

# DRCOG Focus Activity-Based Model Calibration/Validation

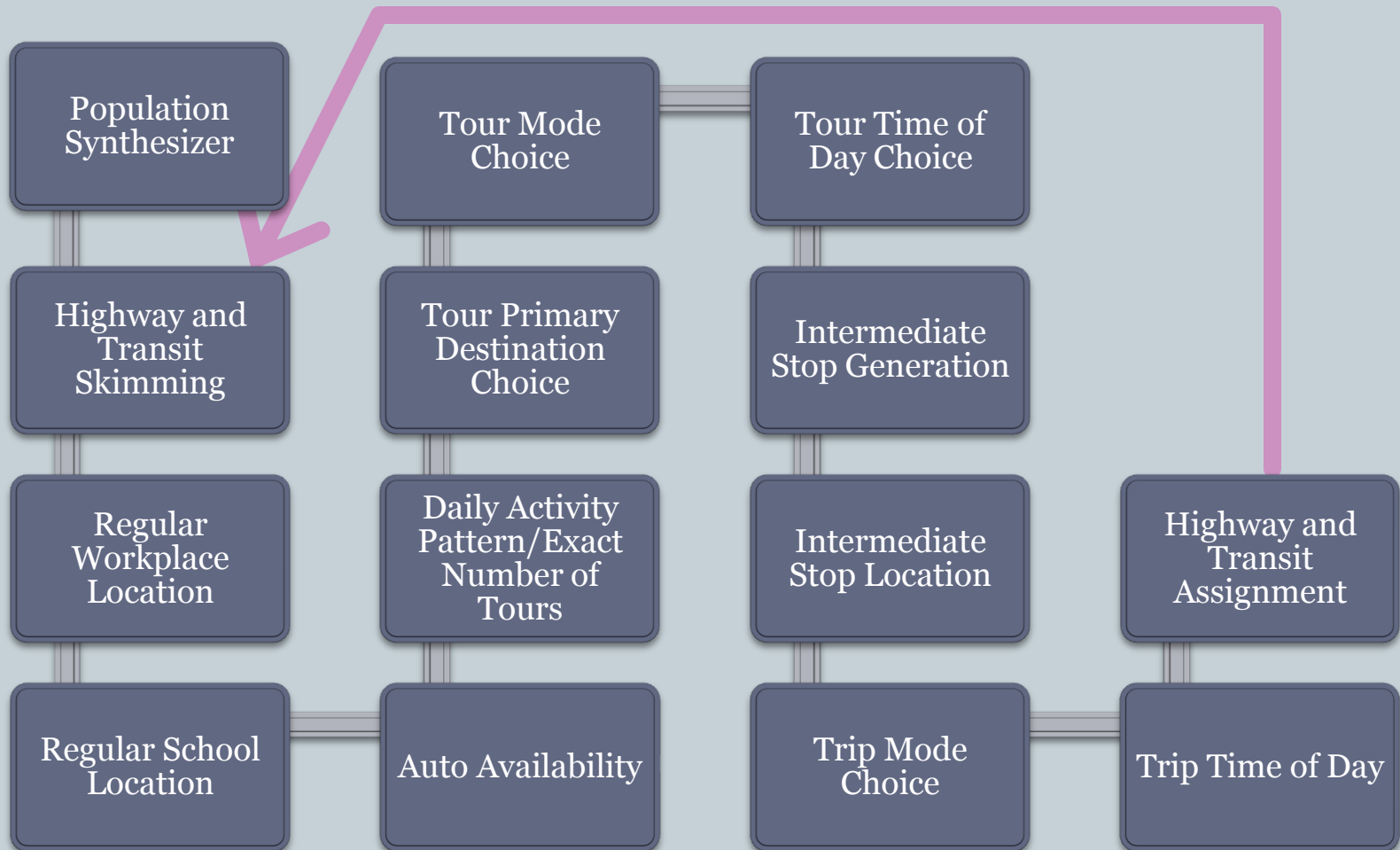


Innovations in Travel Modeling Conference  
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# Focus Model Flow (Simplified)



# What's the plan?



## Extensive Model Calibration/Validation Plan

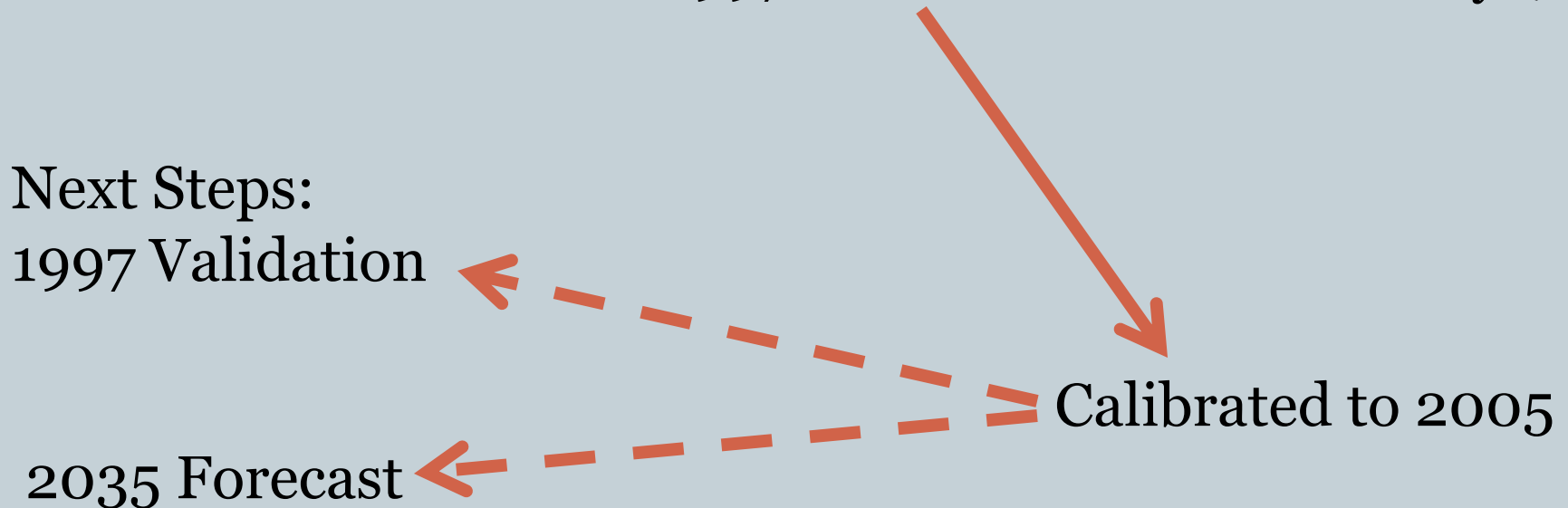
Model Estimation Data: 1997 Travel Behavior Inventory (TBI)

Next Steps:

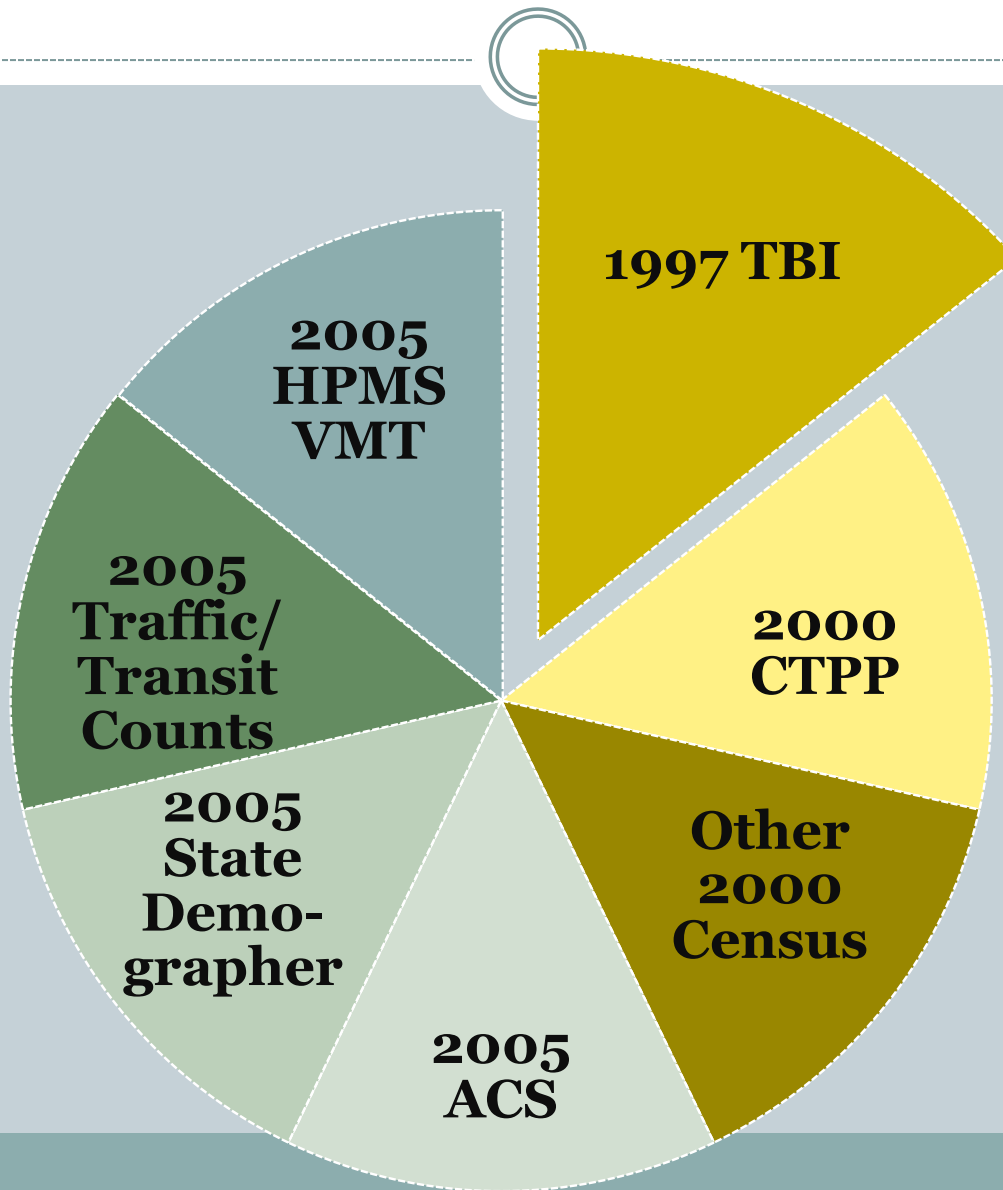
1997 Validation

2035 Forecast

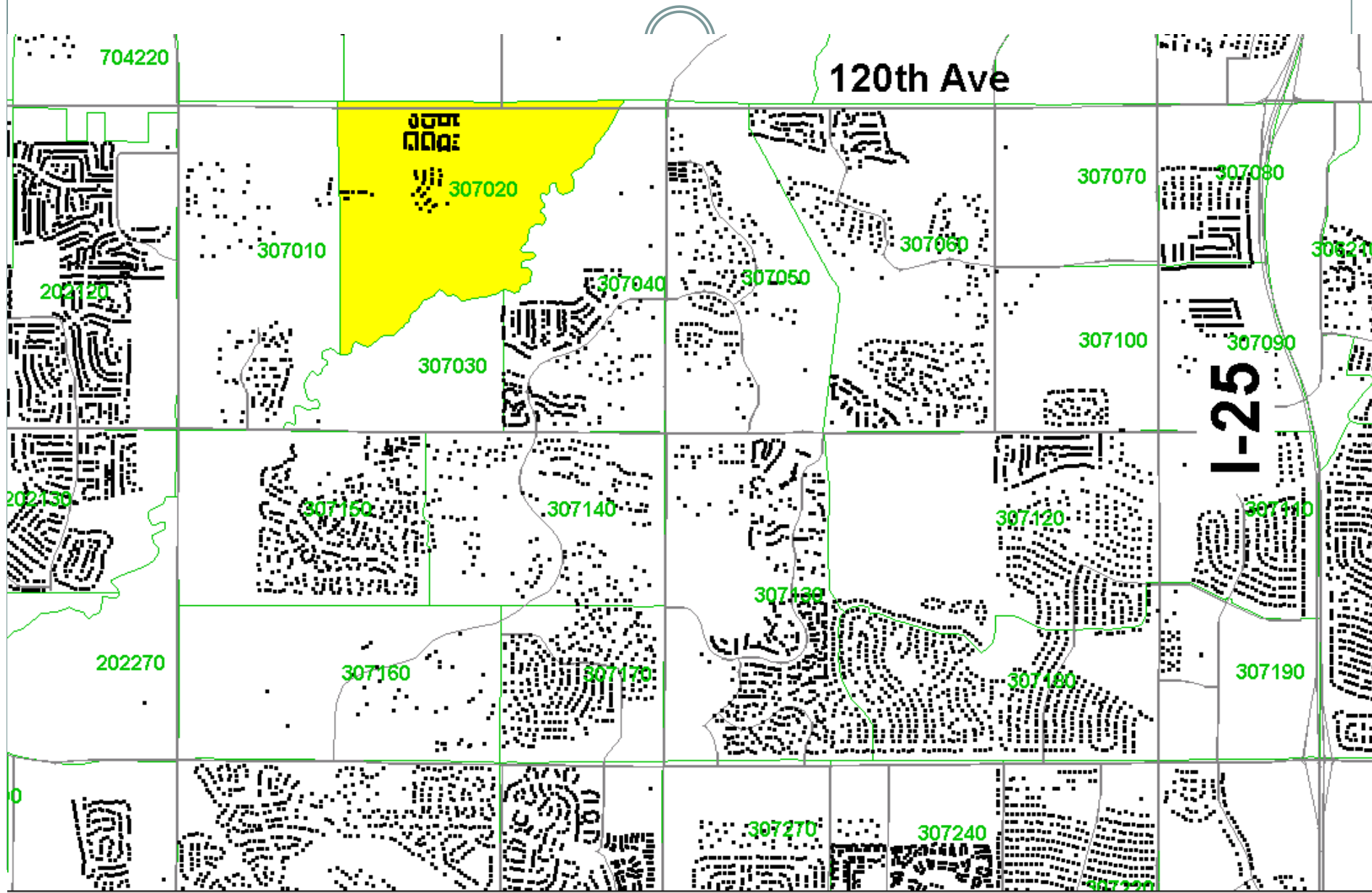
Calibrated to 2005



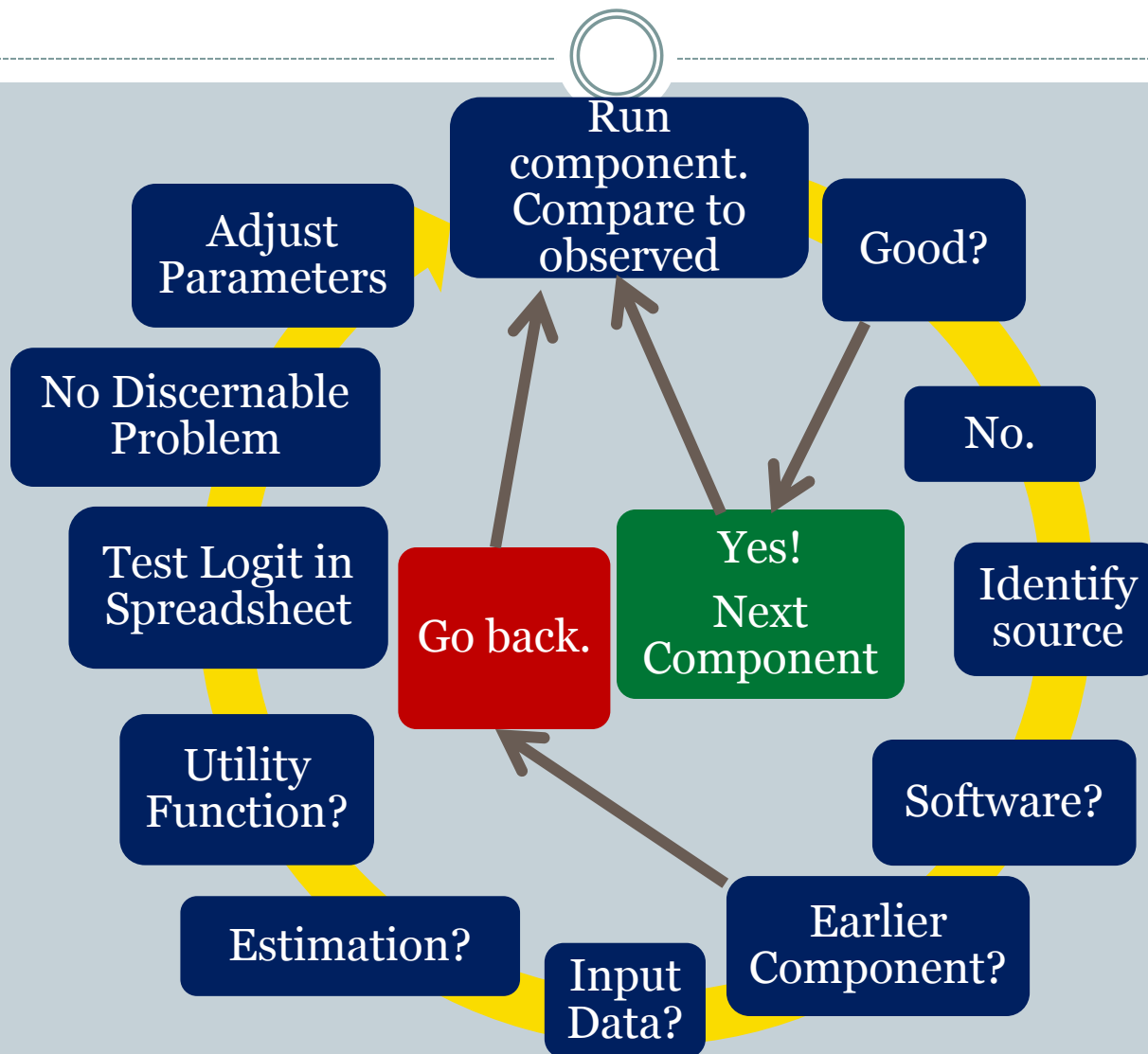
# Data Sources



# Location Data At Point Level



# Disaggregate Until You find the Problem



# Process Example: Vehicle Availability



Household  
Choice

0 Vehicles

1 Vehicles

2 Vehicles

3+  
Vehicles



# Utility Function Example (simplified)



Utility (No Vehicle) = -

5.603 \* 1 HH Driver

-6.598 \* 2 HH Drivers

-6.598 \* 3 HH Drivers

-6.598 \* 4+ HH Drivers

+0.729 \* (Cars >= Workers?)+

+...

+3.735 \* (HH income < \$15k/year?)

+1.408 \* (HH income between \$15k/year - \$30k/year?)

-1.412 \* (HH income between \$75k/year - \$100k/year?)

-1.641 \* (HH income > \$100k/year)

+6.211 \* Transit Accessibility



# Vehicle Availability - **NO** Calibration



Regional Households by Number of Vehicles:

Household Vehicles	2005 Model	2005 ACS	2000 Census
0 vehicles	4%	7%	6%
1 vehicles	30%	33%	33%
2 vehicles	42%	40%	41%
3+ vehicles	25%	19%	20%

# Disaggregate—Where is Problem the Worst?



## 2005 Model: Households by County by Vehicle Availability

Household Vehicles	Adams	Arapahoe	Boulder	Denver	Douglas	Jefferson
0 vehicles	3%	3%	3%	6%	1%	2%
1 vehicle	26%	29%	29%	39%	17%	27%
2 vehicles	42%	42%	43%	35%	53%	44%
3+ vehicles	28%	25%	25%	20%	29%	27%

## 2005 ACS: Households by County by Vehicle Availability

Household Vehicles	Adams	Arapahoe	Boulder	Denver	Douglas	Jefferson
0 vehicles	4%	5%	4%	12%	1%	4%
1 vehicle	32%	34%	29%	43%	20%	32%
2 vehicles	41%	41%	46%	33%	55%	41%
3+ vehicles	23%	20%	21%	12%	24%	23%

# Set Up Logit Model in a Spreadsheet (simplified)



ALTERNATIVE	No Car		1 Car		2 Car		3 Car		4+ Car	
Variable Name	Coeff	Term	Coeff	Term	Coeff	Term	Coeff	Term	Coeff	Term
1 driver in HH	-5.6	-5.6			-1.8	-1.8	-3.4	-3.4	-4.2	-4.2
2 drivers in HH	-6.6	0.0	-2.6	0.0			-1.4	0.0	-2.6	0.0
3 drivers in HH	-6.6	0.0	-2.7	0.0	-1.5	0.0			-1.1	0.0
4+ drivers in HH	-6.6	0.0	-2.2	0.0	-2.1	0.0	-1.4	0.0		
HH inc under \$15k/yr	3.7	3.7	1.1	1.1			-0.2	-0.2	-1.5	-1.5
HH inc \$15k-30k/yr	1.4	0.0	0.4	0.0			-0.2	0.0	-0.2	0.0
HH inc \$75k-100k/yr	-1.4	0.0	-0.7	0.0			0.2	0.0	0.4	0.0
HH inc above \$100k/yr	-1.6	0.0	-1.6	0.0			0.3	0.0	0.5	0.0
Transit Accessibilitiy	6.2	0.0	1.3	0.0	1.3	0.0	1.3	0.0	1.3	0.0
<b>UTILITY</b>		-1.1		1.8		-1.0		-2.9		-5.0
<b>EXP(Utility)</b>		0.3		6.2		0.4		0.1		0.0
<b>Sum of EXP(Utility)</b>		6.9		6.9		6.9		6.9		6.9
<b>Probability</b>		<b>4.6%</b>		<b>89.3%</b>		<b>5.1%</b>		<b>0.8%</b>		<b>0.1%</b>

# Get Your Software to Write Out All Coefficients, Variable Values, and Utilities



2010-02-11 16:08:37,098 DEBUG 5268

IRMCommon.UtilityFunctionTerm - Constant Value is -  
4.86

2010-02-11 16:08:37,098 DEBUG 5268

IRMCommon.UtilityFunction - Running Utility Sum is -  
4.86

2010-02-11 16:08:37,098 DEBUG 5268

IRMCommon.UtilityFunctionTerm - Coefficient is 1.18,  
Variable Name is PersTypeUniversity, Variable Value is 1.

2010-02-11 16:08:37,098 DEBUG 5268

IRMCommon.UtilityFunction - Running Utility Sum is -  
3.68

# Final Changes



- Changed Coefficient for Transit Accessibility from 6.211 to 8.0 in 0 car alternative
- Added Constant 0.3 to 0 car alternative



# Auto Availability Model Calibrated—5<sup>th</sup> Run



## Regional Households by Number of Autos

Household Vehicles	2005 Model	2005 ACS	2000 Census
0 autos	6%	7%	6%
1 autos	27%	33%	33%
2 autos	41%	40%	41%
3+ autos	26%	19%	20%

# Auto Availability Model Calibrated—5<sup>th</sup> Run



## 2005 Model: Households by County by Vehicle Availability

Household Vehicles	Adams	Arapahoe	Boulder	Denver	Douglas	Jefferson
0 vehicles	6%	7%	5%	9%	2%	4%
1 vehicle	25%	22%	27%	36%	16%	26%
2 vehicles	42%	38%	46%	35%	53%	44%
3+ vehicles	28%	33%	22%	20%	29%	26%

## 2005 ACS: Households by County by Vehicle Availability

Household Vehicles	Adams	Arapahoe	Boulder	Denver	Douglas	Jefferson
0 vehicles	4%	5%	4%	12%	1%	4%
1 vehicle	32%	34%	29%	43%	20%	32%
2 vehicles	41%	41%	46%	33%	55%	41%
3+ vehicles	23%	20%	21%	12%	24%	23%

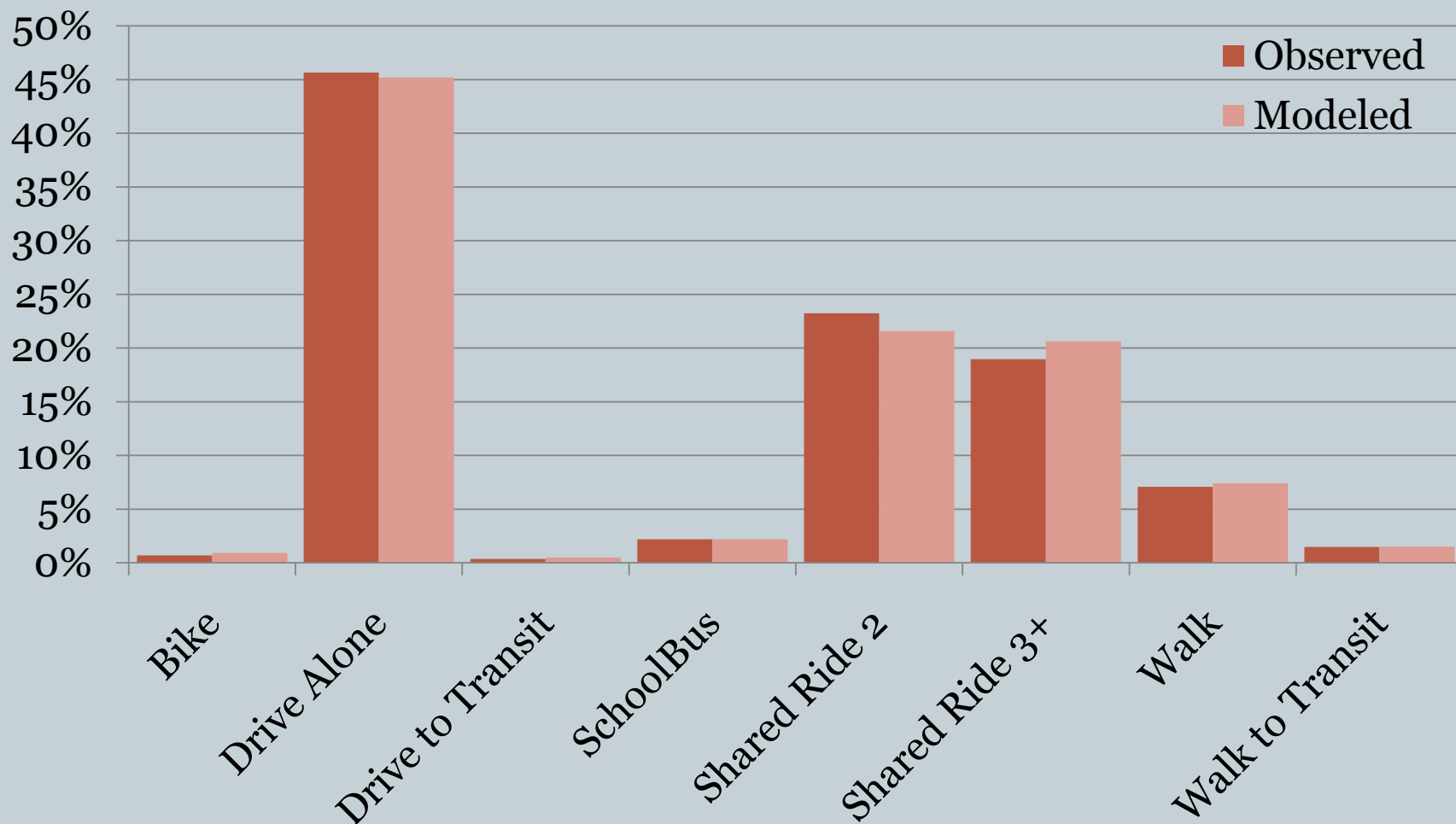
# Final Thoughts



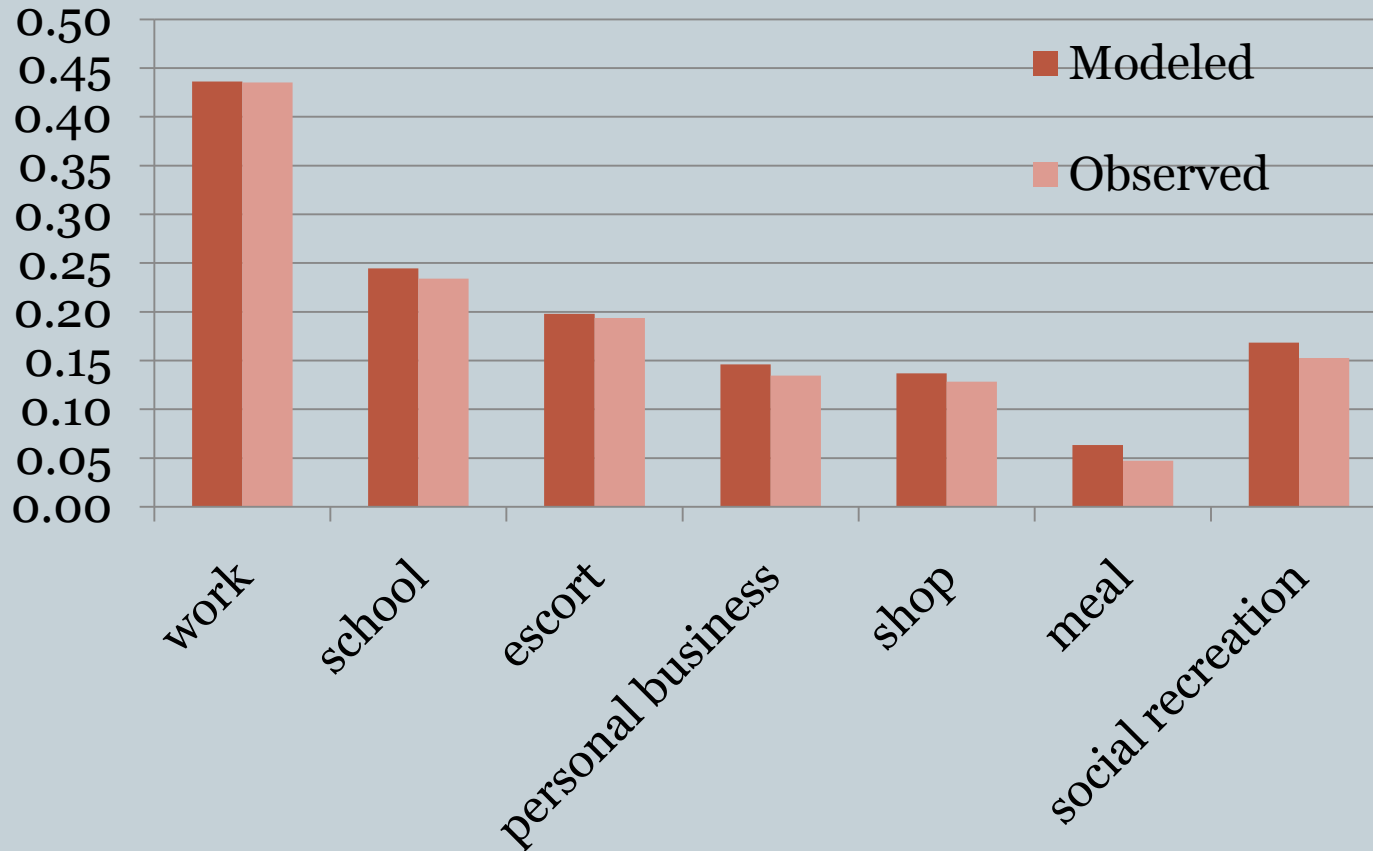
- **Make a plan –**
  - How good does the model have to be?
  - By when?
  - For what purpose?
- **Be creative in comparison –**
  - For data sources and summaries.
  - Look at as much as possible.
- **Break the problem down until the source is revealed.**
- **Do an alternate year run –**
  - May reveal other issues with calibration.
  - Important for validation.



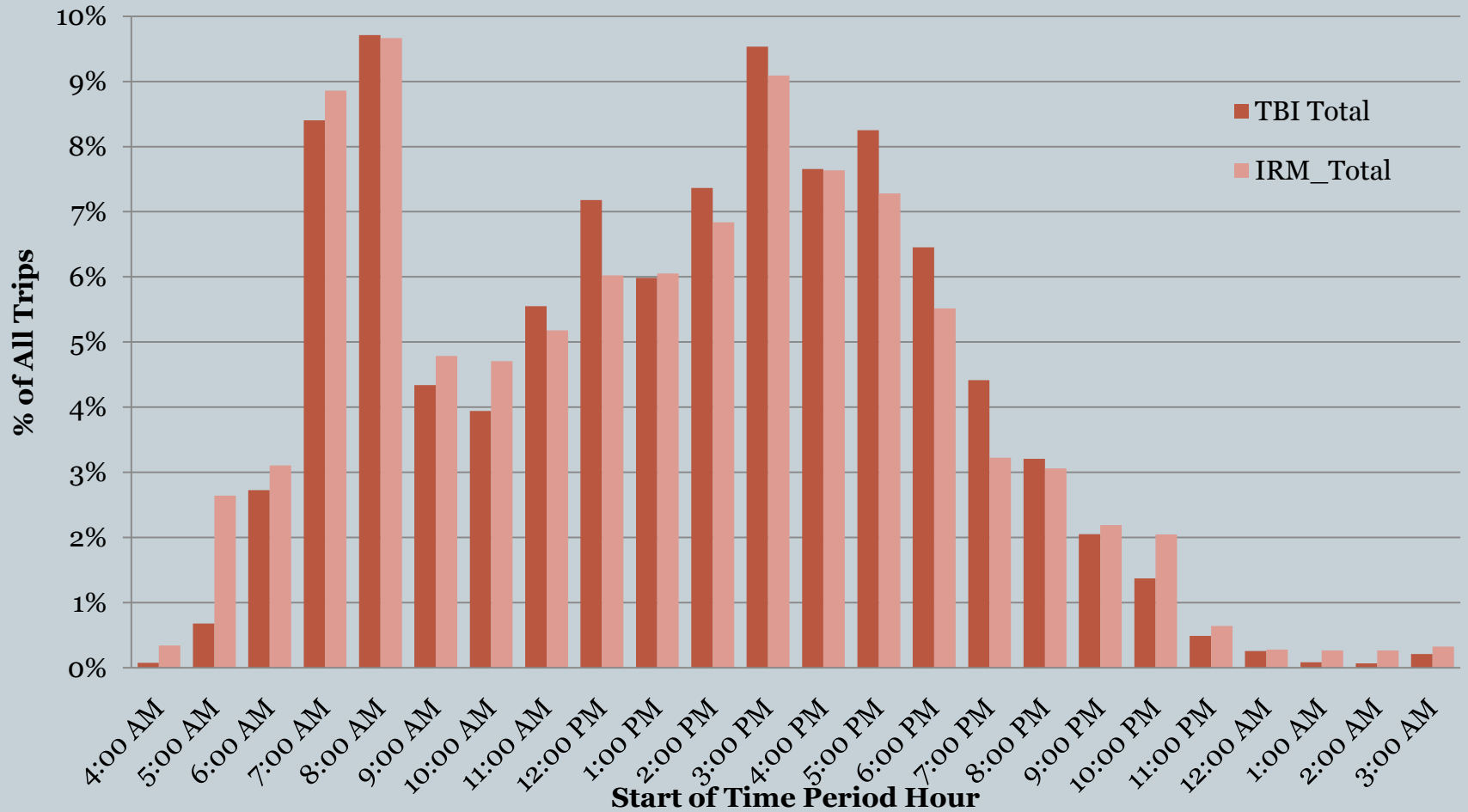
# Person Trips By Mode



# Average Tours per Person per Day By Tour Purpose



# Trips By Time of Day



# Modeled Versus Observed VMT



# Links With Counts	Modeled VMT With Counts	Actual VMT With Counts	%Error
1,683	21,166,000	20,507,000	3.2%

## Total VMT by Facility Type

Facility Type	#Links	Modeled VMT	% Modeled VMT	Actual VMT	% Actual VMT	Difference of Percents
Freeway	210	8,791,000	42%	9,605,000	47%	-8%
Major Regional Arterial	71	1,834,000	9%	1,587,000	8%	16%
Principal Arterial	863	8,990,000	43%	7,452,000	36%	21%
Minor Arterial	316	1,121,000	5%	1,279,000	6%	-12%
Collector	218	406,000	2%	558,000	3%	-27%

# VMT by Screenline



Screenline	Links with Counts	Total Observed VMT on Links with Counts	Modeled Volume on Links with counts	Percent Error
120Th	10	247,457	280,346	13%
CastleRock	2	59,520	75,742	27%
Colfax	16	405,928	455,474	12%
ColoradoBlvd	10	419,719	457,651	9%
DIA	3	100,862	80,711	-20%
DowntownCir	19	423,675	444,112	5%
Hampden	10	504,249	513,116	2%
Kipling	9	188,526	215,214	14%
TowerRd	5	64,603	37,195	-42%
Wadsworth	20	581,624	585,736	1%

# Transit trips by sub-mode



Submode	2005 Observed	2005 Modeled	Difference: Observed- Modeled
Mall Shuttle	47,276	56,606	-9,330
Denver Local	123,821	172,231	-48,410
Denver Limited	17,497	19,943	-2,446
Boulder Local	19,210	21,983	-2,773
Longmont Local	689	2,385	-1,696
Express	10,741	24,737	-13,996
Regional	11,355	9,972	1,383
skyRide	5,121	542	4,579
Light Rail	34,578	44,689	-10,111
Total	270,288	353,088	-82,800