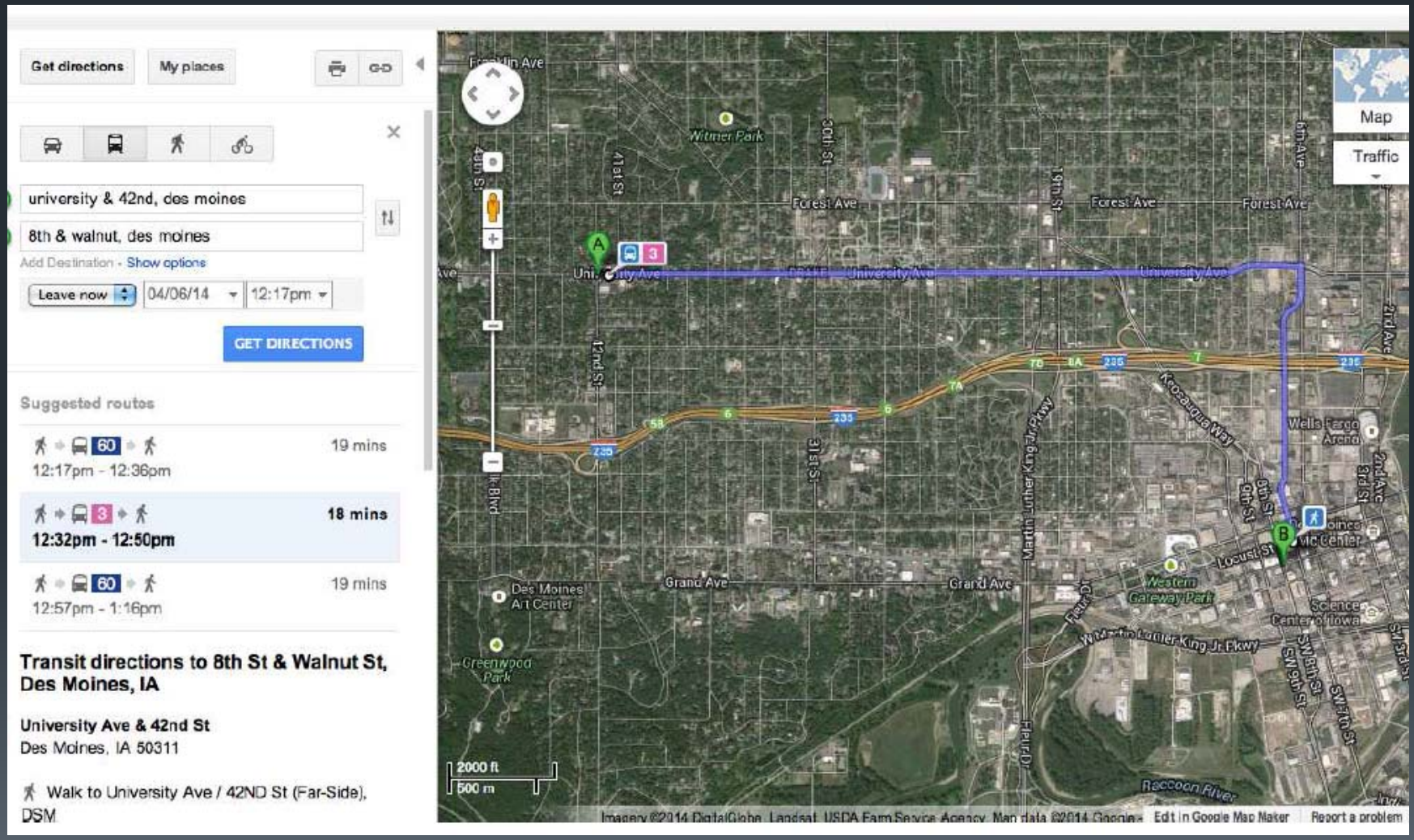
Google Auto Directions



Google Transit Directions



Google Transit Directions



Market Segments

- Des Moines model allocates trips to zero auto households, one auto households, and household with 2 or more autos
- Other schemes include using household income and a combination of factors like auto ownership and workers per household
- Non-home based and school trips are often not segmented

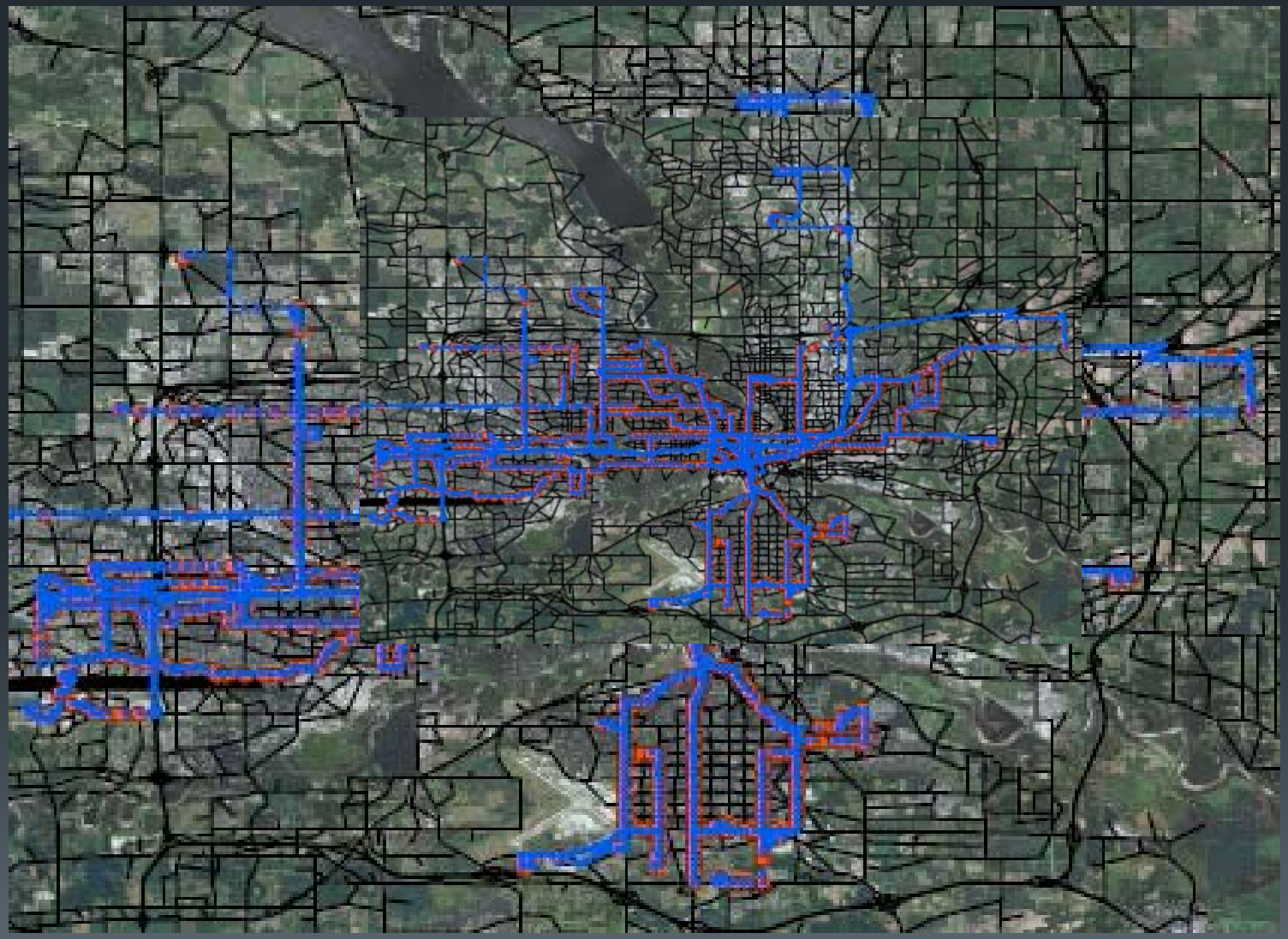
2010 DMAMPO Average Weekday Trips by Mode

SEGMENT	MODE	HBW	HBSH	HBO	MODE	HBSCH	NHBW	NHBO
0 AUTO	DA	-	-	-	DA	23,059	164,206	160,249
0 AUTO	SR	1,450	4,240	439	SR	52,030	49,270	257,877
0 AUTO	TR	1,748	1,410	1,300	TR	851	1,027	606
0 AUTO	WK	3,561	10,412	1,078	WK	19,969	23,206	7,913
0 AUTO	BK	-	-	-	BK	2,098	578	-
1 AUTO	DA	72,714	55,840	14,258	TOTAL	98,007	238,288	426,646
1 AUTO	SR	25,928	70,591	29,708				
1 AUTO	TR	1,772	253	649				
1 AUTO	WK	5,928	2,714	10,503				
1 AUTO	BK	60	607	1,548				
2+ AUTO	DA	440,330	219,091	80,650				
2+ AUTO	SR	42,520	236,595	150,161				
2+ AUTO	TR	1,855	483	331				
2+ AUTO	WK	5,707	9,388	32,688				
2+ AUTO	BK	279	2,201	7,776				
TOTAL		603,851	613,826	331,089				

Transit Model Inputs

- TransCAD transit network describing the path of each route variation, transit link times, service frequencies, stop locations, fares and walk and drive access links
- Walk access fractions by TAZ, purpose, and production/attraction
- Weekday person trips by purpose and time period (AM peak, PM peak, off-peak)
- Market segment fractions by TAZ and purpose
- Congested highway times and distances by time period at link level and TAZ-TAZ
- Parking costs and auto terminal times by TAZ
- TAZ-TAZ Walk and bike times

Google Transit Feed Data



Route 1

TBOUND-Inbound — **Monday-Friday**

ston d & th Ct /OB	Hubbell Ave & E 42nd St	Easton Blvd & E 37th Ct WB/IB	Sherry Lynn & E University	NE 56th St & E University	Grand Ave & E 30th St	Grand Ave & E 14th St	DART Central Station
36	5:42	5:50	----	----	5:56	6:05	6:15
49	5:55	6:03	----	----	6:11	6:20	6:30
	----	----	6:15	6:18	6:26	6:35	6:45
19	6:25	6:33	----	----	6:41	6:50	7:00
	----	----	6:45	6:48	6:56	7:05	7:15
50	6:56	7:04	----	----	7:11	7:20	7:30
	----	----	7:15	7:18	7:26	7:35	7:45

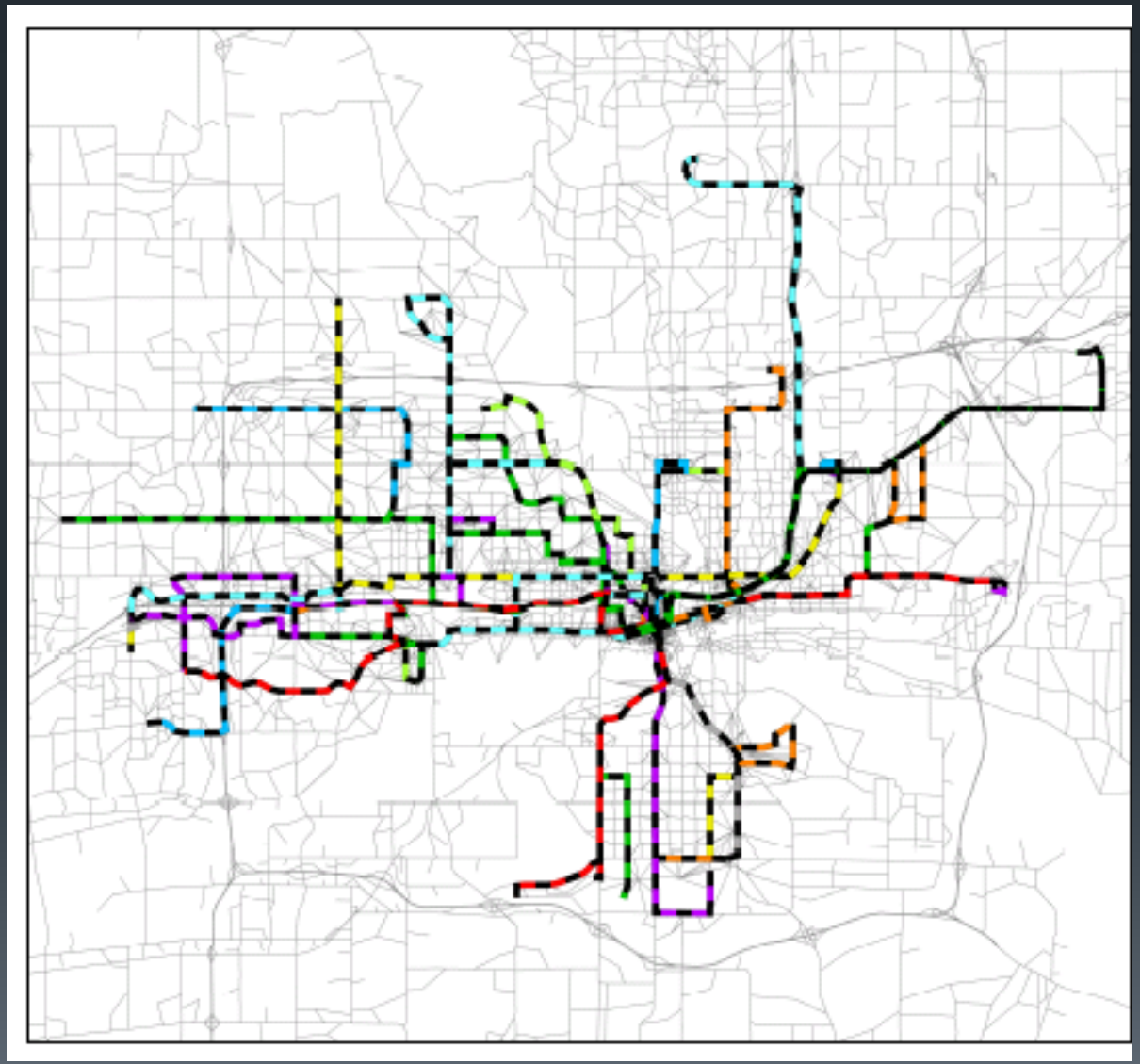
EASTBOUND-Outbound — **Monday-Fri**

Street / Cross St	DART Central Station	Grand Ave & E 14th St	Grand Ave & E 30th St	Sherry Lynn & E University	NE 56th St & E University	Easton Blvd & E 37th Ct EB/OB	Hubbell Ave & E 42nd St	Hoyt Middle School	Easton Blvd & E 37th Ct EB/OB
AM	6:05	6:13	6:20	6:26	----	----	----	----	----
	6:20	6:28	6:35	----	----	6:41	----	----	----
	6:35	6:43	6:50	6:56	----	----	----	----	----
	6:50	6:58	7:05	----	----	7:11	----	7:15	7:21
	7:05	7:13	7:20	----	----	7:26	----	----	----
	7:20	7:29	7:36	----	----	7:42	----	----	----
	7:50	7:59	8:05	----	----	8:11	----	----	----

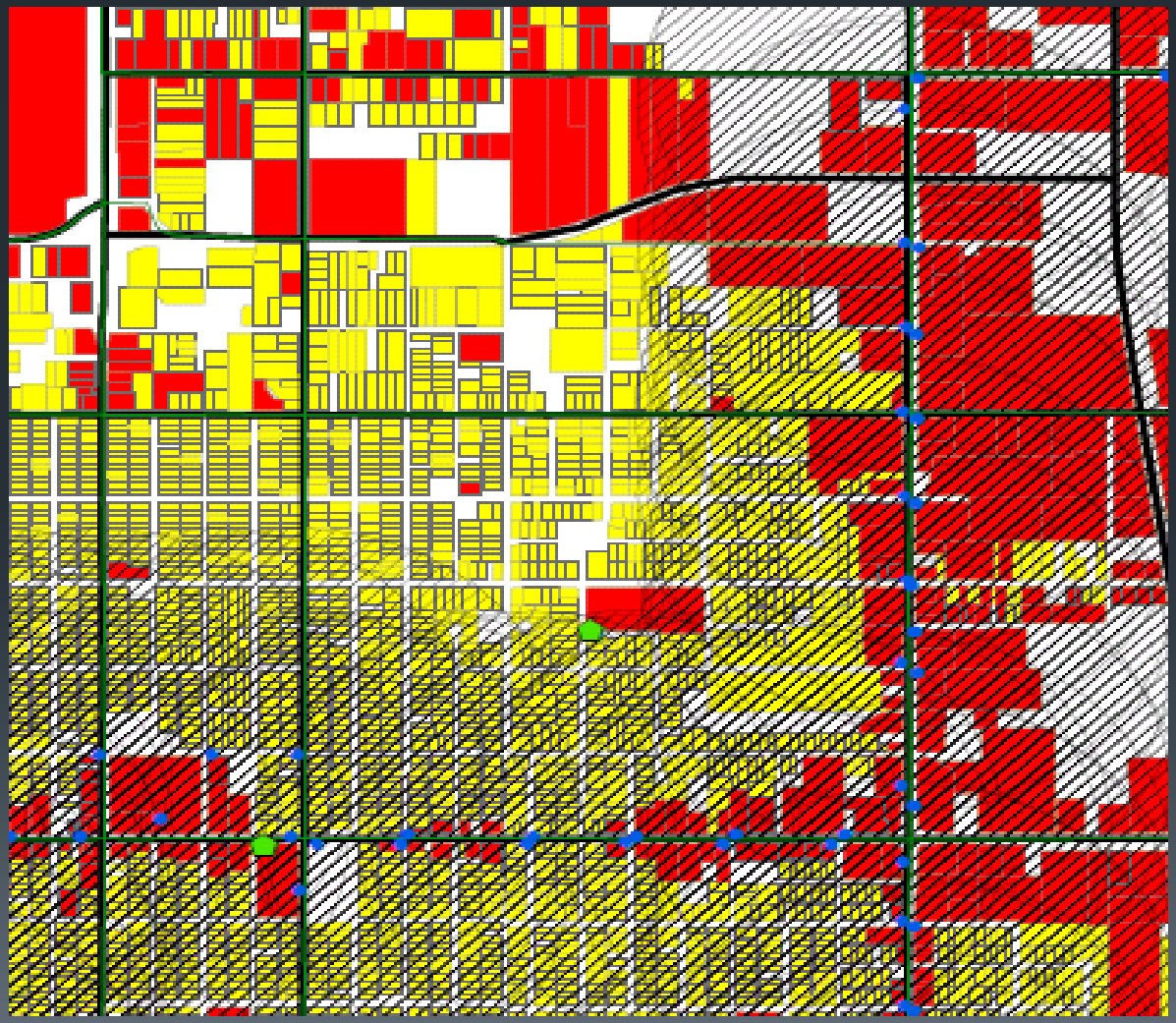
TransCAD Route Table

ROUTEID	MODE	ROUTENO	DIR	VARNO	AMHWY	OPHWY	PMHWY
1001	1	1	IB	1	30.0	40.0	30.0
1002	1	1	IB	2	90.0	120.0	60.0
1101	1	1	OB	1	22.5	36.0	30.0
1102	1	1	OB	2	90.0	180.0	90.0
3001	1	3	IB	1	20.0	30.0	20.0
3101	1	3	OB	1	20.0	30.0	22.5
…							
98001	2	98	IB	1	60.0	120.0	0.0
98002	2	98	IB	2	180.0	0.0	0.0
98101	2	98	OB	1	0.0	360.0	45.0
98102	2	98	OB	2	0.0	0.0	90.0
99001	2	99	IB	1	180.0	0.0	0.0
99002	2	99	IB	2	90.0	0.0	0.0
99101	2	99	OB	1	0.0	0.0	180.0
99102	2	99	OB	2	0.0	0.0	180.0

TransCAD Route System



Walk Access



Mode Utility Coefficents

- In-vehicle travel time (drive alone, shared ride, transit) = -0.025
- First wait time (transit) = -0.05
- Terminal time (drive alone, shared ride) = -0.05
- Transfer wait time (transit) = -0.075
- Walk/bike time (transit, walk, bike) = -.05
- Cost in dollars zero auto segment (drive alone, shared ride transit) = -0.12
- Cost in dollars one auto segment (drive alone, shared ride transit) = -0.05
- Cost in dollars 2+ auto segment (drive alone, shared ride transit) = -0.03
- Cost = Transit fare or $0.12 per mile plus parking cost for drive alone and shared ride

Mode Choice Constants

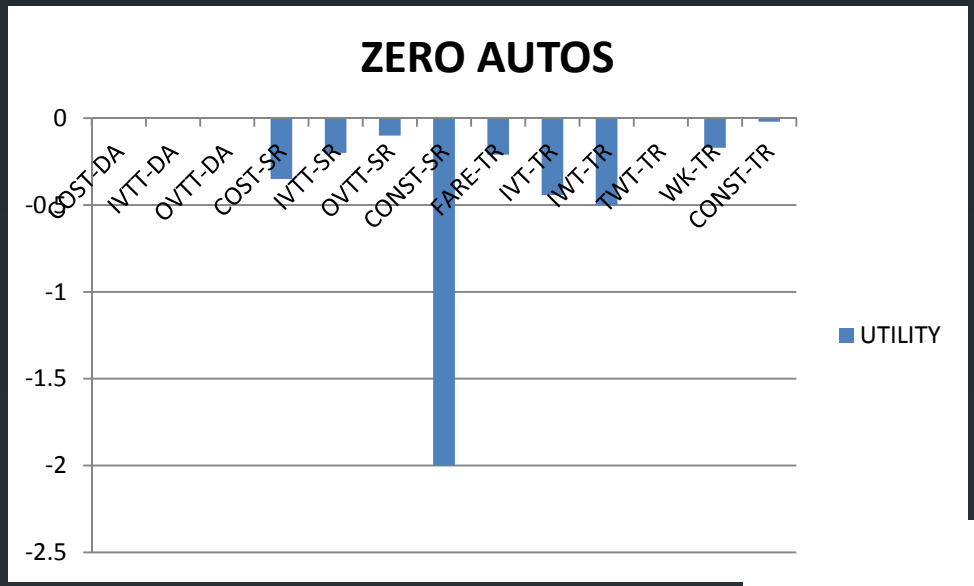
SEGMENT	MODE	HBW	HBSH	HBO
0 AUTO	SR	-2.00	-2.00	-1.50
0 AUTO	TR	-0.02	-0.39	3.00
0 AUTO	WK	3.00	3.00	3.00
0 AUTO	BK	-5.00	-5.00	-5.00
1 AUTO	SR	-0.80	0.80	0.61
1 AUTO	TR	-1.63	-3.00	-0.43
1 AUTO	WK	0.42	-0.24	3.00
1 AUTO	BK	-5.00	-2.30	-0.36
2+ AUTO	SR	-2.00	0.52	0.65
2+ AUTO	TR	-3.00	-3.00	-3.00
2+ AUTO	WK	-1.70	-0.33	1.70
2+ AUTO	BK	-5.00	-3.00	-0.35

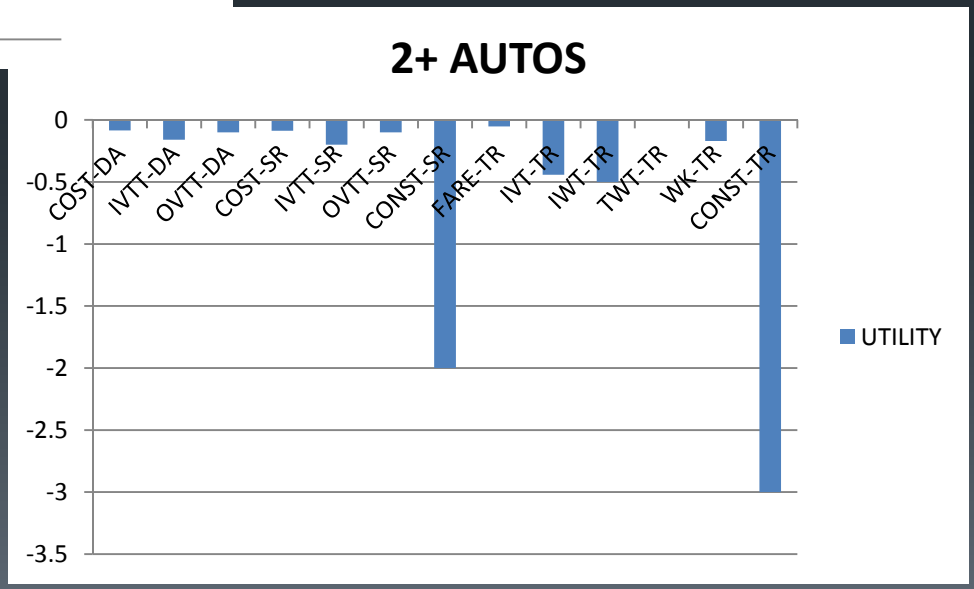
SEGMENT	HBSCH	NHBW	NHBO
All	0.68	-0.86	0.97
All	0.06	-1.77	-1.79
All	1.87	0.22	-0.33
All	-0.47	-2.50	-5.00

HBW Utility Calculations

COMPONENT	VALUE	ZERO AUTO		ONE AUTO		2+ AUTO	
		COEFF	UTILITY	COEFF	UTILITY	COEFF	UTILITY
COST-DA	2.83			-0.050	-0.14	-0.030	-0.09
IVTT-DA	6.40			-0.025	-0.16	-0.025	-0.16
OVTT-DA	2.00			-0.050	-0.10	-0.050	-0.10
TOTAL-DA			0.00		-0.40		-0.35
COST-SR	2.92	-0.120	-0.35	-0.050	-0.15	-0.030	-0.09
IVTT-SR	8.00	-0.025	-0.20	-0.025	-0.20	-0.025	-0.20
OVTT-SR	2.00	-0.050	-0.10	-0.050	-0.10	-0.050	-0.10
CONST-SR			-2.00		-0.80		-2.00
TOTAL-SR			-2.65		-1.25		-2.39
FARE-TR	1.75	-0.120	-0.21	-0.050	-0.09	-0.030	-0.05
IVT-TR	17.70	-0.025	-0.44	-0.025	-0.44	-0.025	-0.44
IWT-TR	10.00	-0.050	-0.50	-0.050	-0.50	-0.050	-0.50
TWT-TR	0.00	-0.075	0.00	-0.075	0.00	-0.075	0.00
WK-TR	3.40	-0.050	-0.17	-0.050	-0.17	-0.050	-0.17
CONST-TR			-0.02		-1.63		-3.00
TOTAL-TR			-0.19		-1.80		-3.17
OVTT-BK	21.69	-0.050	-1.08	-0.050	-1.08	-0.050	-1.08
CONST-BK			-5.00		-5.00		-5.00
TOTAL-BK			-6.27		-7.88		-9.25

Utility Calculations





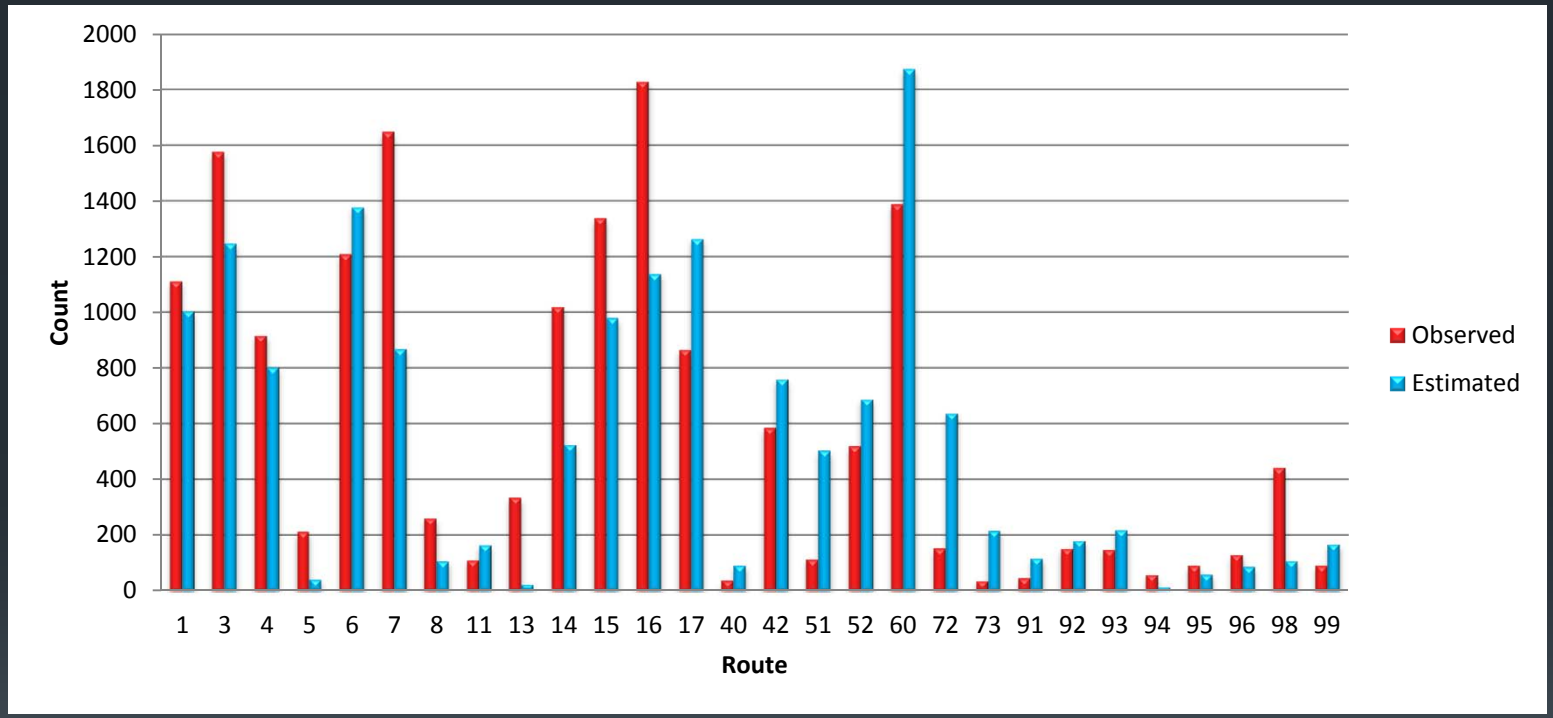
Mode Choice Logit Equation

$$P_n(i) = prob(Y_n = i) = \frac{e^{V_{ni}}}{\sum_{j=C_n} e^{V_{ni}}}$$

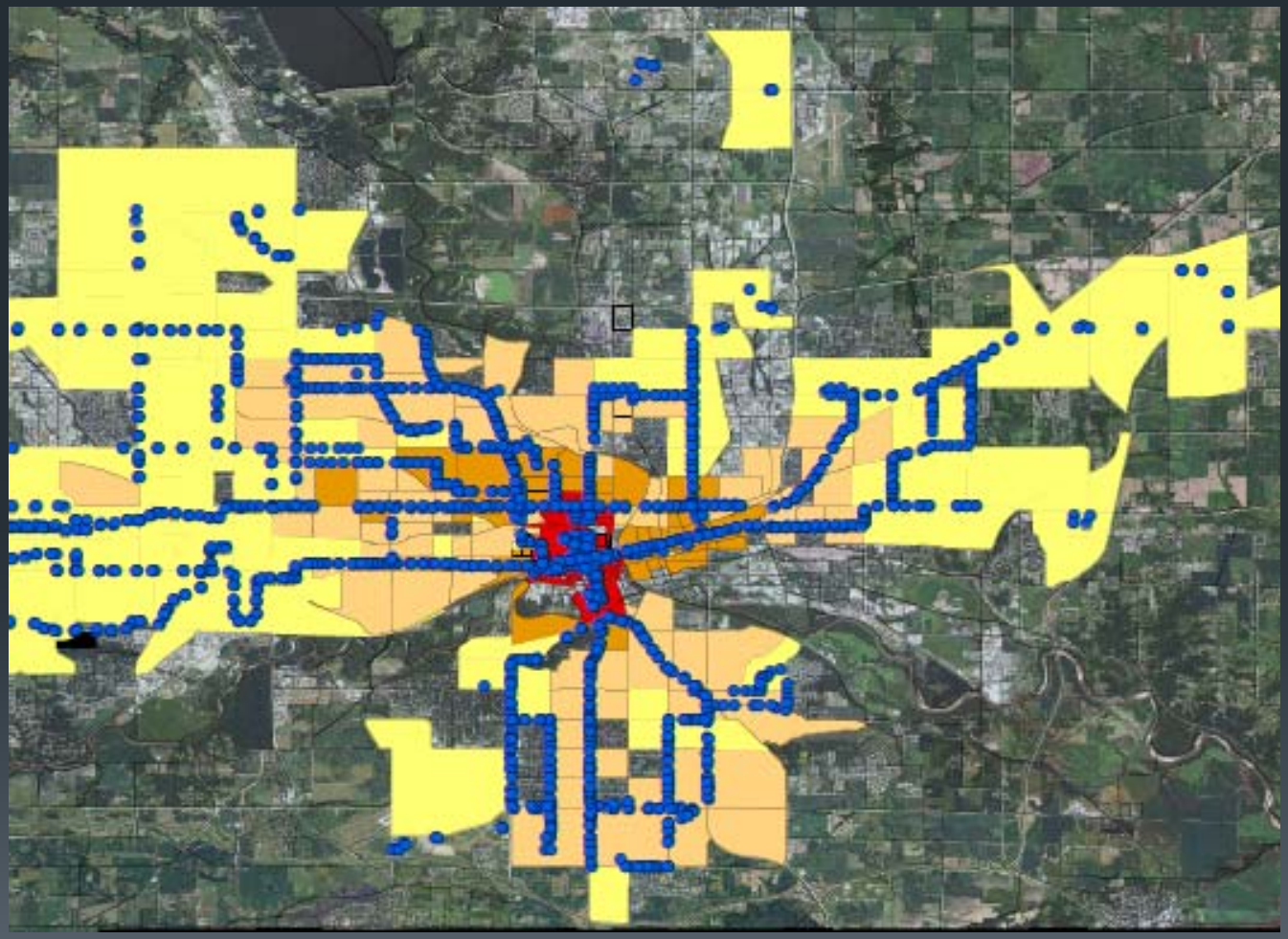
where:

- $P_n(i)$ – The probability with which person $\boldsymbol{n}$ will choose alternative $\boldsymbol{i}$
- Y_n – The value of the response variable for individual $\boldsymbol{n}$
- C_n – The set of alternatives in person $\boldsymbol{n}'$s choice set
- V_{ni} – The measureable component of the utility of alternative $\boldsymbol{i}$ for individual $\boldsymbol{n}$

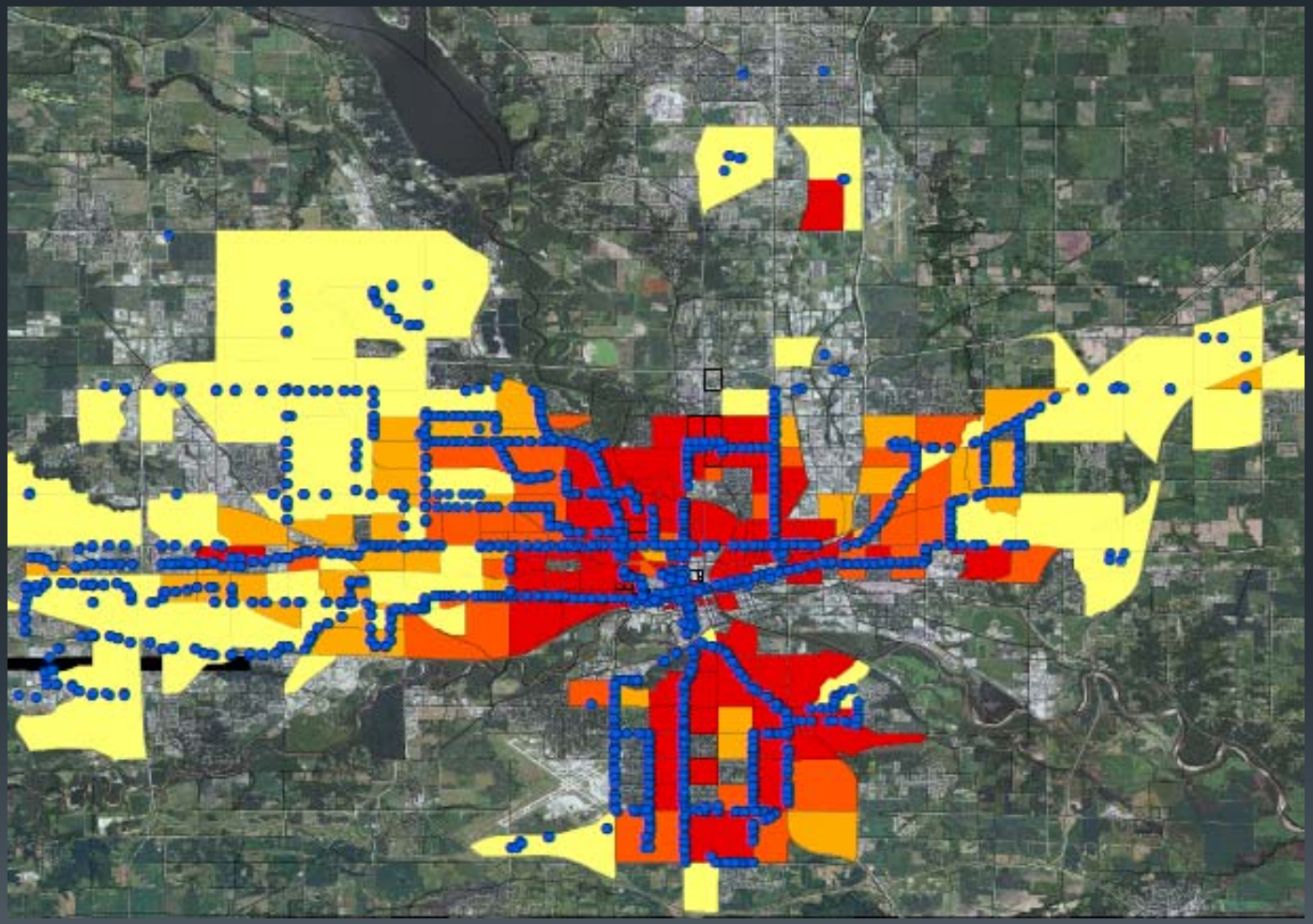
Transit Route Ridership



HBW Transit Share – Attractions



HBW Transit Share - Productions



Other Outputs

- Transit boardings by stop
- Transit link volumes
- Highway trip tables
- Walk and bike trips reports