



# Time of Day in FSUTMS

*presented to*  
**Florida Model Task Force**

*presented by*  
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FLORIDA  
MODEL  
TASK  
FORCE



## Scope

- **Two phase project**
  - Phase 1 – Develop and implement factors from NHTS and count data
  - Phase 2 – Econometric models for incorporating into FSUTMS
- **Three tasks in Phase 1**
  - Develop and implement constant Time of Day factors
    - Develop new CONFAC
    - 2009 NHTS data for TOD factors
  - Identify data elements for econometric approach
  - Develop empirical methods to calculate travel skims



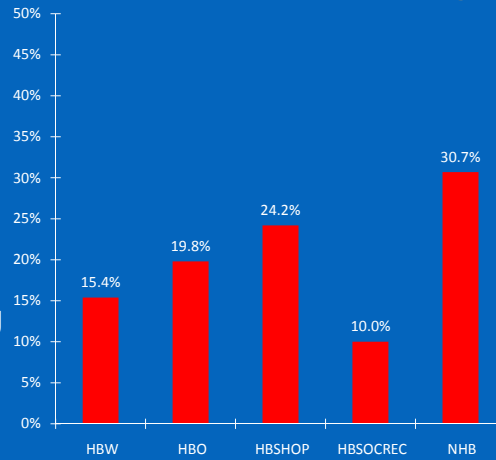
## Data Overview

- **2009 NHTS Data Used**

- 15,884 Households
- 30,992 Persons
- 114,910 Person Trips
- 1.3% of trips are via Transit

- **All analysis done using mid point of trip**

- **Trips into 24 one-hour periods**



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## Segmentations for TOD

- Compare across sampling regions
- Compare across urban areas by population
- Compare across income categories

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## ANOVA Tests for Time of Day Variability

- Hypothesis: There is no variability among different levels

LEVEL	SAMPLING REGION		
	Degrees of Freedom	F-Value	Hypothesis Result
Purpose			Do Not
HBW	6	0.8	Reject
HBSHOP	6	14.0	Reject
HBSOCREC	6	13.7	Reject
HBO	6	10.7	Reject
NHB	6	10.3	Reject

LEVEL	URBAN SIZE		
	Degrees of Freedom	F-Value	Hypothesis Result
Purpose			Do Not
HBW	5	1.8	Reject
HBSHOP	5	19.6	Reject
HBSOCREC	5	11.1	Reject
HBO	5	7.5	Reject
NHB	5	6.3	Reject

LEVEL	INCOME		
	Degrees of Freedom	F-Value	Hypothesis Result
Purpose			
HBW	2	2.1	Do Not Reject
HBSHOP	2	77.6	Reject
HBSOCREC	2	54.1	Reject
HBO	2	11.2	Reject
NHB	2	24.2	Reject
HBW*	2	7.9	Reject

\* Did Kruskal-Wallis Non-parametric test

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## Variability Testing within Income Level

- Hypothesis: There is no variability between different regions within each income level

LEVEL	COUNTY		
	Degrees of Freedom	Chi-Square	Hypothesis Result
Income Category			
Less than \$25,000	18	86.0	Reject
Between \$25,000 and \$75,000	24	48.4	Reject
More than \$75,000	22	86.7	Reject

The Kruskal Wallis tests were done to make sure that there are differences among all counties within each income category

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## Time of Day Factors – Low Income

Purpose	Number of Trips	Direction	Midnight to 7 AM	7 AM to 9 AM	9 AM to 3 PM	3 PM to 6 PM	6 PM to Midnight
HBW	1541	From Home	12.4%	25.9%	13.5%	2.7%	1.9%
		To Home	1.4%	1.0%	5.7%	21.3%	14.1%
HBSHOP	3312	From Home	2.1%	4.9%	21.8%	6.9%	8.5%
		To Home	0.5%	1.7%	22.9%	13.4%	17.4%
HBSOCR EC	1262	From Home	1.8%	4.0%	19.7%	11.4%	13.1%
		To Home	1.5%	0.6%	11.1%	11.1%	25.8%
HBO	2446	From Home	2.8%	15.6%	21.4%	6.8%	5.4%
		To Home	1.3%	3.7%	16.0%	13.7%	13.2%
NHB	3843		2.9%	10.8%	49.5%	22.5%	14.3%

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## Time of Day Factors – Medium Income

Purpose	Number of Trips	Direction	Midnight to 7 AM	7 AM to 9 AM	9 AM to 3 PM	3 PM to 6 PM	6 PM to Midnight
HBW	2291	From Home	16.8%	22.0%	10.9%	3.0%	1.3%
		To Home	1.9%	0.4%	7.8%	24.7%	11.2%
HBSHOP	6119	From Home	1.2%	5.5%	25.2%	8.6%	5.2%
		To Home	0.2%	2.0%	26.4%	14.6%	11.2%
HBSOCREC	2249	From Home	1.6%	6.2%	22.4%	9.4%	9.5%
		To Home	1.5%	1.3%	15.6%	11.7%	20.7%
HBO	3732	From Home	4.2%	14.2%	22.6%	8.0%	3.9%
		To Home	0.5%	3.5%	18.8%	14.8%	9.4%
NHB	6678		2.4%	8.7%	57.1%	21.1%	10.8%

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## Time of Day Factors – High Income

Purpose	Number of Trips	Direction	Midnight to 7 AM	7 AM to 9 AM	9 AM to 3 PM	3 PM to 6 PM	6 PM to Midnight
HBW	5107	From Home	16.0%	23.5%	11.6%	2.4%	1.1%
		To Home	0.8%	0.2%	7.4%	24.2%	12.8%
HBSHOP	10902	From Home	1.5%	3.8%	22.6%	8.5%	8.1%
		To Home	0.2%	1.3%	23.2%	15.1%	15.6%
HBSOCREC	4386	From Home	2.5%	5.8%	20.9%	10.1%	10.6%
		To Home	2.3%	1.0%	13.9%	11.7%	21.2%
HBO	7460	From Home	4.1%	15.6%	20.4%	8.2%	5.2%
		To Home	0.7%	5.2%	15.8%	14.2%	10.6%
NHB	12290		2.4%	9.3%	52.5%	22.4%	13.4%

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## CONFAC Table

	Income Segmentation		
	Less than \$25,000	\$25,000 to \$75,000	More than \$75,000
Midnight to 7 AM	0.625	0.659	0.633
7 AM to 9 AM	0.510	0.533	0.501
9 AM to 3 PM	0.184	0.182	0.189
3 PM to 6 PM	0.379	0.340	0.355
6 PM to Midnight	0.319	0.353	0.367

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## Time of Day into Transit Modeling

- Transit mode choice and assignment
  - Depends on transit paths between origins and destinations
- Data sets are dominated by auto travel
  - Both household survey and count data
- Examine differences in peaking for auto and transit demand
  - Transit might have different peak percent compared to autos for same trip purpose and direction


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## Time of Day into Transit Modeling

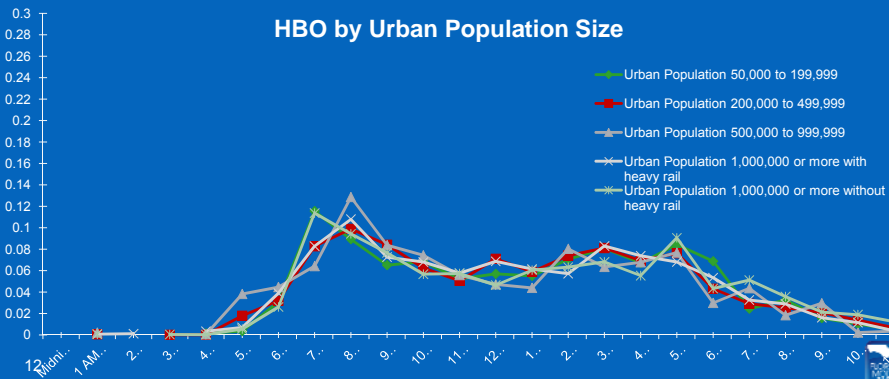
- Transit level service variation during the day
  - Schedule information
  - Fare information
  - Define peak time periods to coincide closely to those used by transit providers
  - Include separate overnight period when no service is provided
- Use ridership data to determine whether peak transit demand occurs at times similar to peak auto demand and peak transit supply

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## Validating Time of Day Models

- Two important considerations
  - Validating the time of day modeling component itself
  - Validation of other model components



## Validating Time of Day Modeling Component

- Reasonable checks
  - Model parameters
  - Application results
- Compare factors by trip purpose to other areas
  - Compare to a wide range of areas
  - Consider unique characteristics of modeled area
- Ideal to have independent data sources
  - Not always available
  - Checks may have to wait until other model components are complete



## Validating Time of Day Modeling Component

- Time of day choice models have different reasonableness checks
  - Few time of day models applied in the context of 4-step models
- Compare model derived percentage of trips for each time period to survey data
- Time of day choice models include sensitivity checks
- Model components applied subsequent to TOD should be run for each time period
  - Implies consideration of TOD by each model component

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## Task 2 – Time of Day Choice Models

- Purpose of Investigation
  - Estimate time-of-day (TOD) models to make recommendations for incorporating TOD in FSUTMS.
- Key Elements:
  - Examine data to understand resolution of TOD modeling that can be achieved
  - Develop a modeling framework
  - Estimate TOD models to understand key determinants of TOD choice

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## Data

- Three datasets:
  - National Household Travel Survey (NHTS)
  - NE & SE Florida Household Surveys
- NHTS Data used here:
  - Provides many more observations (115,000 trip records vs. 22,000 and 20,000 records of other two datasets)
  - Relevant for the entire state of Florida (rather than particular regions of the state)

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## Modeling Framework

- Multinomial Logit (MNL) Structure
- TOD units
  - Five broad TODs (AM, midday, PM, evening, & night)
  - 30-minute interval alternatives (except for evening & night periods)
- Explanatory variables
  - A variety of household-, person-, & trip-specific variables introduced.
    - Specific to broad TOD periods
    - Interactions with *shift* variables

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## Summary

- Overall, models offer reasonable behavior for each trip type.
- Several variables found to have little or no effect across models
  - Gender & region population have almost no practical significance
  - Household income & vehicles have only small implications on TOD choice for only some trip purposes

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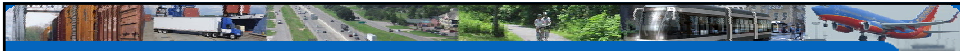


## Task 3 – Travel Time Computations

- Two objectives
  - Synthesize travel time data for larger number of time periods
  - Evaluate feasibility of STEWARD database
- Task Rationale
  - Travel time restricted to small number of periods
  - Not very feasible for estimating TOD choice models

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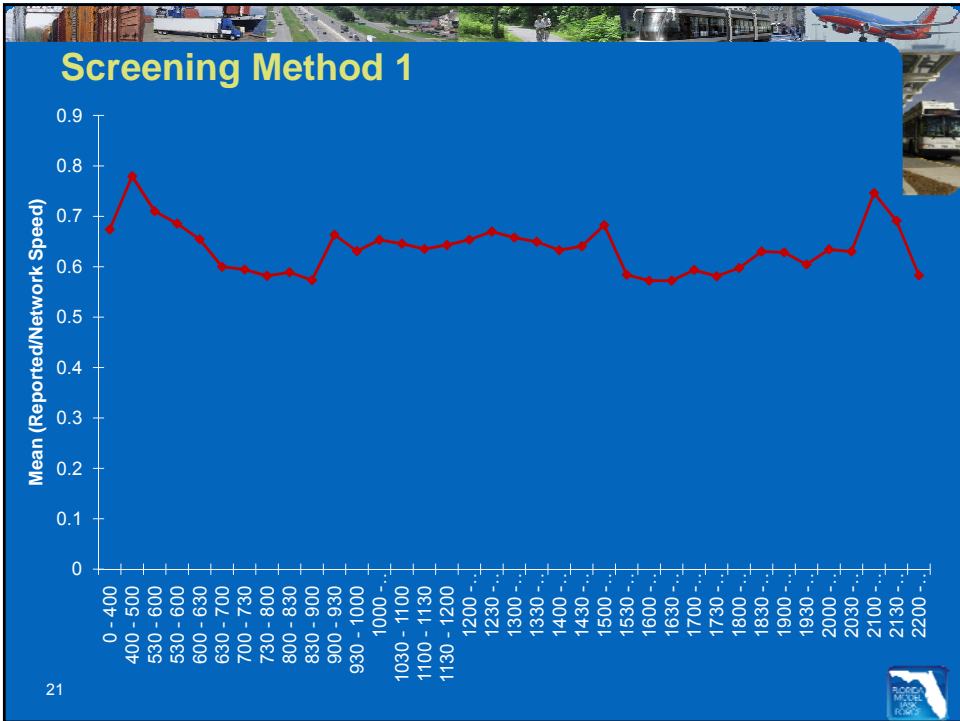


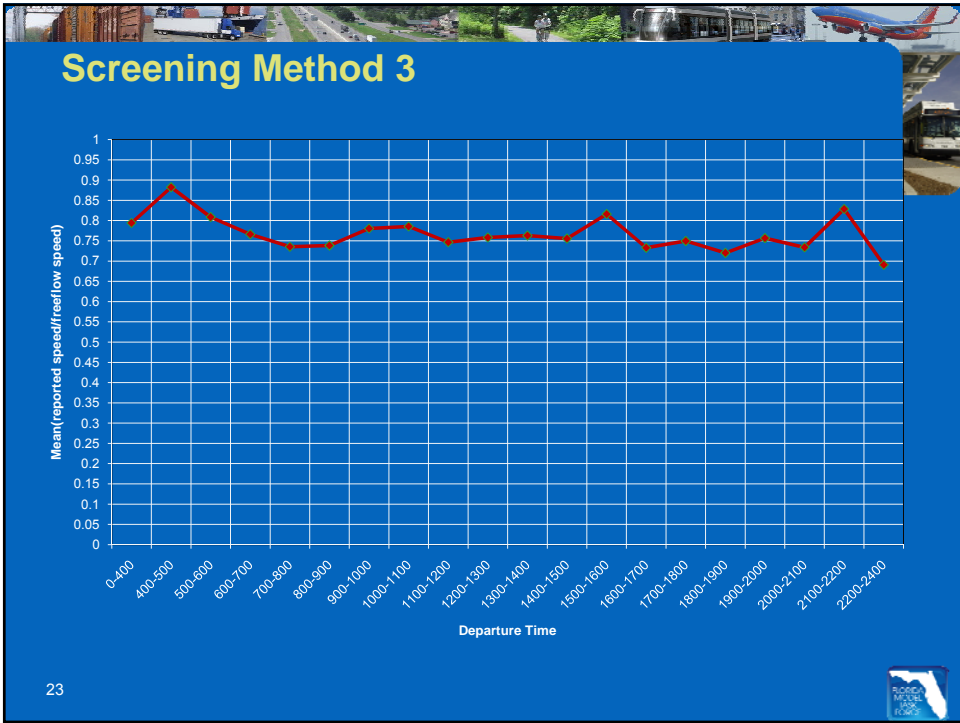
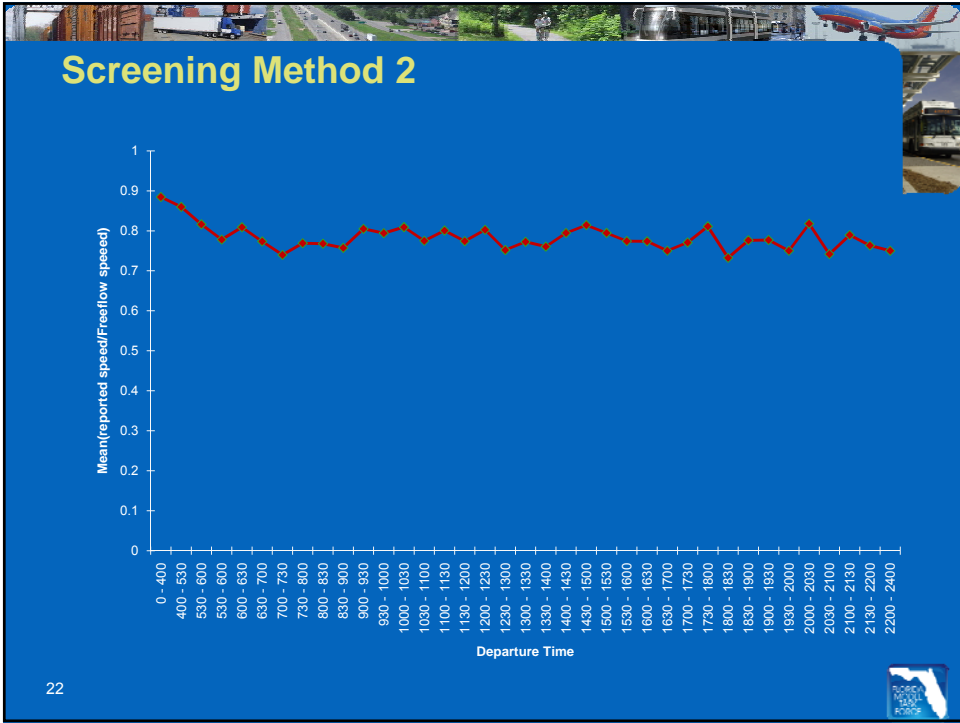


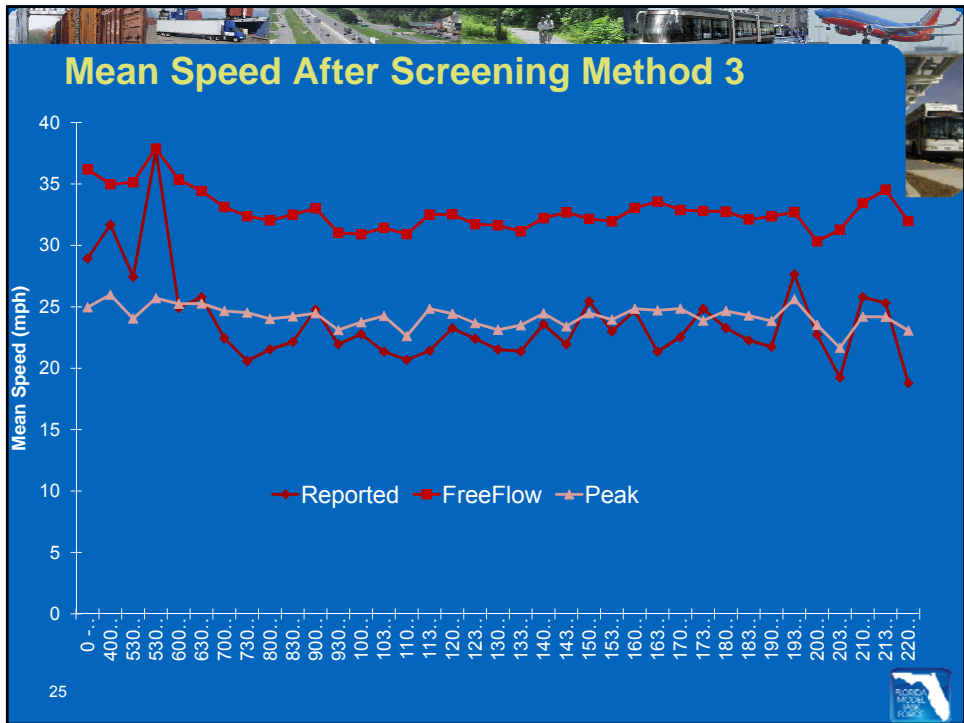
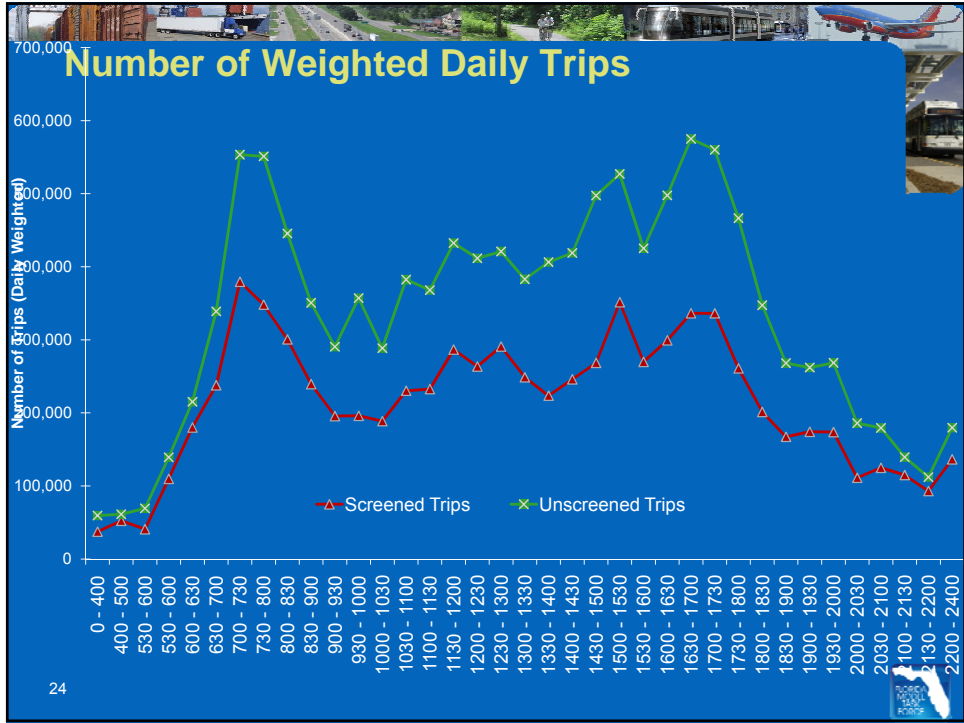
## Data Validation and Statistics

- 2009 NHTS Data and SERPM 6.5 Network Skims
- 29,916 trips in SERPM region
- 27,945 inter zonal trips (14% non-auto)
- 15,570 weekday inter zonal auto (drive alone and shared ride) trips
- Screening methods developed to obtain reliable travel times

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## Regression Analysis

- Analysis done to relate reported travel times to available network skims
- Speed instead of time used as in estimation variable
  - Allows for estimation over a range of O/D pairs
- Regressions are departure time based
- Various specifications estimated

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## Regression Analysis

- Delay based where  $\text{delay} = 1 - (\text{peak speed}/\text{free flow speed})$
- Density based area variable
  - CBD = SERPM ATYPE 1 and 2
  - Urban = SERPM ATYPE 3
  - Suburban = SERPM ATYPE 4
  - Rural = SERPM ATYPE 5 (used as base)

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## Regression Specification and Results

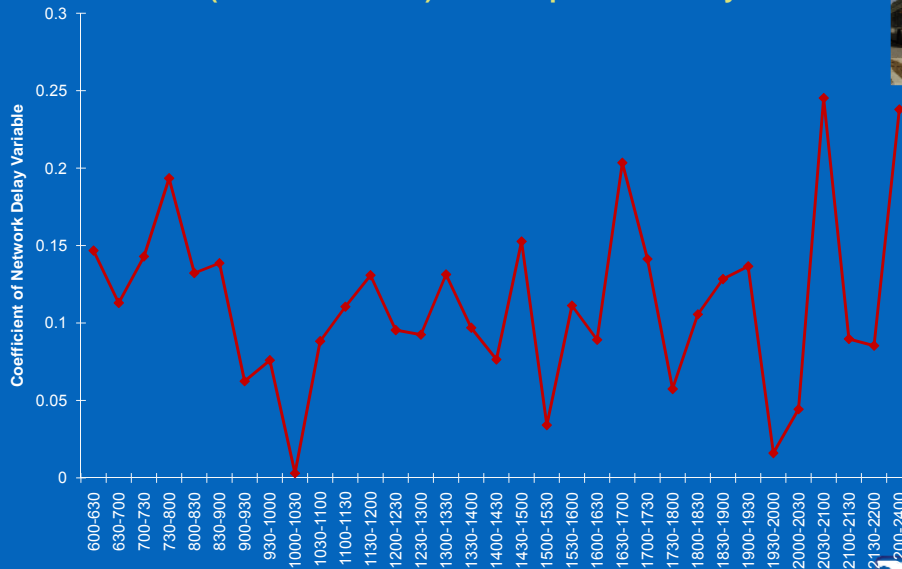
$$\ln\left(\frac{\text{Reported speed}}{\text{Freeflow speed}}\right) = \text{Intercept} + \beta_1 \log(\text{distance}) + \beta_2 (\text{CBD or core origin}) + \beta_3 (\text{urban origin}) + \beta_4 (\text{suburban origin}) + \beta_5 (\text{CBD or core destination}) + \beta_6 (\text{urban destination}) + \beta_7 (\text{suburban destination}) + \beta_8 \text{Dummy}(0600 - 0630) + \beta_9 \text{Dummy}(0630 - 0700) + \dots + \beta_{39} \text{Dummy}(2130 - 2200) + \beta_{40} \text{Dummy}(2200 - 2400) + \beta_{41} * \text{Carpool Dummy}$$

Variable	Parameter	t-stat
Intercept	-0.48768	-13.6
log (Distance)	0.15081	36.13
Carpool Dummy	-0.01354	-1.93
CBD Origin	-0.08276	-3.52
Urban Origin	-0.09486	-4.32
Suburban Origin	-0.04859	-2.26
CBD Destination	-0.04087	-1.83
Urban Destination	-0.06992	-3.36
Suburban Destination	-0.03351	-1.65

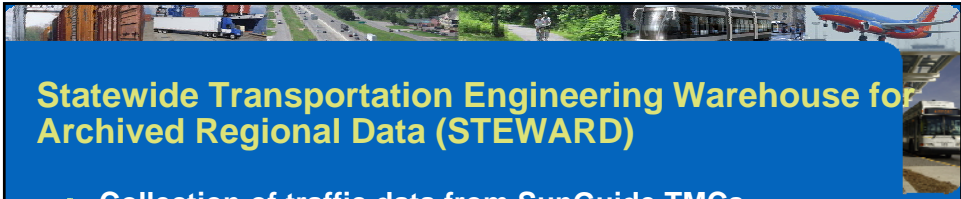
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## Regression Results

Coefficients (Absolute Values) Period Specific Dummy Variables



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## Statewide Transportation Engineering Warehouse for Archived Regional Data (STEWARD)

- Collection of traffic data from SunGuide TMCs
- Contains daily traffic volumes, speeds, occupancies, and travel times along major corridors
- Data aggregated in 5, 15, and 60 minute intervals for each district
- User option to download data for specific district

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## STEWARD Available Data

- Facility Level
  - All data fields
  - Volume map and I/O balance
  - Traffic counts
- Section Level
  - Performance measure
  - Travel time reliability
- Station Level
  - All data fields
  - Traffic counts
  - Max flow rates
  - Effective vehicle length

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## STEWARD As Data Source

- STEWARD does not provide any travel time data
  - Section level speed data can be used
- Currently available for only 5 FDOT districts
- Data is available only for freeways
- Issues with STEWARD website access and data request processing