

MODEL VALIDATION

WASATCH FRONT TRAVEL DEMAND

MODEL

VERSION 9.0.2

WFRC / MAG

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1 Trip Generation

Trip Generation validation was considered for both production ratios and relative shares.

1.1 Ratios

Validation for production ratios looked at three sets of measures: productions-to-household ratios (Figure 1.1), total trips (Figure 1.2), and trip balance ratios (Figure 1.3). The sources of the data include the Utah Household Travel Survey from 2012 (2012 HTS), the base year model (BY 2019 Model), and the National Household Travel Survey from 2017 with data from the Mountain Census Division (2017 NHTS - Mountain).

The model shows an average 4.01 trips per person which is slightly higher than the 2017 NHTS - Mountain average of 3.54. The model also shows an average 12.4 trips per household which is higher than the 2017 NHTS - Mountain average of 9.1. Utah, including the Wasatch Front, has a significantly higher average household size of 3.09 persons per household when compared to the Mountain Census Division average of 2.58, which accounts for the differences when compared to the 2017 NHTS - Mountain averages.

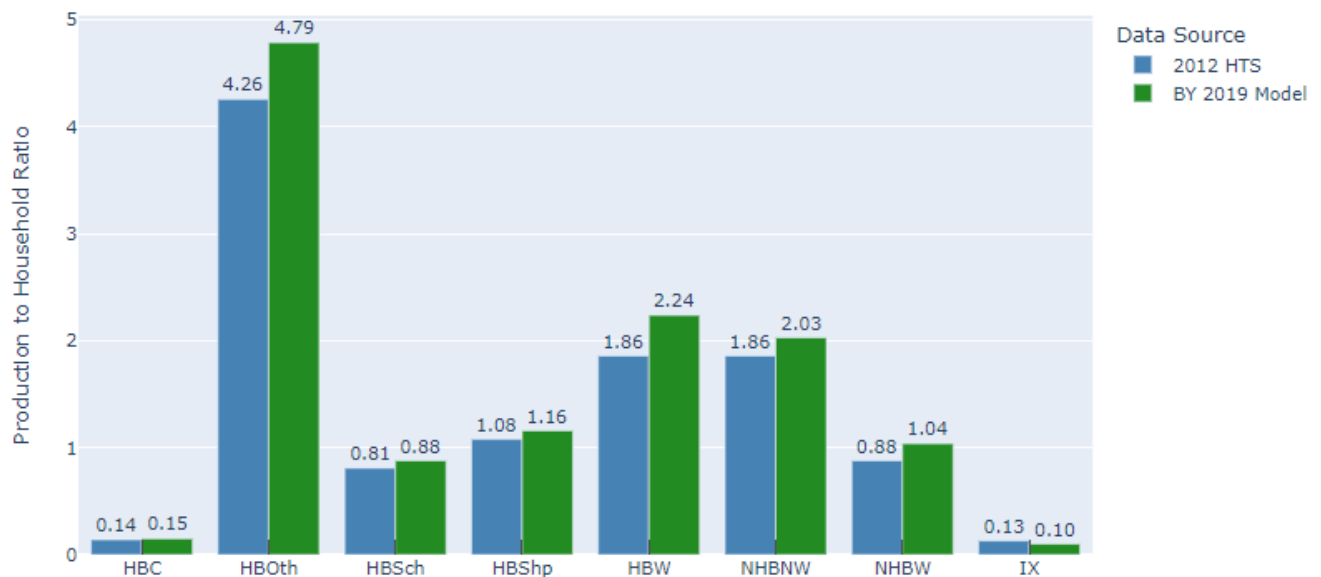


Figure 1.1 Productions to Households Ratio - Total Trip Ends (II + IX)



Figure 1.2 Total Trip Validation

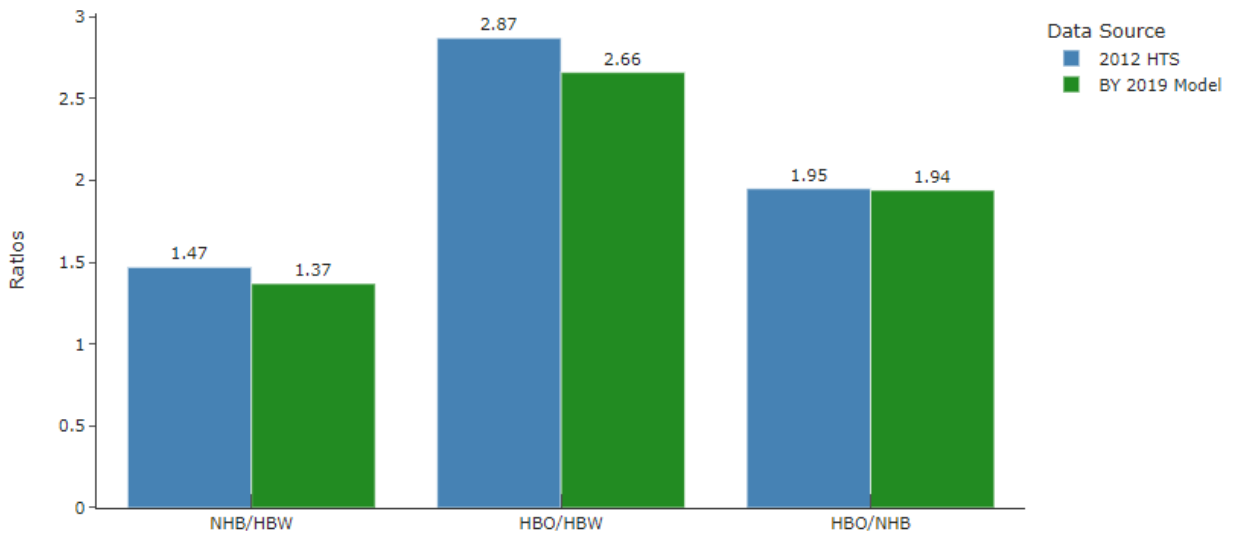


Figure 1.3 Trip Balance Ratios

1.2 Relative Shares

Validation for production relative shares considered the reasonableness of relative shares as shown in [Table 1.1](#). The relative share between HBW, HBO and NHB trips looks reasonable with HBW at about 14% of the total and the highest share going to HBO. Commercial vehicles account for about 22% of the total trips generated by the model. This is within the expected range for an urban area like

the Wasatch Front. IX and XI trips account for around 2% of the total trip generation. This also appears to be reasonable.

Table 1.1: Relative Shares

Purpose	Production	Share
HBW	1,758,104	14.1%
HBO	5,317,476	42.5%
HBShp	908,733	7.3%
HBOth	3,719,191	29.7%
HBScK6	365,084	2.9%
HBSc712	324,468	2.6%
NHB	2,405,720	19.2%
NHBW	812,855	6.5%
NHBNW	1,592,865	12.7%
Total Person	9,481,300	75.8%
Total External	172,855	1.4%
IX	78,057	0.6%
XI	94,798	0.8%
Total Truck	2,802,234	22.4%
LT	1,553,653	12.4%
MD	884,558	7.1%
HV	364,023	2.9%
Total IX Truck	21,750	0.2%
IX MD	10,716	0.1%
IX HV	11,034	0.1%
Total XI Truck	30,741	0.2%
XI MD	14,372	0.1%
XI HV	16,369	0.1%
Telecommute Share of HBW	69,175	0.6%
Telecommute Share of NHBW	19,552	0.2%
TOTAL	12,508,880	100.0%

2 Trip Distribution

Modeled average trip lengths for the base year were compared to the 2012 Household Travel Survey. The model was validated for distance, time, and generalized cost using the following measures:

- » Average Trip Lengths
- » Trip Length Frequencies

2.1 Average Trip Lengths

Figure 2.1, Figure 2.2, Figure 2.3, Figure 2.4, Figure 2.5, and Figure 2.6, show the average trip lengths between the modeled and observed time, distance, and generalized cost.

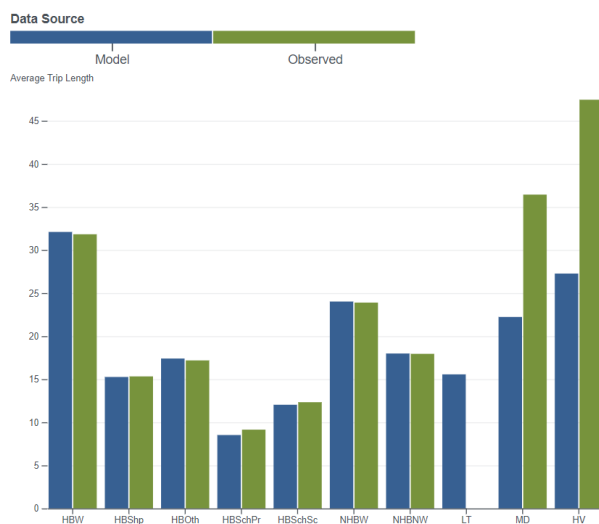


Figure 2.1 Average Trip Length (Generalized Cost, Internal Purposes)

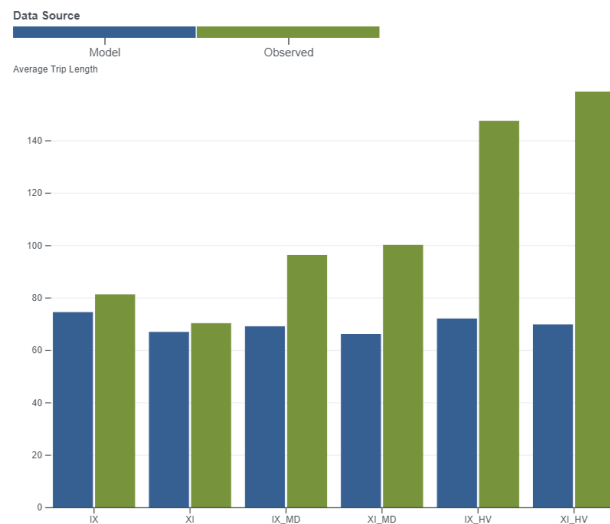


Figure 2.2 Average Trip Length (Generalized Cost, External Purposes)

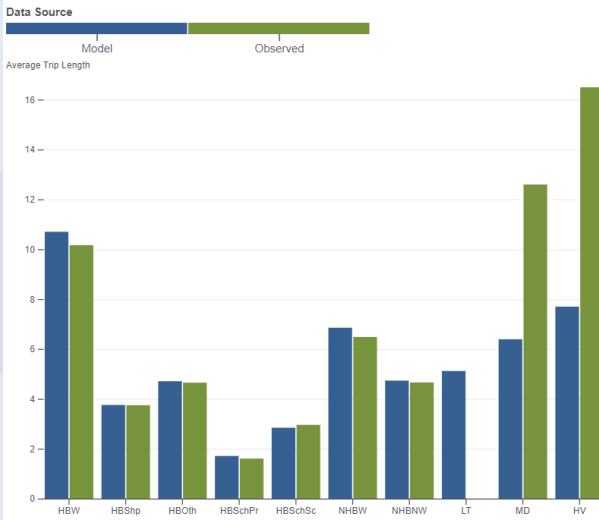


Figure 2.3 Average Trip Length (Distance, Internal Purposes)

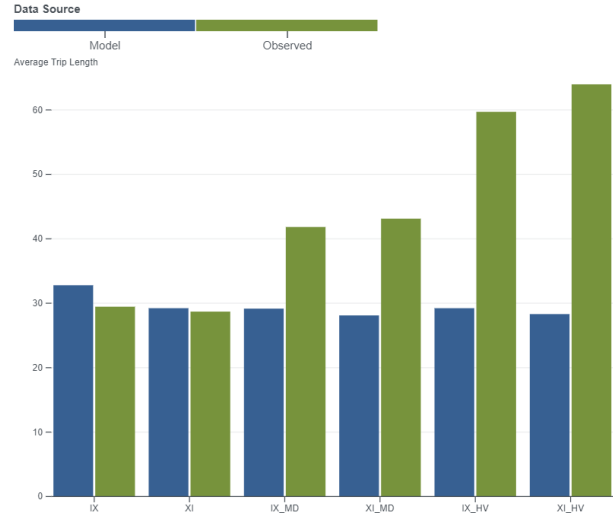


Figure 2.4 Average Trip Length (Distance, External Purposes)

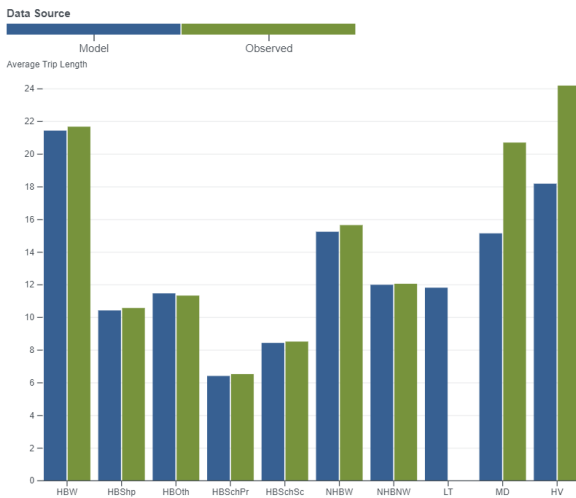


Figure 2.5 Average Trip Length (Time, Internal Purposes)

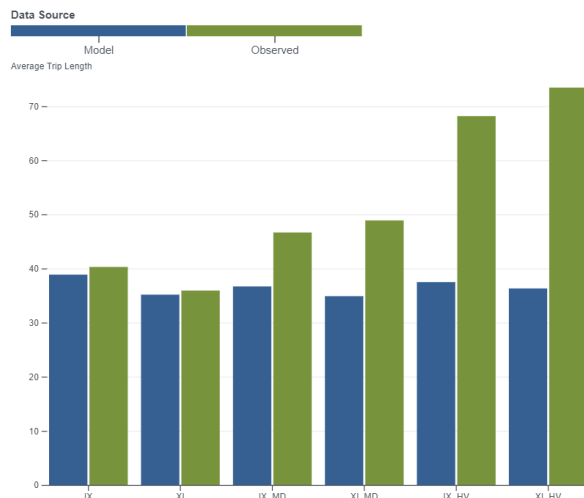


Figure 2.6 Average Trip Length (Time, External Purposes)

2.2 Trip Length Frequencies

Modeled trip lengths for the base year were compared to the 2012 Household Travel Survey. [Figure 2.7](#), [Figure 2.8](#), and [Figure 2.9](#) show the modeled and observed time, distance, and generalized cost (GC) trip length frequencies by purpose. Note that only the beginning section of the trip length frequencies plots are shown for greater detail (for additional purposes and for full length plots, please direct yourself to the [online documentation](#)).

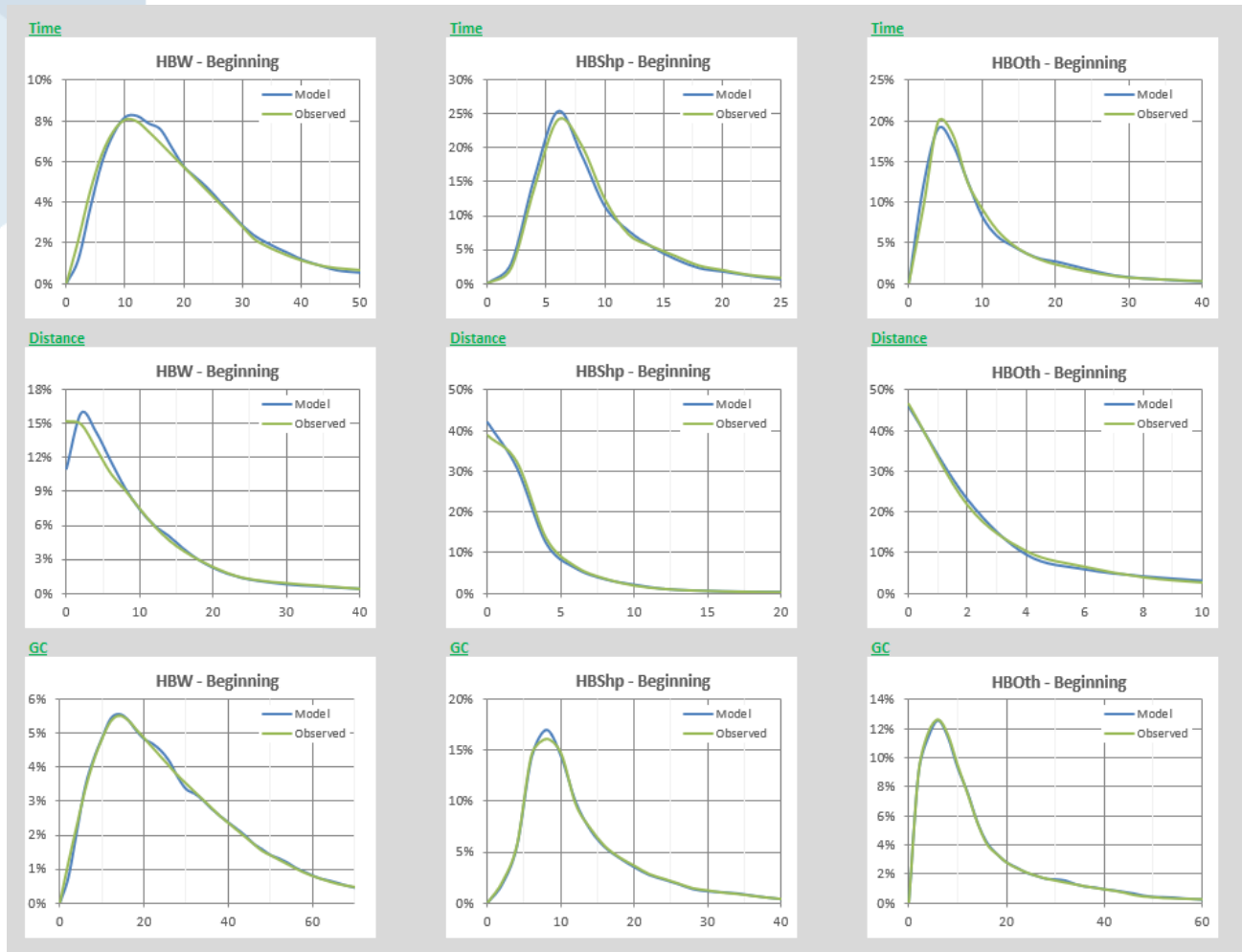


Figure 2.7 Trip Length Frequency (HBW, HBShp, HBOth)

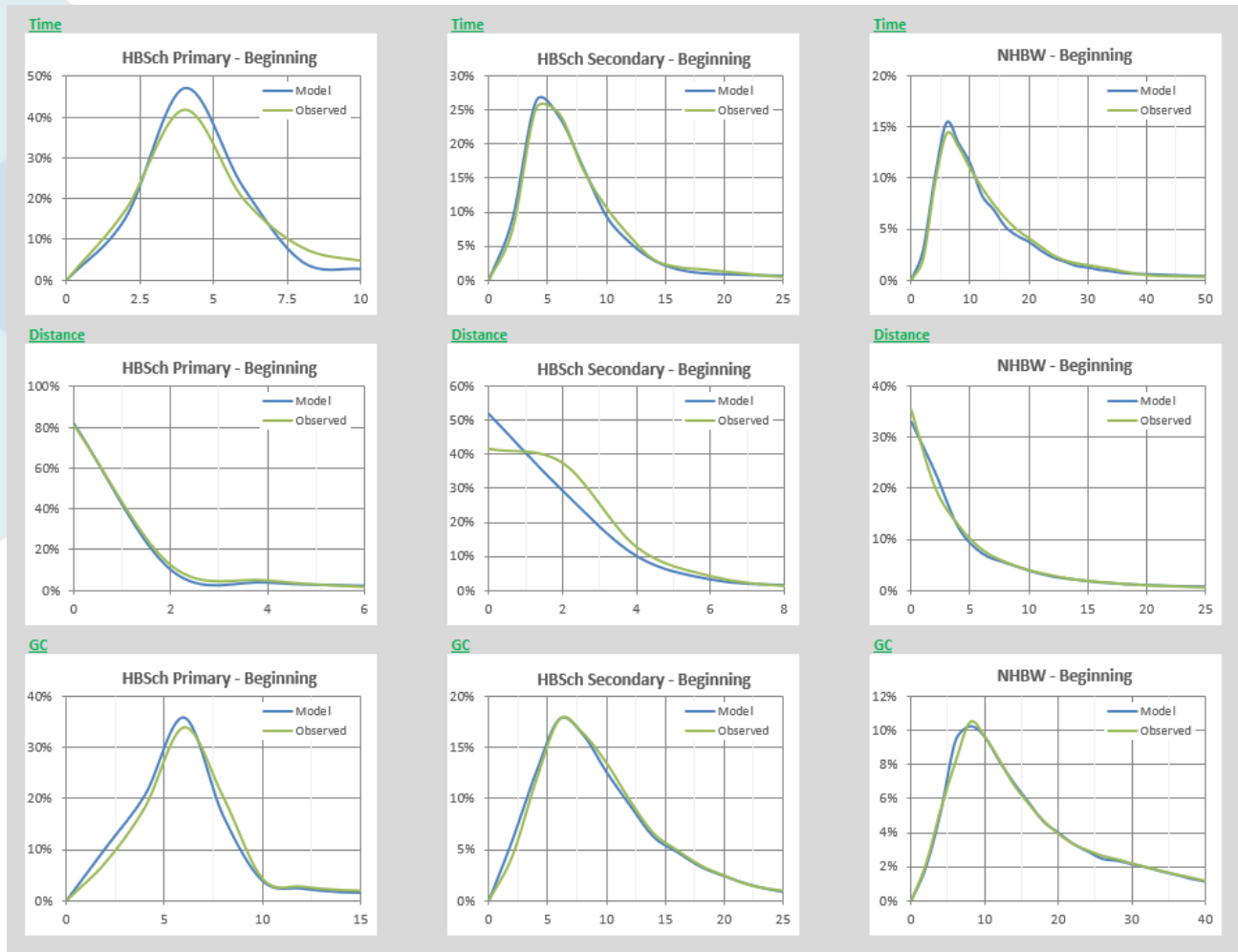


Figure 2.8 Trip Length Frequency (HBSch Primary, HBSch Secondary, NHBW)

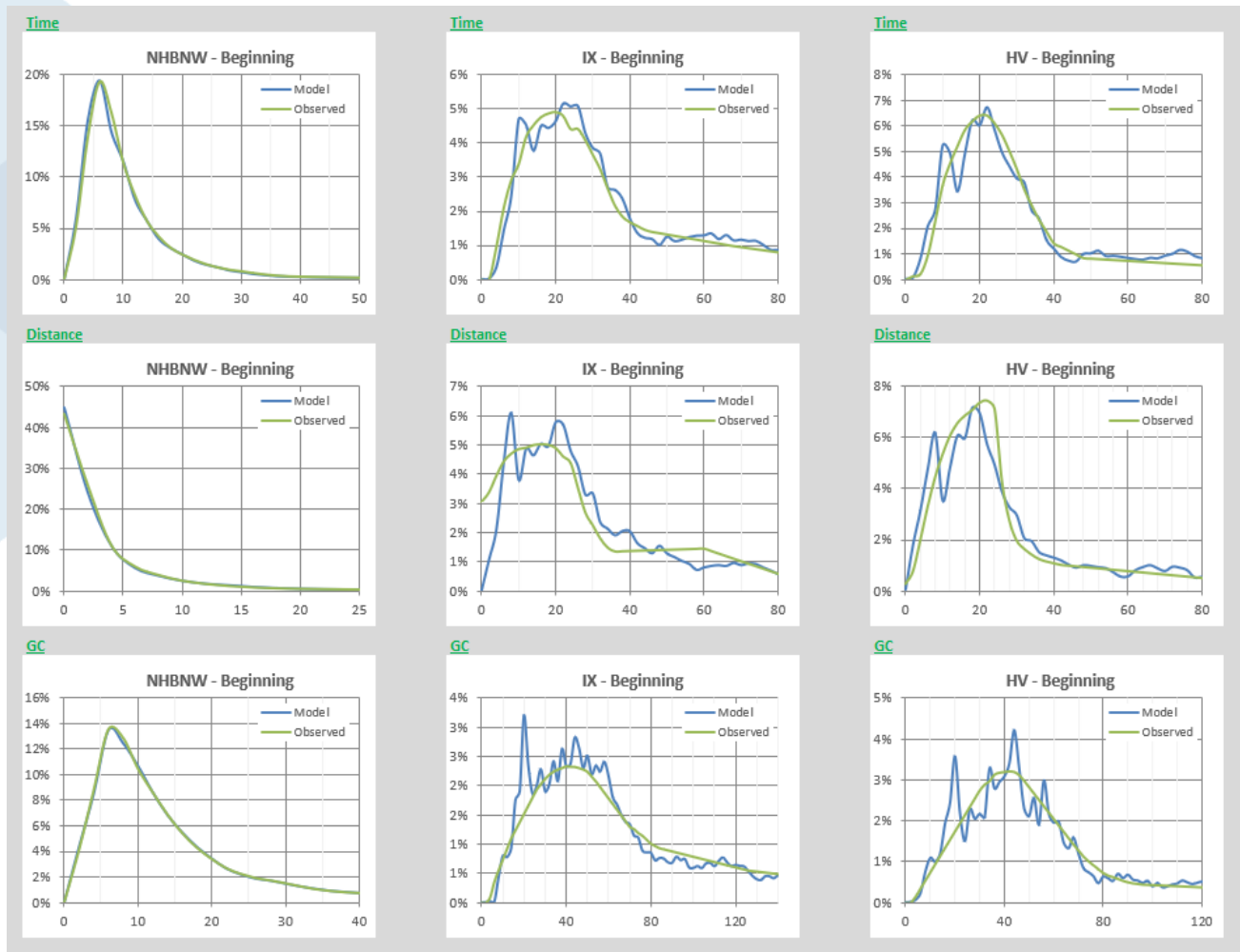


Figure 2.9 Trip Length Frequency (NHBW, IX, HV)

3 Mode Choice

The validation results for the Mode Choice portion of the model are shown in this section. Mode Choice was validated against the Utah Transit Authority 2019 On-Board Survey as well as the 2012 Household Travel Survey. Validation is summarized by the following categories:

- » Transit Trips and Boardings
- » Mode Share

3.1 Transit Trips and Boardings

The validation of daily transit trips and boardings is shown through the comparison of model and observed data by mode. The model was validated by the following measures:

- » Trips by Hierarchical Mode
- » Boardings by Hierarchical Mode
- » Transfer Ratio by Hierarchical Mode
- » Boardings by Surveyed Mode (for comparison only)

The three hierarchical mode measures are summarized by the highest hierarchy mode in a given trip with local bus being the lowest on the hierarchy and commuter rail being the highest. For example, if a trip uses Local Bus and then transfers to LRT, the trip is stored as an LRT trip. *Trips by Hierarchical Mode* represent each trip as a single number, regardless of the number of transfers or different modes that were used on a trip.

Boardings by Hierarchical Mode represent each boarding separately but summarized at the highest hierarchical mode of the trip. For example, for one transfer from Local Bus to LRT there are two boardings, one on each mode, but they are both stored in the highest hierarchical mode of LRT. The Transfer Ratio by *Hierarchical Mode* is the ratio between boardings and trips for any given mode.

The final measure *Boardings by Surveyed Mode* represents the total boardings on each mode individually. They are not summarized at the highest hierarchical mode of the trip but rather at the mode on which the boarding actually occurred. For example, the Local Bus to LRT trip mentioned previously would be summarized in this measure as one boarding on Local Bus and one boarding on LRT. This measure is for comparison use only since the structure of the Mode Choice model does not consider this measure during calibration.

The total number of boardings are the same between hierarchical mode and surveyed mode, but depending on the make-up of the trips, their totals by mode will vary.

The model data for hierarchical mode measures is taken from the shares reports `v902_SE19_Net19_RegionShares_Pk.csv` and `v902_SE19_Net19_RegionShares_0k.csv`. The model data for the surveyed mode comparison is taken from `_v902_SE19_Net19_1_PA_Route.dbf`.

Figure 3.1, Figure 3.2, Figure 3.3, and Figure 3.4 show a comparison of model and observed values for *Trips by Hierarchical Mode*, *Boardings by Hierarchical Mode*, *Transfer Ratio by Hierarchical Mode*, and *Boardings by Surveyed Mode* respectively.

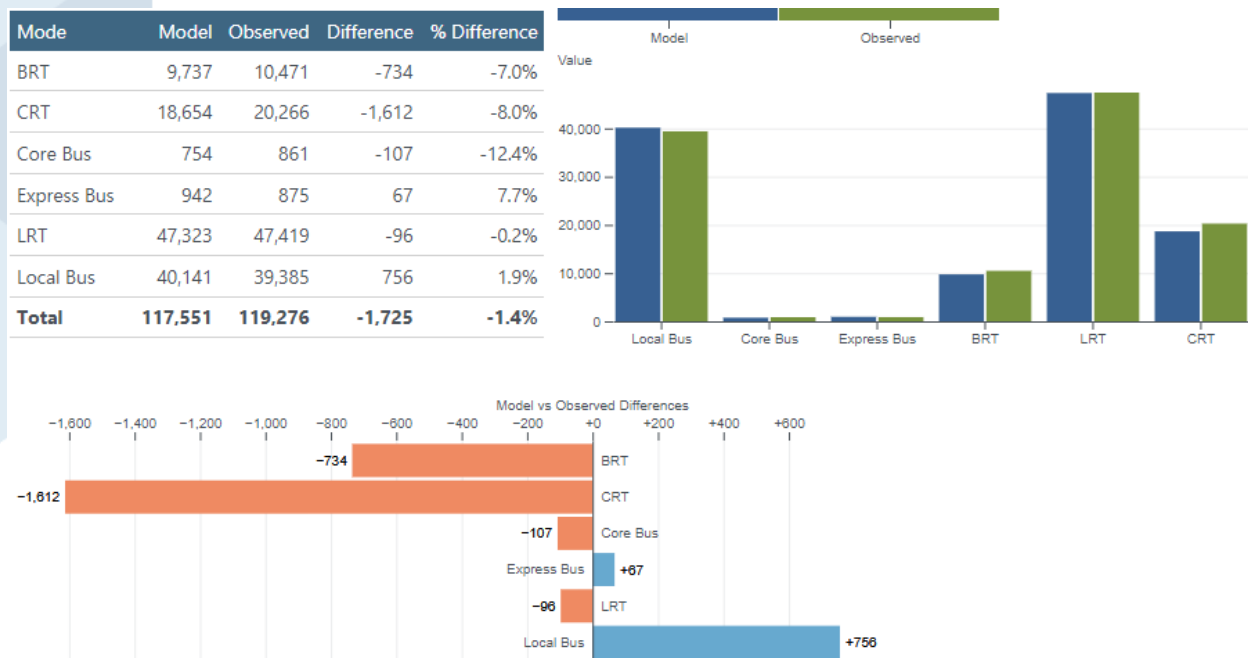


Figure 3.1 Transit Trips by Hierarchical Mode - Model vs. Observed Comparison

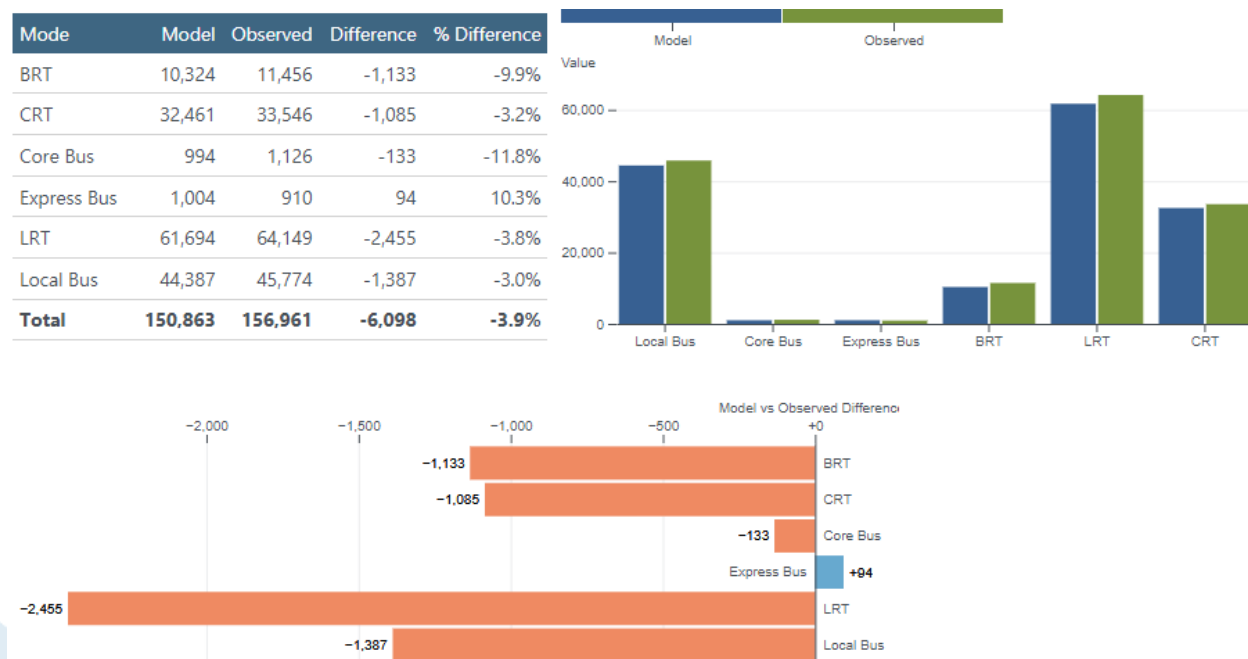


Figure 3.2 Boardings by Hierarchical Mode - Model vs. Observed Comparison

Mode	Model	Observed	Difference	% Difference
BRT	1.06	1.09	-0.03	-3.1%
CRT	1.74	1.66	0.08	5.1%
Core Bus	1.32	1.31	0.01	0.7%
Express Bus	1.07	1.04	0.03	2.5%
LRT	1.30	1.35	-0.05	-3.6%
Local Bus	1.11	1.16	-0.06	-4.9%
Total	1.28	1.32	-0.03	-2.5%

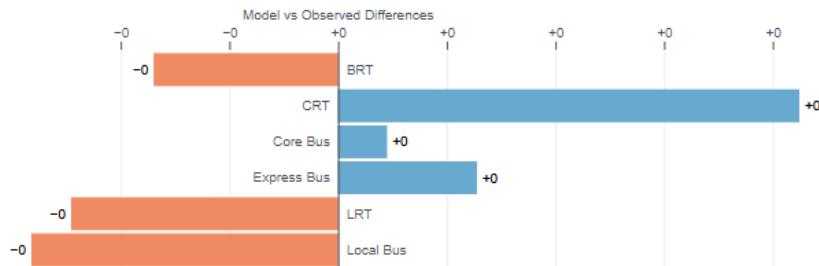
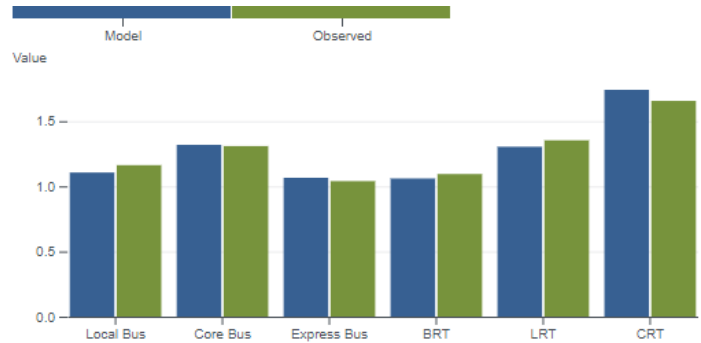


Figure 3.3 Transfer Ratio by Hierarchical Model - Model vs. Observed Comparison

Mode	Model	Observed	Difference	% Difference
BRT	11,186	12,821	-1,635	-12.8%
CRT	18,654	20,387	-1,733	-8.5%
Core Bus	2,122	1,754	368	21.0%
Express Bus	966	1,170	-204	-17.4%
LRT	57,233	58,897	-1,664	-2.8%
Local Bus	60,701	61,931	-1,230	-2.0%
Total	150,863	156,961	-6,098	-3.9%

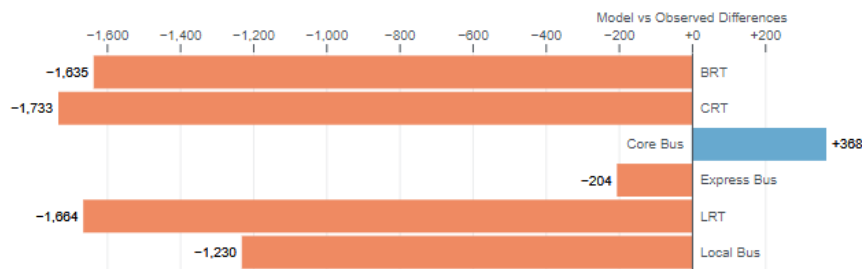
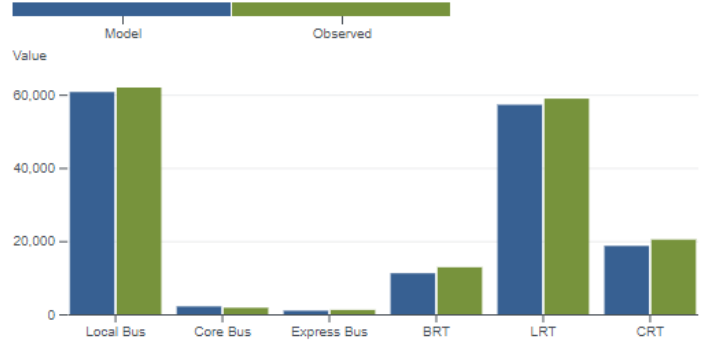


Figure 3.4 Boardings by Mode Surveyed - Model vs. Observed Comparison

When considering *Trips by Hierarchical Mode* (Figure 3.1), the calibration routine of the model results in the total number of transit trips in the model being very close to the observed. For this model the model trips are only 1.4% lower than observed for the total number of trips. By mode the differences are within reasonable ranges for the higher trip modes. For example, LRT is only 0.2% low and CRT is only 8.0% low.

Due to the very low number of trips for Core Bus and Express Bus, their differences are acceptable. Currently, Core Bus for example has only one route. In future phases of the RTP, additional Core Bus service is planned. While further calibration could have brought the Core Bus validation more in line with observed, over-calibrating the model was not desired.

Boardings by Hierarchical Mode (Figure 3.2) show a similar pattern. Overall boardings are only 3.9% lower in model compared to observed, and the modes Local Bus, LRT, and CRT all within 5%. Express Bus is the furthest away, but it has a lower number of boardings as compared to the higher boarding modes.

The *Transfer Ratio by Hierarchical Mode* (Figure 3.3) shows the relationship between the trips and the boardings. While the model was only slightly higher in trips, the boardings were low. This results in a lower transfer ratio, which is still acceptable with all values being within about 5%.

And for comparison, *Boardings by Mode Surveyed* (Figure 3.4) shows acceptable differences. The Core Bus and Express Bus values show much larger differences; but again given their low volumes, these are reasonable differences.

3.2 Mode Share

Mode share validation is shown through the comparison by groups of mode, time period, and trip purpose. For model and observed shares, the total percent for each combination of mode group, time period, and trip purpose adds up to 100%.

Mode groups compared include groupings of auto, transit, vehicle occupancy, and transit modes. The highest nest is motorized and non-motorized down to lower nests of individual transit modes and transit access modes. Shares were calculated for the following mode groupings:

- » Motorized / Non-Motorized
- » Auto / Transit
- » Drive Alone / Shared Ride
- » Shared Ride # of Occupants
- » Transit Mode
- » Transit Access Mode

Additionally, the shares were compared by the following time period groupings:

- » Daily
- » Peak
- » Off-peak

Finally, the shares were further compared for each of the following trip purposes:

- » All Purposes
- » Home-Based Work
- » Home-Based College
- » Home-Based Other
- » Non-Home Based

In the model, Home-Based College is the only trip purpose that does not include trips in the off-peak time period. So, any trips with this purpose in the observed data were moved to the peak time period for comparison.

Figure 3.5, Figure 3.6, Figure 3.7, Figure 3.8, Figure 3.9, and Figure 3.10 compare model vs observed mode shares by specific mode groups for the daily time period for all purposes. The observed data in the figures comes from a combination of the Household Travel Survey and the 2019 Transit On-Board Survey. This document does not include figures for peak and off-peak time period comparisons nor for home-based work, home-based college, home-based other, and non-home based purpose comparisons (for these specific comparisons, please direct yourself to the [online documentation](#)).

Motorized / Non-Motorized	Model	Observed	Difference
Motorized	91.5%	91.6%	-0.1%
Non-Motorized	8.5%	8.4%	0.1%

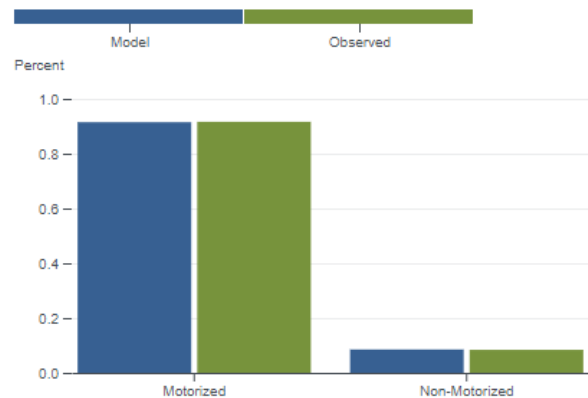


Figure 3.5 Model vs Observed Mode Shares by Motorized / Non-Motorized (Daily, All Purposes)

Auto / Transit	Model	Observed	Difference
Auto	98.5%	98.0%	0.6%
Transit	1.5%	2.0%	-0.6%

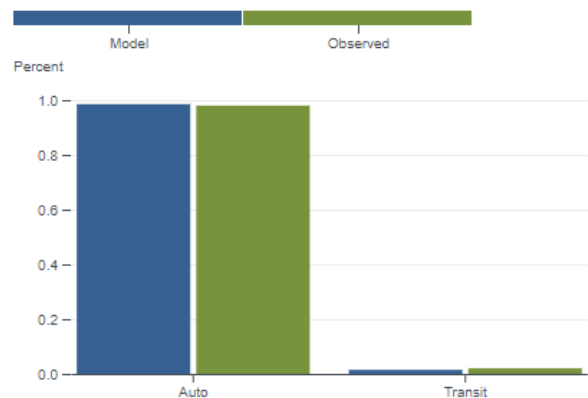


Figure 3.6 Model vs Observed Mode Shares by Auto / Transit (Daily, All Purposes)

Drive Alone / Shared Ride	Model	Observed	Difference
Drive Alone	46.9%	46.5%	0.5%
Shared Ride	53.1%	53.5%	-0.5%

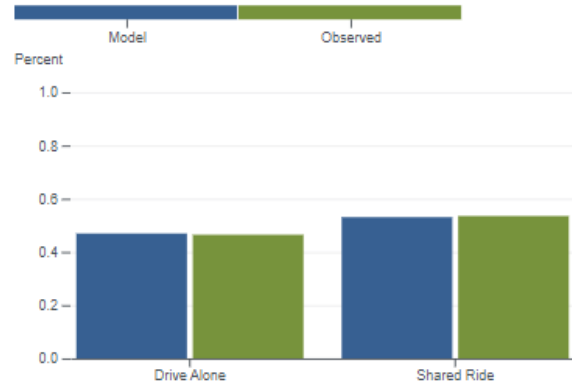


Figure 3.7 Model vs Observed Mode Shares by Drive Alone / Shared Ride (Daily, All Purposes)

Shared Ride # of Occupants	Model	Observed	Difference
Shared Ride 2 Occupants	42.7%	42.6%	0.0%
Shared Ride 3+ Occupants	57.3%	57.4%	-0.0%

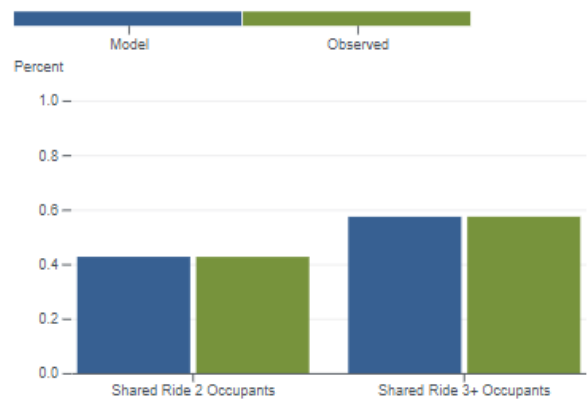


Figure 3.8 Model vs Observed Mode Shares by Shared Ride # of Occupants (Daily, All Purposes)

Transit Mode	Model	Observed	Difference
BRT	8.3%	9.0%	-0.8%
CRT	15.9%	17.3%	-1.4%
Core Bus	0.6%	0.7%	-0.1%
Express Bus	0.8%	0.8%	0.0%
LRT	40.3%	40.0%	0.3%
Local Bus	34.2%	32.2%	2.0%

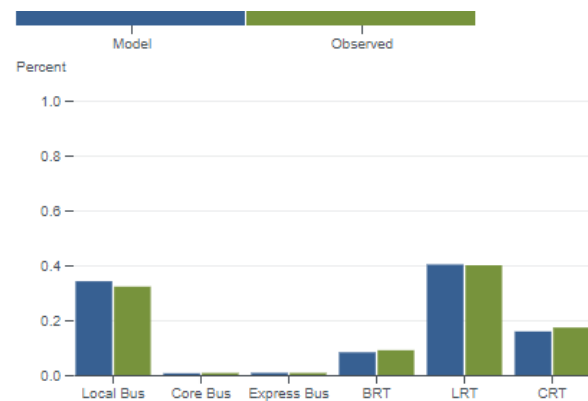


Figure 3.9 Model vs Observed Mode Shares by Transit Mode (Daily, All Purposes)

Transit Access Mode	Model	Observed	Difference
Drive	22.5%	26.3%	-3.8%
Walk	77.5%	73.7%	3.8%

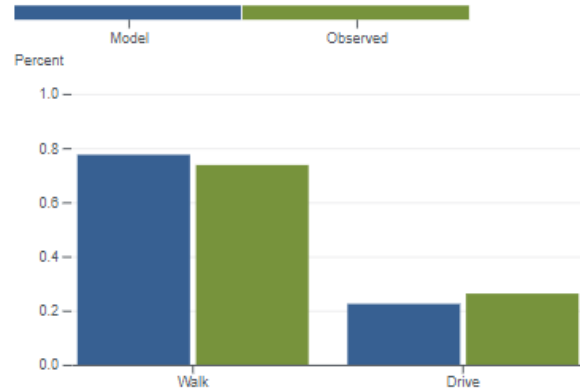


Figure 3.10 Model vs Observed Mode Shares by Transit Access Mode (Daily, All Purposes)

The *Motorized / Non-motorized* grouping of model shares (Figure 3.5) are within 0.1% of the observed data for the daily time period and all trip purposes with non-motorized shares being slightly higher than observed and motorized shares being slightly lower. The model shares for additional combinations of time period and purpose are all within 0.5%.

The *Transit Mode* grouping of model shares (Figure 3.9) are also close to observed with all modes for all time periods and trip purposes. At the Daily time period for all purposes, Local Bus has slightly higher share at 2.0% compared to observed than other modes, such as CRT that is 1.4% lower than observed and LRT that is 0.3% higher than observed. Nearly all the model shares for *Transit Mode* combinations of time period and are within 5% of observed. The one exception is Home-Based Other which in the peak period for Local Bus is 5.7% higher than observed. Transit Access Mode model shares are all within 5% of observed shares.

4 Highway Assignment

Validation of final highway assignment was done comparing model outputs from the final loaded networks with observed data. The comparisons were done with volumes and speeds.

4.1 Volumes

The validation results for the Highway Assignment portion of the model are shown in this section. The observed data for 2019 volumes is taken from the Utah Department of Transportation (UDOT) [Average Annual Daily Traffic \(AADT\) History](#) and associated with their respective model segments. The traffic model data is taken from segment summary report for the 2019 base year model: [v902_SE19_Net19_Summary_SEGID.csv](#). The results are divided into three sections:

- » Summary Comparison
- » Detailed Comparison
- » Map Comparison

4.1.1 Summary Comparison

The summary comparison shows region and county-wide differences between model and observed for *Average Daily Volume* and *Vehicle-Miles Traveled (VMT)* by vehicle type. The values for Box Elder and Weber counties are only the portions within the MPO planning area. Validation was checked comparing the average daily volume at the region and county levels. [Figure 4.1](#), [Figure 4.2](#),

Figure 4.3,

Figure 4.4, and Figure 4.5, contain percent difference validation charts for *All Roadways*, *Freeways*, *Principal Arterials*, *Minor Arterials*, and *Collectors* by *All Vehicles*, *Passenger Cars*, *Medium Trucks*, and *Heavy Trucks* respectively (for comparisons dealing with absolute difference, please direct yourself to the [online documentation](#)).

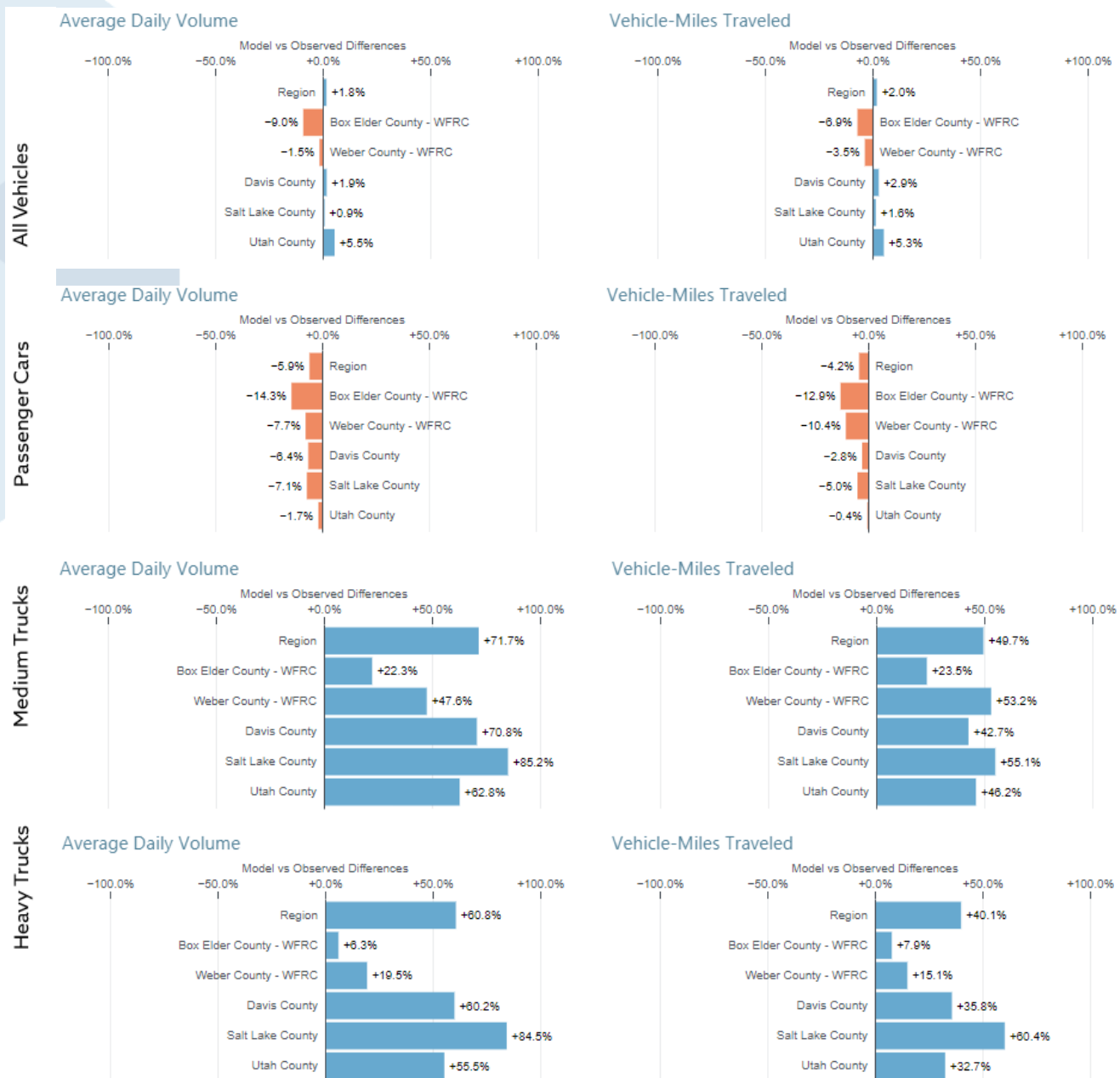


Figure 4.1 Model vs Observed Percent Difference of All Roadways by Vehicle Type

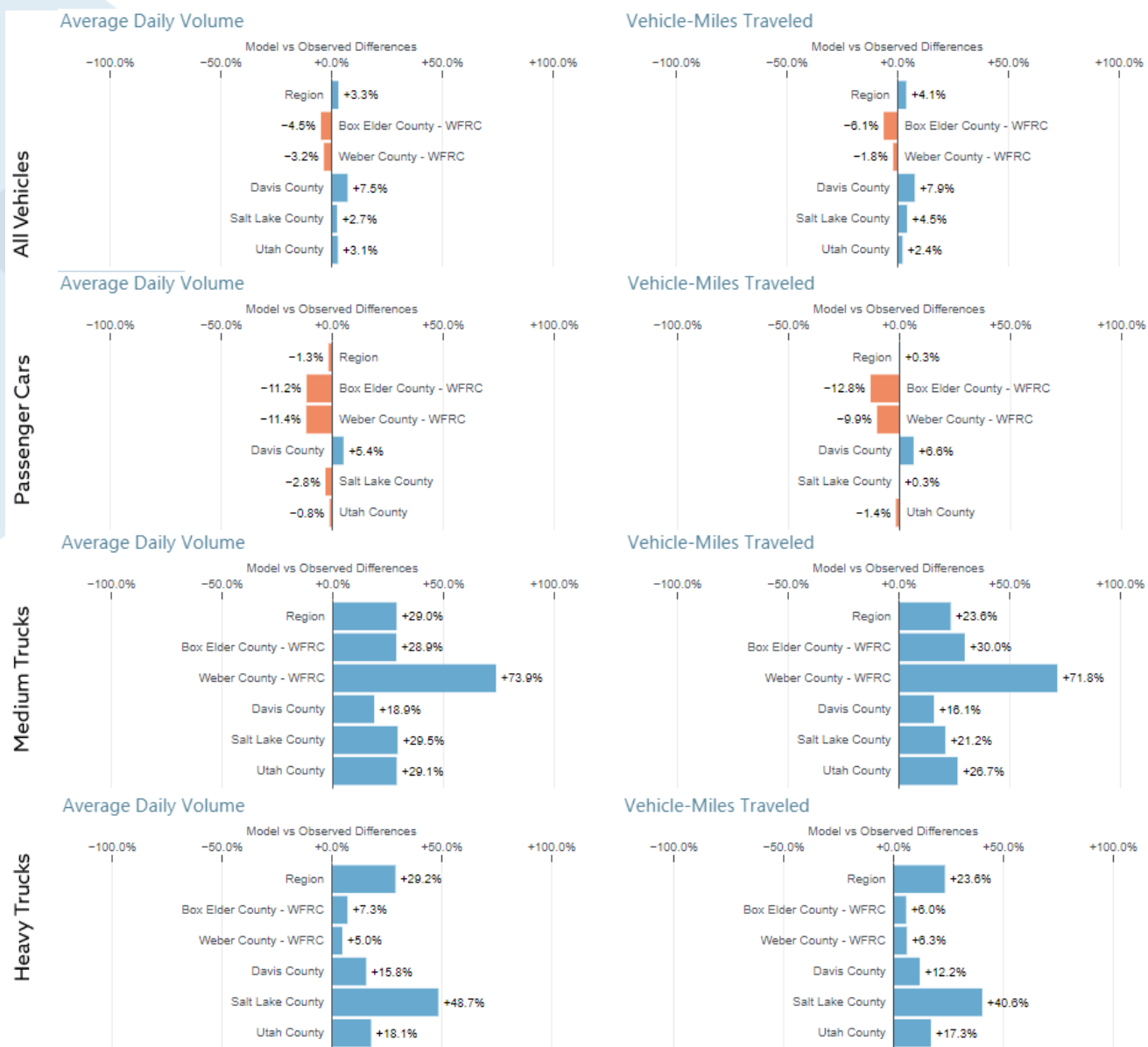


Figure 4.2 Model vs Observed Percent Difference of Freeways by Vehicle Type

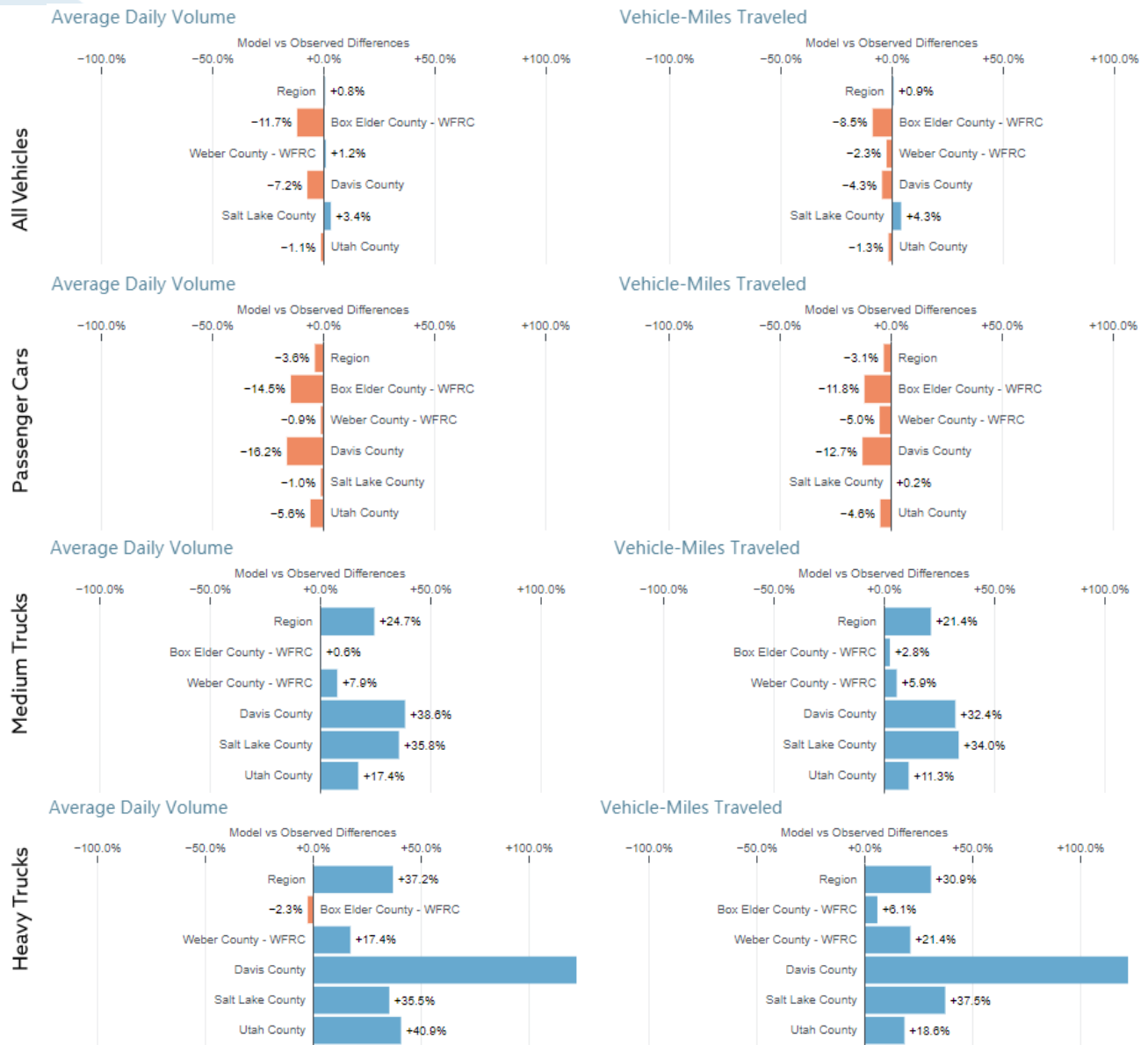


Figure 4.3 Model vs Observed Percent Difference of Principal Arterials by Vehicle Type

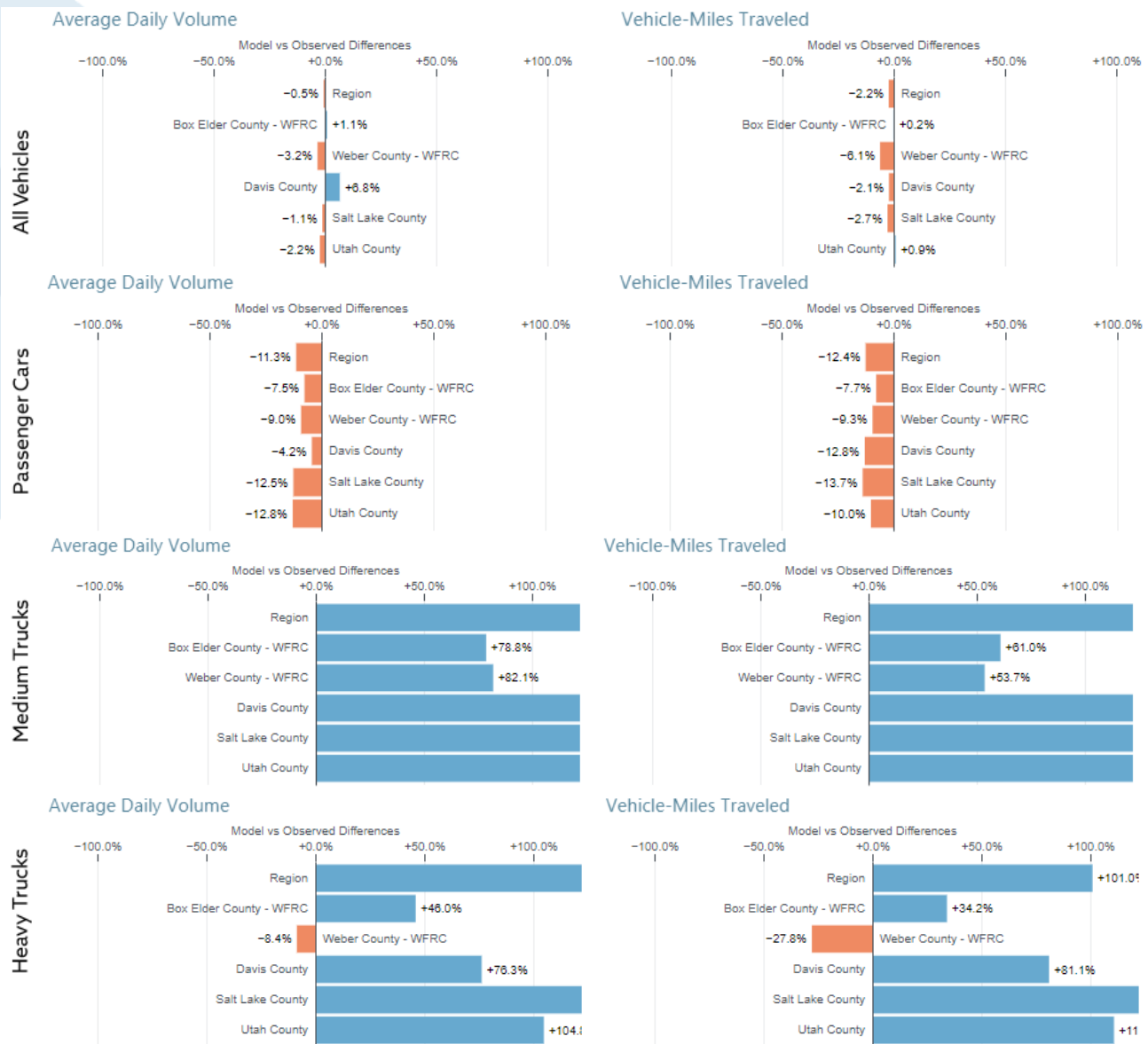


Figure 4.4 Model vs Observed Percent Difference of Minor Arterials by Vehicle Type

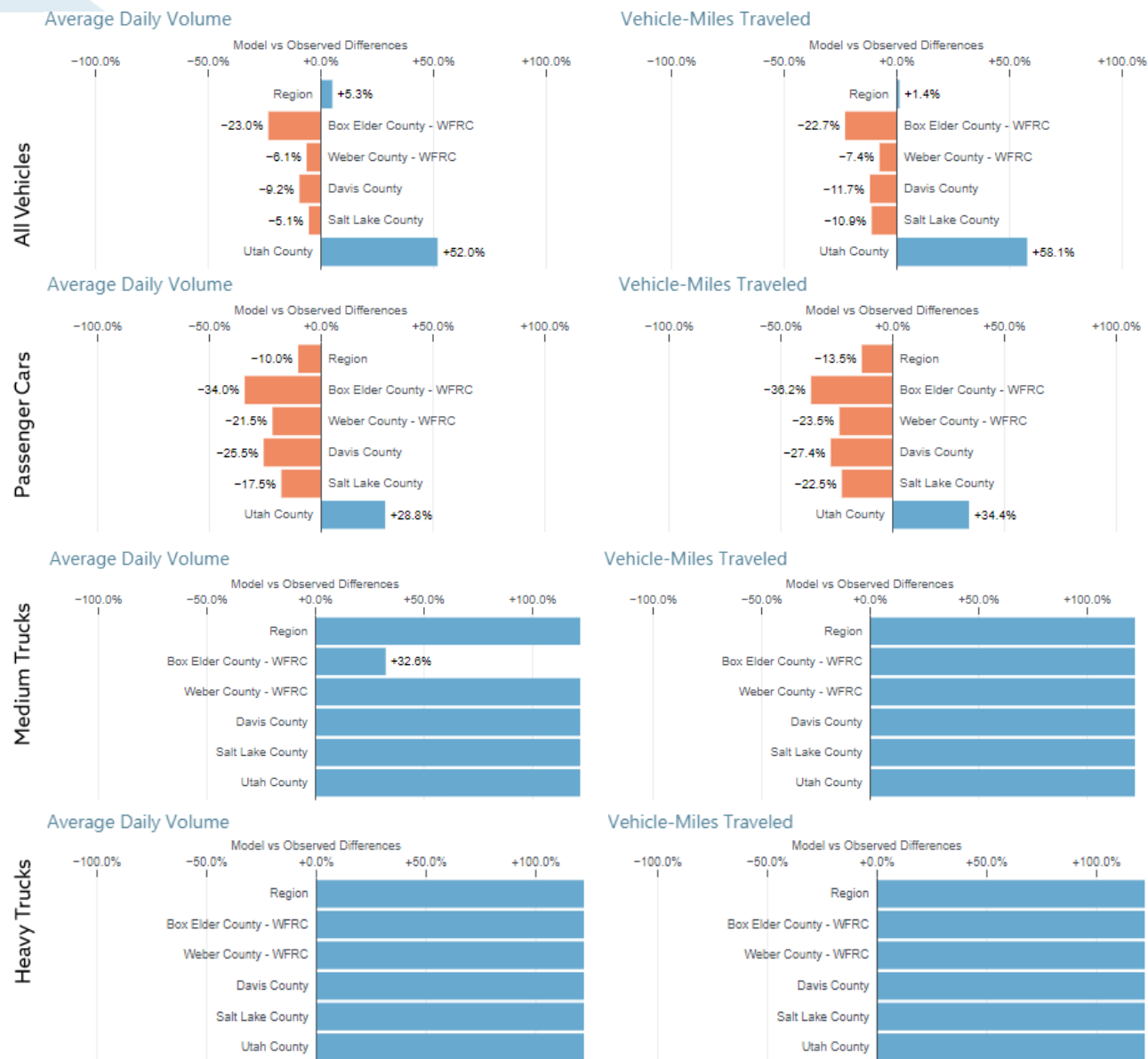


Figure 4.5 Model vs Observed Percent Difference of Collectors by Vehicle Type

At the region level model volume is 1.8% higher than observed volume. The four more urban counties (Weber, Davis, Salt Lake, and Davis) were all within 6% of observed volumes with Salt Lake County being the closest. Weber County was slightly lower and Utah and Davis were slightly higher. Box Elder County is more rural than the other counties. Box Elder model volumes are about 9% lower than observed. Time did not allow for further calibration of the volumes in Box Elder area to account for the larger differences.

One important observation at the *All Vehicles* (Figure 4.1) and *Collectors* (Figure 4.5) level is that Utah County shows a much higher difference than the other counties. Upon further investigation of observed *Collector* volumes in Utah County, many roadway segments had very low volumes

compared to what was expected. Utah County is one of the highest growth areas in the region. For this reason, we expect that the observed count data may be underrepresenting actual volumes. We also anticipate observed volumes in Utah County to improve in the near-term. Within the last several years, a large investment in continuous count station in Utah County has been made. The new counters will add additional information to generate observed volumes for all roadway segments.

The largest differences in model vs observed volumes occur in the Medium Truck and Heavy Truck vehicle types. A good amount of time was spent attempting to bring model truck volumes closer to observed. However, due to the limited data sources for truck information, further need to investigate observed truck volumes, and a desire to not over-calibrate the model, further calibration was stopped. Truck modeling remains a future priority for model improvement.

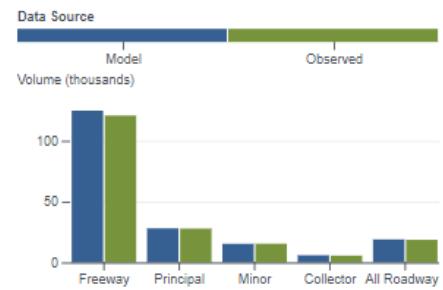
4.1.2 Detailed Comparison

The model vs observed details in this section are presented by *Volume* and *Vehicle-Miles Traveled (VMT)* through the comparison of model and observed data facility type by region and by county. [Figure 4.6](#), [Figure 4.7](#), [Figure 4.8](#), [Figure 4.9](#), [Figure 4.10](#), and [Figure 4.11](#) show model and observed values for the region and each county for all vehicles (for comparisons for cars, medium trucks, and heavy trucks, please direct yourself to the [online documentation](#)). The comparisons are shown in four different types of charts and tables:

- » *Average Daily Volume by Roadway Class (2a)*: The daily volume is averaged across all segments within their respective geography and vehicle type.
- » *Total VMT by Roadway Class (2b)*: For each segment, the daily volume is multiplied by segment distance and then summed across all segments within their respective geography and vehicle type.
- » *Model vs Count Segment Volume (2c)*: This is a scatter plot of segment daily volume with the x-axis as the observed volume and the y-axis as the model volume. The red line shows the location of where model and observed volumes are equal. The dashed blue line shows a least-squares linear regression. The further the blue line moved away from the red line, the further the model is from observed.
- » *Segment Percent Error (2d)*: This is a scatter plot showing the amount of error (percent difference) between the observed volume and the model volume. The observed volume is the x-axis and the percent error is the y-axis. The red lines are a bounding box that shows the control target. As volume increases, it is expected that the percent error should decrease.

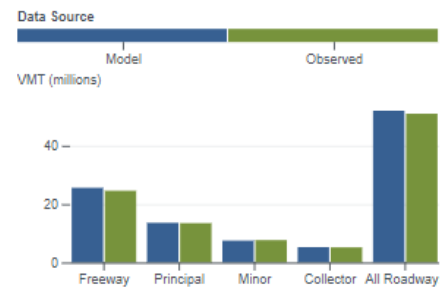
2a. Average Daily Volume by Roadway Class

Roadway Class	# Segs	Volume	Observed	Difference	Percent Difference	RMSE	Percent RMSE
Local	1	285	450	-165	-36.7%		
Freeway	165	124,761	120,773	3,988	3.3%	23,366	19.3%
Principal	897	28,053	27,840	213	0.8%	9,475	34.0%
Minor	1,110	15,344	15,420	-76	-0.5%	8,139	52.8%
Collector	1,666	5,920	5,620	300	5.3%	5,082	90.4%
All Roadways	3,839	18,923	18,593	330	1.8%	8,546	46.0%

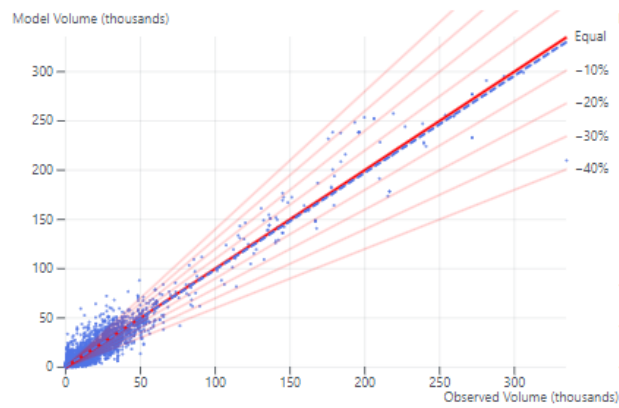


2b. Total Daily VMT by Roadway Class

Roadway Class	Model	Observed	Difference	Percent Difference
Local	1,707	2,698	-991	-36.7%
Freeway	25,601,558	24,593,628	1,007,930	4.1%
Principal	13,608,575	13,492,116	116,459	0.9%
Minor	7,506,874	7,673,385	-166,512	-2.2%
Collector	5,275,342	5,202,111	73,231	1.4%
All Roadways	51,994,056	50,963,939	1,030,117	2.0%



2c. Model vs Observed Volumes



2d. Segment Percent Error

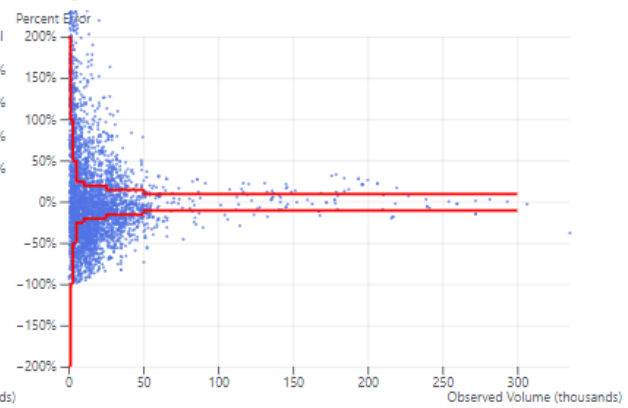
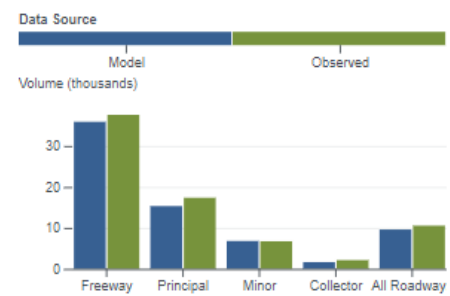


Figure 4.6 Model vs Observed Volume and VMT Comparison (Region, All Vehicles)

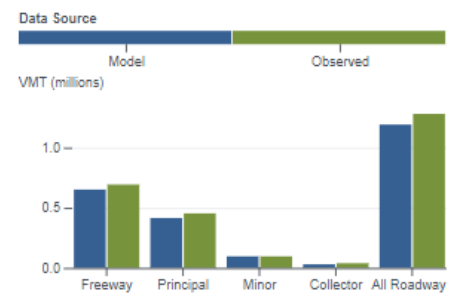
2a. Average Daily Volume by Roadway Class

Roadway Class	# Segs	Volume	Observed	Difference	Percent Difference	RMSE	Percent RMSE
Freeway	5	35,905	37,600	-1,695	-4.5%	2,931	7.8%
Principal	29	15,324	17,362	-2,038	-11.7%	5,436	31.3%
Minor	21	6,808	6,736	73	1.1%	2,653	39.4%
Collector	30	1,646	2,137	-492	-23.0%	1,440	67.4%
All Roadways	85	9,603	10,554	-951	-9.0%	3,557	33.7%

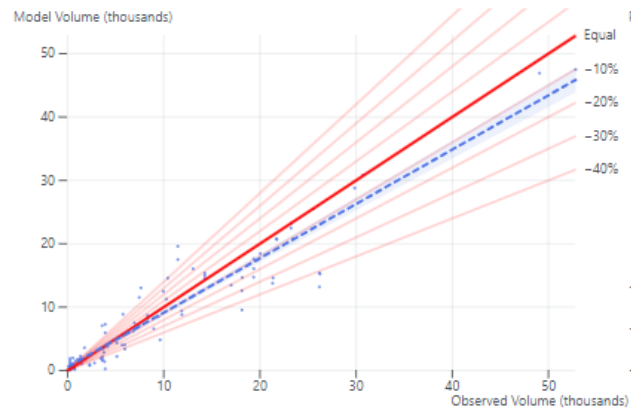


2b. Total Daily VMT by Roadway Class

Roadway Class	Model	Observed	Difference	Percent Difference
Freeway	651,227	693,206	-41,979	-6.1%
Principal	414,878	453,299	-38,420	-8.5%
Minor	95,932	95,709	223	0.2%
Collector	29,919	38,715	-8,796	-22.7%
All Roadways	1,191,957	1,280,929	-88,972	-6.9%



2c. Model vs Observed Volumes



2d. Segment Percent Error

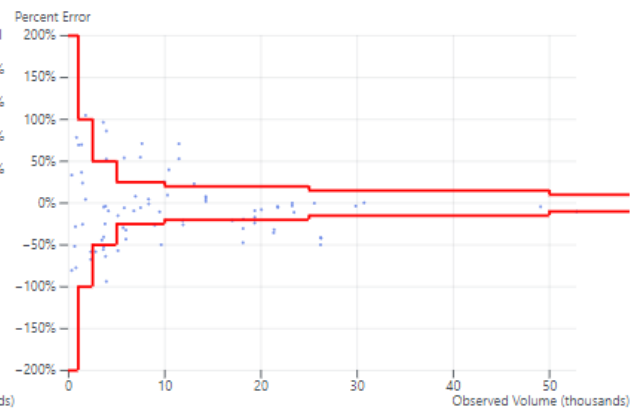
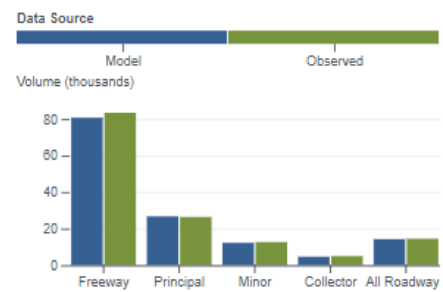


Figure 4.7 Model vs Observed Volume and VMT Comparison (Box Elder - WFR, All Vehicles)

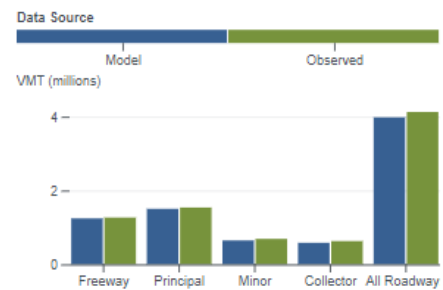
2a. Average Daily Volume by Roadway Class

Roadway Class	# Segs	Volume	Observed	Difference	Percent Difference	RMSE	Percent RMSE
Freeway	11	80,740	83,391	-2,651	-3.2%	8,488	10.2%
Principal	132	26,708	26,402	306	1.2%	7,951	30.1%
Minor	112	12,258	12,667	-409	-3.2%	5,382	42.5%
Collector	224	4,653	4,953	-300	-6.1%	3,648	73.6%
All Roadways	479	14,256	14,469	-213	-1.5%	5,639	39.0%

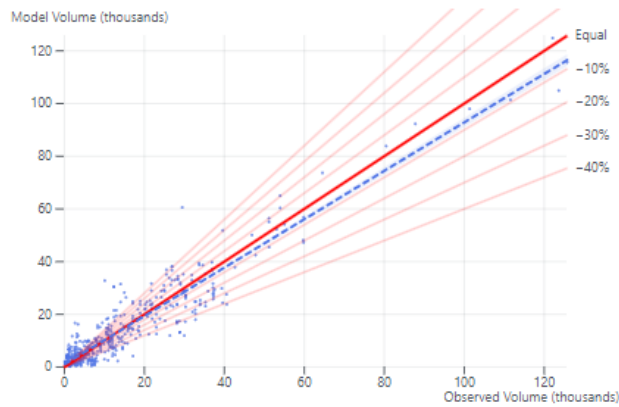


2b. Total Daily VMT by Roadway Class

Roadway Class	Model	Observed	Difference	Percent Difference
Freeway	1,244,933	1,267,498	-22,565	-1.8%
Principal	1,504,475	1,539,198	-34,723	-2.3%
Minor	647,980	689,814	-41,834	-6.1%
Collector	583,654	630,299	-46,645	-7.4%
All Roadways	3,981,043	4,126,809	-145,767	-3.5%



2c. Model vs Observed Volumes



2d. Segment Percent Error

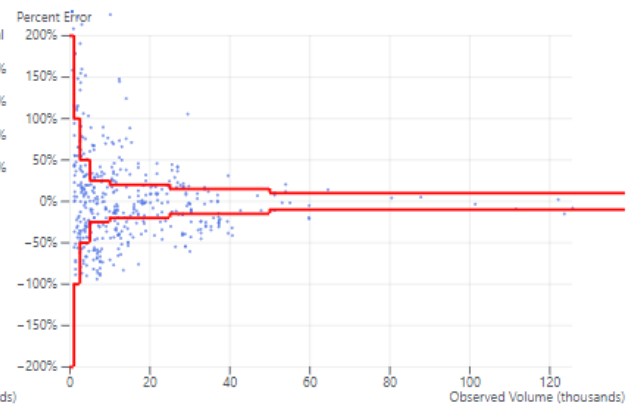
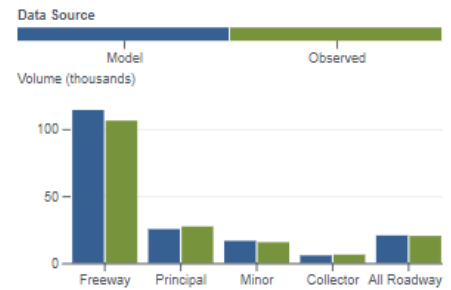


Figure 4.8 Model vs Observed Volume and VMT Comparison (Weber - WFRM, All Vehicles)

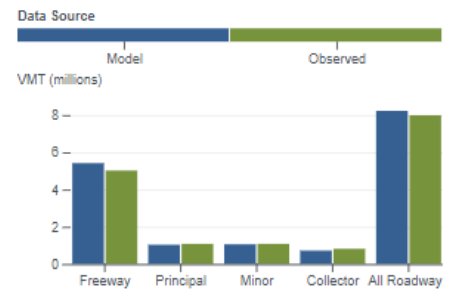
2a. Average Daily Volume by Roadway Class

Roadway Class	# Segs	Volume	Observed	Difference	Percent Difference	RMSE	Percent RMSE
Freeway	33	114,212	106,274	7,938	7.5%	14,745	13.9%
Principal	67	25,374	27,328	-1,954	-7.2%	7,602	27.8%
Minor	136	16,615	15,562	1,053	6.8%	9,200	59.1%
Collector	192	5,733	6,317	-584	-9.2%	4,350	68.9%
All Roadways	428	20,630	20,251	379	1.9%	7,724	38.1%

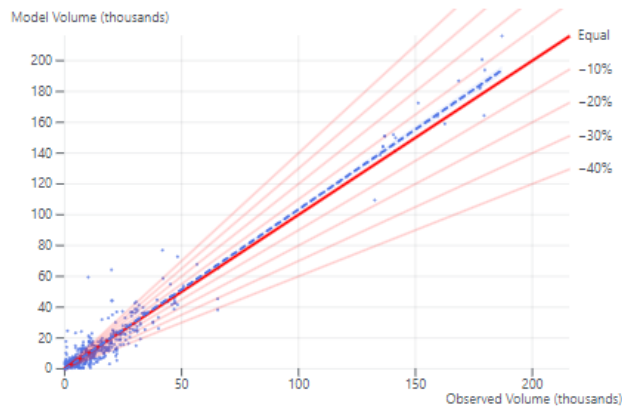


2b. Total Daily VMT by Roadway Class

Roadway Class	Model	Observed	Difference	Percent Difference
Freeway	5,419,387	5,021,212	398,176	7.9%
Principal	1,033,331	1,079,292	-45,961	-4.3%
Minor	1,057,577	1,079,885	-22,308	-2.1%
Collector	718,614	813,787	-95,173	-11.7%
All Roadways	8,228,910	7,994,176	234,734	2.9%



2c. Model vs Observed Volumes



2d. Segment Percent Error

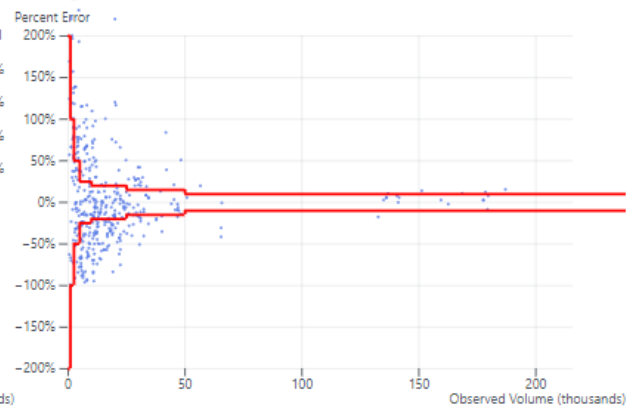
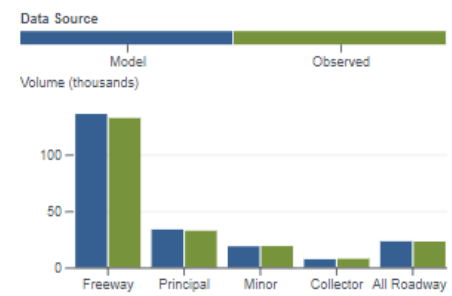


Figure 4.9 Model vs Observed Volume and VMT Comparison (Davis, All Vehicles)

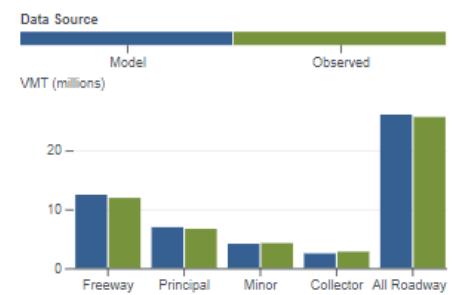
2a. Average Daily Volume by Roadway Class

Roadway Class	# Segs	Volume	Observed	Difference	Percent Difference	RMSE	Percent RMSE
Local	1	285	450	-165	-36.7%		
Freeway	79	135,939	132,341	3,598	2.7%	27,285	20.6%
Principal	375	33,652	32,547	1,105	3.4%	10,824	33.3%
Minor	522	18,762	18,966	-203	-1.1%	8,831	46.6%
Collector	664	7,350	7,742	-392	-5.1%	6,175	79.8%
All Roadways	1,641	23,177	22,975	202	0.9%	10,067	43.8%

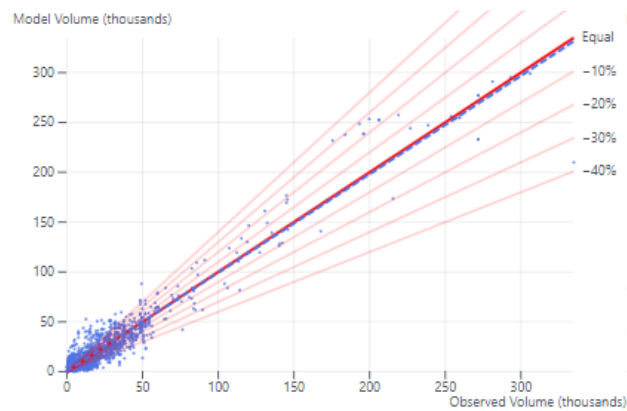


2b. Total Daily VMT by Roadway Class

Roadway Class	Model	Observed	Difference	Percent Difference
Local	1,707	2,698	-991	-36.7%
Freeway	12,467,635	11,929,974	537,661	4.5%
Principal	6,964,886	6,679,053	285,834	4.3%
Minor	4,142,774	4,259,363	-116,589	-2.7%
Collector	2,502,234	2,807,868	-305,634	-10.9%
All Roadways	26,079,236	25,678,956	400,281	1.6%



2c. Model vs Observed Volumes



2d. Segment Percent Error

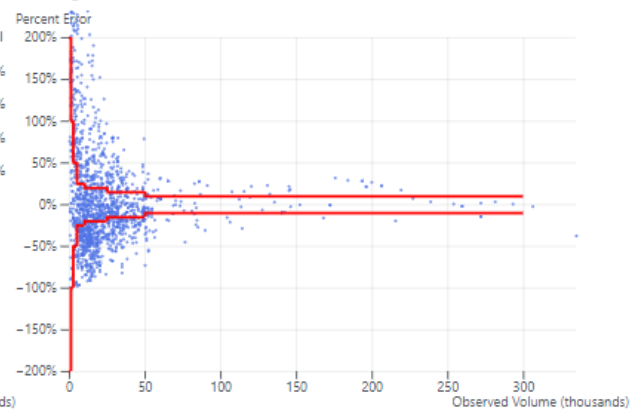
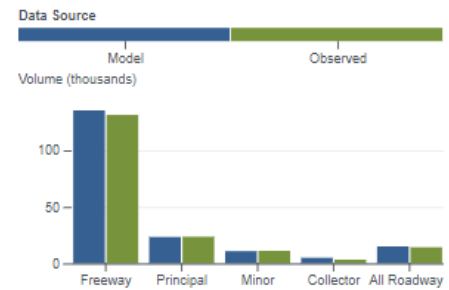


Figure 4.10 Model vs Observed Volume and VMT Comparison (Salt Lake, All Vehicles)

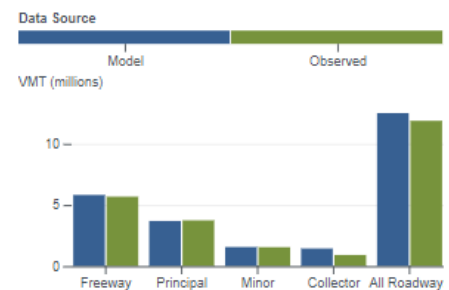
2a. Average Daily Volume by Roadway Class

Roadway Class	# Segs	Volume	Observed	Difference	Percent Difference	RMSE	Percent RMSE
Freeway	37	135,398	131,356	4,042	3.1%	26,374	20.1%
Principal	294	23,382	23,632	-250	-1.1%	8,993	38.1%
Minor	319	10,856	11,097	-242	-2.2%	7,530	67.8%
Collector	556	5,017	3,300	1,717	52.0%	4,471	135.5%
All Roadways	1,206	15,039	14,248	791	5.5%	7,745	54.4%

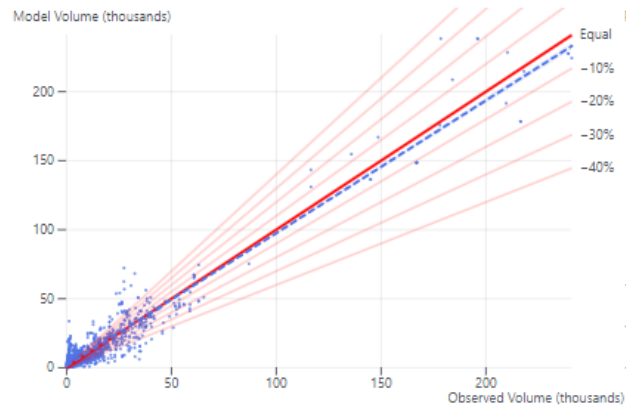


2b. Total Daily VMT by Roadway Class

Roadway Class	Model	Observed	Difference	Percent Difference
Freeway	5,818,375	5,681,738	136,637	2.4%
Principal	3,691,005	3,741,275	-50,270	-1.3%
Minor	1,562,610	1,548,614	13,996	0.9%
Collector	1,440,921	911,441	529,480	58.1%
All Roadways	12,512,910	11,883,069	629,842	5.3%



2c. Model vs Observed Volumes



2d. Segment Percent Error

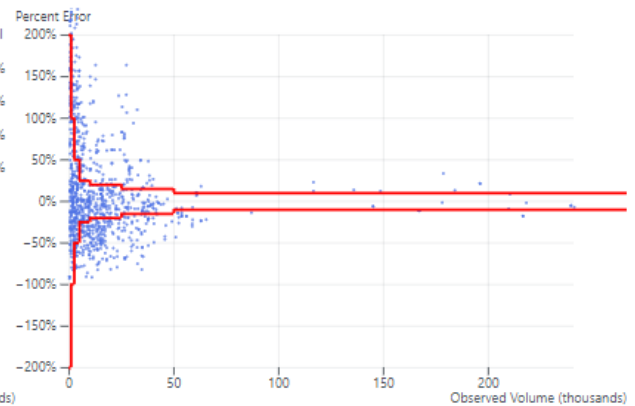


Figure 4.11 Model vs Observed Volume and VMT Comparison (Utah, All Vehicles)

4.1.3 Map Comparison

The maps in Figure 4.12 shows a comparison of segment level model vs observed volumes by vehicle types. Blue represents model lower than observed and red represent model volume higher than observed.

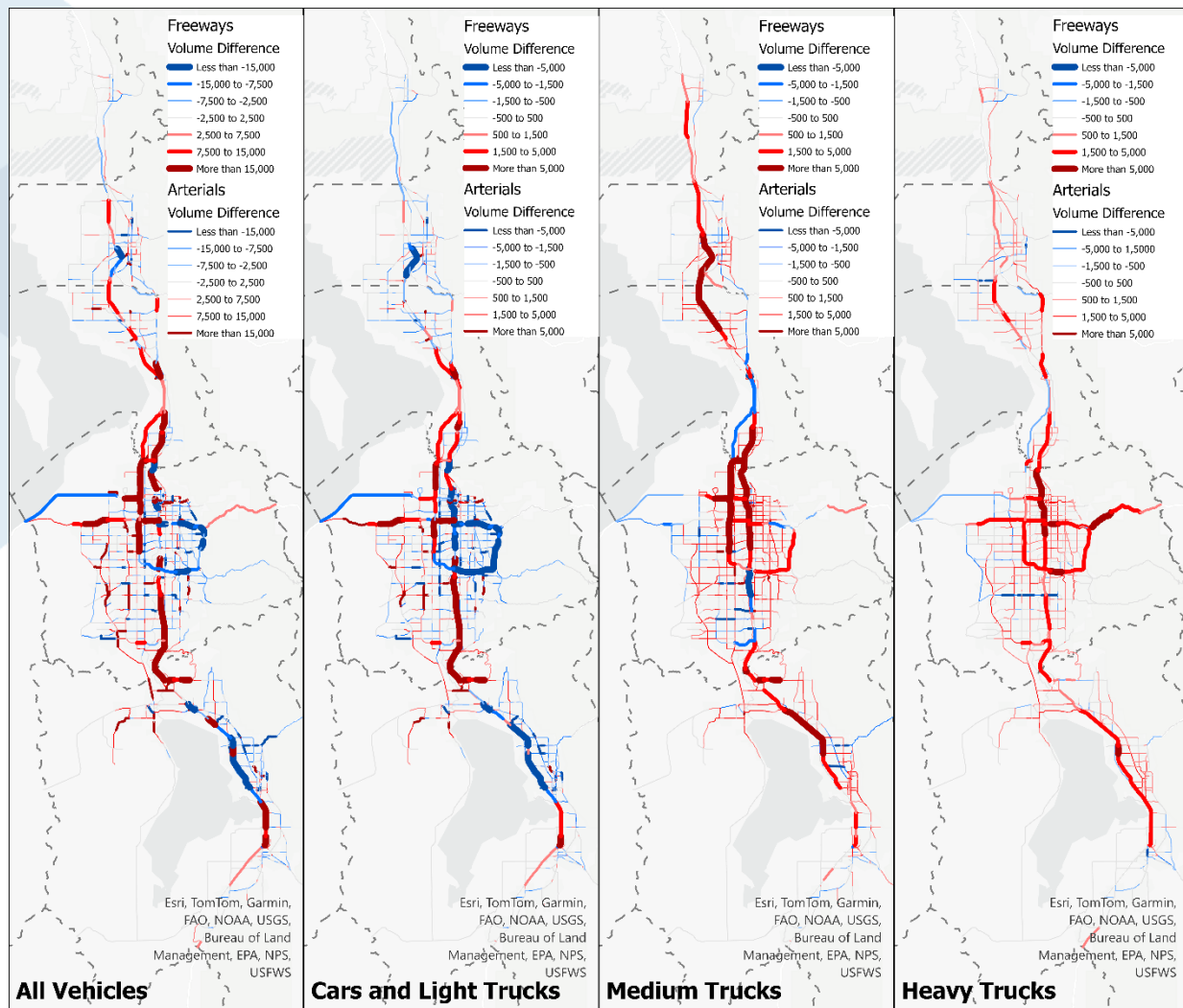


Figure 4.12 Segment-Level Model vs Observed Volume Comparison by Vehicle Type

Looking at the *All Vehicles* map, the model volumes are lower than observed for by more than 15,000 vehicles per day for the east side of I-215 and for I-15 through northern Utah County. Model volumes are higher than observed volumes by more than 15,000 vehicles for I-15 in southern Salt Lake County and for I-15 in Utah County between Springville and Spanish Fork. When looking at these areas by vehicle type, the drop in *Cars and Light Trucks* are actual greater since the *Medium Trucks* and *Heavy Trucks* in these areas are greater in the model vs observed. Outside of these areas, the volume differences between model and observed are relatively minor.

The lower arterial model vs observed volumes of *Heavy Trucks* on 9000 South in Salt Lake County was further investigated. The *Heavy Truck* observed volume for this roadway seemed much higher than expected for this roadway. The lower volumes are likely due to the observed data and not anything in the model.

4.2 Speeds

Comparisons were made between model and observed for a sample of OD pairs. Observed speeds come from sampled data at various time periods in 2019 for the WFR area using the Google API for reported travel times between coordinates for an origin and destination. Model speeds come from the final network skims that report travel times between all TAZs in the model for each period of the day. The two data sets were joined using a coordinate to TAZ spatial join to locate Google end points to match their respective TAZ.

Model vs Observed Speeds

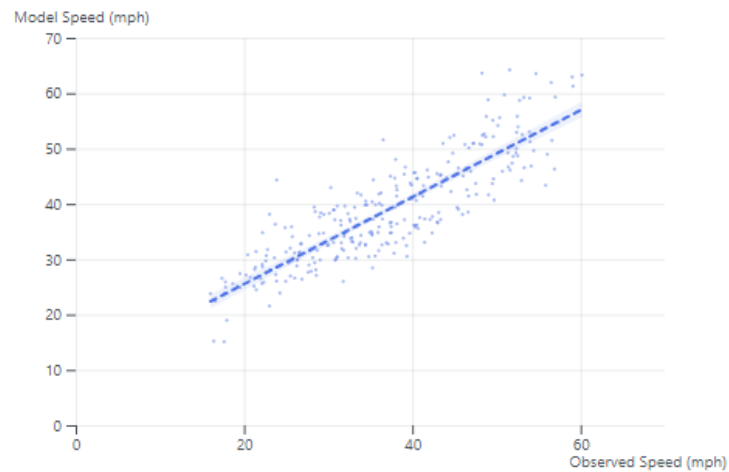


Figure 4.13 Model vs Observed Speed AM Period

Model vs Observed Speeds

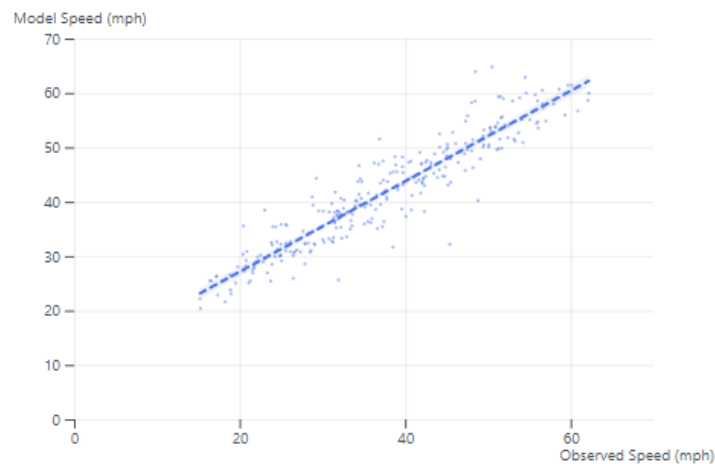


Figure 4.14 Model vs Observed Speeds Midday Period

Model vs Observed Speeds

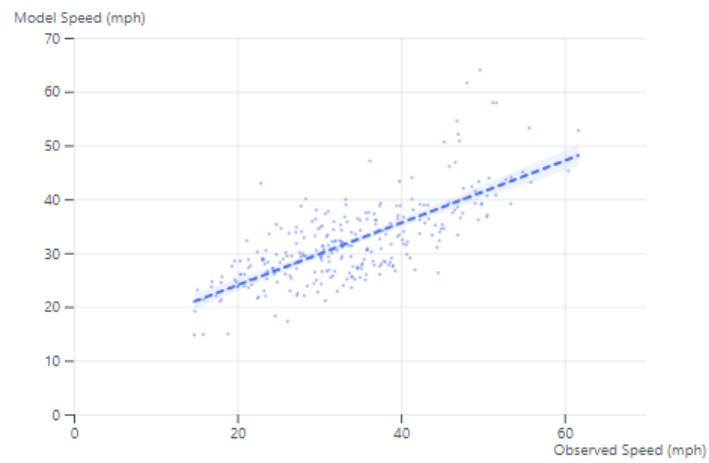


Figure 4.15 Model vs Observed Speeds PM Period

Model vs Observed Speeds

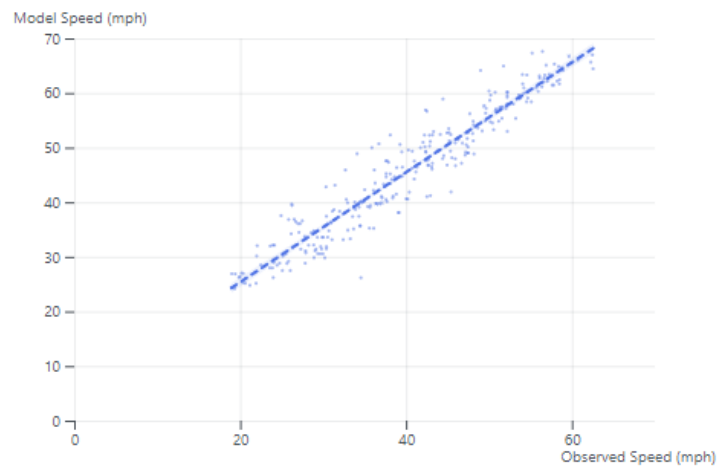


Figure 4.16 Model vs Observed Speeds Evening Period