Truck At-fault Percentages on Interstate Crashes

Table C shows an analysis of all fatal, disabling injury, and minor injury crashes involving truck and/or passenger vehicles on Missouri interstates between 2002 and 2006. It was found that passenger vehicles were solely at fault in 68.2% of fatal crashes, 59.8% of disabling injury crashes, and 44.3% of minor injury crashes while trucks were solely at fault 19.9%, 29.5%, and 41.0% of the time in fatal, disabling injury, and minor injury crashes, respectively. Table C shows that trucks are involved in a smaller percentage of crashes as compared to passenger vehicles if exposure is not taken into account by using truck and vehicle volumes. This is more true in the case of fatal crashes (19.9% vs. 68.2%) and less true in the case of minor injury crashes (41.0% v. 44.3%).

Table C - Vehicle At-fault Percentages in Fatal Truck-Passenger Vehicle Crashes

	No. of Crashes and % of Total		
Veh. At Fault	**Fatal Crashes**	**Disabling Injury**	**Minor Injury**
Pass. Veh. Only	103 (68.2%)	288 (59.8%)	907 (44.3%)
Truck Only	30 (19.9%)	142 (29.5%)	839 (41.0%)
Both Veh.	13 (8.6%)	34 (7.1%)	158 (7.7%)
None	5 (3.3%)	18 (3.7%)	143 (7.0%)
Total Sample	151 (100%)	482 (100%)	2047 (100%)

In contrast to **Table C**, **Table D** takes into account exposure in analyzing crashes. In other words, **Table D** takes into account the percentage of trucks in the total traffic stream. Thus the data in **Table D** shows if truck at-fault in crashes are "over or under represented" as compared to non-truck at-fault in crashes. This data is expressed as at-fault section crash rate (RSEC) ratios. The numerator in the ratio is the truck at-fault crash rate and the denominator is the passenger vehicle at-fault crash rate. If this ratio is greater than 1, then truck crashes are over represented when volume (exposure) is taken into account. If this ratio is less than 1, then passenger vehicle crashes are over represented. **Table D** shows that on urban freeways, RSEC ratios for trucks are consistently over 1 especially for minor injury crashes (e.g. 4.928, I-70; 3.345, I-44). Similarly, RSEC ratios are rarely under 1. One exception when comparing trucks to passenger cars is the case of fatal crashes on rural I-70 where the RSEC ratio is 0.46, i.e. passenger car at-fault crash rate is more than two times larger than truck at-fault crash rate. In general, **Table D** shows the difference between truck and passenger vehicle at-fault crash rates are statistically significant for minor injury crashes probably due to the larger sample size. One caution in interpreting the statistical significance is that the sample size is not very large, especially for fatal crashes. For RSEC ratios on urban freeways, **Table D** shows an interesting trend upward as the severity type decreases.

Table D – RSEC Ratios vs. At-fault Crash Rate Statistical Significance

Interstate Location		RSEC Ratio vs. At Fault Crash Rate Significance					
		Fatal		Disabling Injury		Minor Injury	
		RSEC Ratio	At Fault Crash Rate Significant?	RSEC Ratio	At Fault Crash Rate Significant?	RSEC Ratio	At Fault Crash Rate Significant?
I-70	**Rural**	0.46	Yes	1.294	No	1.71	No
	Urban	1.771	No	2.28	No	4.928	Yes
I-44	**Rural**	0.602	No	0.822	No	2.524	Yes
	Urban	1.235	No	1.755	No	3.345	Yes
I-270	**Urban**	1.922	No	6.15	No	6.667	Yes
I-435	**Urban**			2.307	No	12.459	Yes

*The I-435 Urban scenario had a low frequency of fatal crashes and was not included in the analysis of at-fault crash rates.

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INTRODUCTION AND BACKGROUND INFORMATION

Due to concerns expressed by its motorists, the Missouri Department of Transportation (MoDOT) has articulated the importance of research regarding large truck travel and its effect on the safety of its highways. Missouri has anywhere from 5% trucks on urban interstates to almost 40% trucks on its rural interstates. With these numbers on the rise each year, increasing truck safety is a key objective in the improvement of the statewide transportation network. Measures to be used in determining the safety of interactions between large trucks and passenger autos are speed differentials between the vehicle types (in both rural and urban settings), truck lane usage on sections of urban interstates with three or more lanes per direction, and at-fault percentages in fatal and injury truck-passenger vehicle crashes.

The issue of increased truck travel has raised much debate over policies of truck speed limits, restricted truck lanes, and dedicated truck-only lanes. Although an exhaustive literature review was not necessary for this report, important sources on the topic are provided at the end of the report. Literature shows differing opinions on the effects of differential speed limits (DSL). Research has found that states with a uniform speed limit (USL) compared to states with DSL do not show many differences in mean and 85^{th} % speeds of trucks (Harkey & Mera, 1994). Harkey & Mera also found that states with a USL had higher car into truck and truck into car crashes than states with a DSL. A study has also shown that the two types of speed limits do not produce any differences in crash rates (Garber & Gadiraju, 1991). Research has also shown that high speed differentials between trucks and passenger vehicles increase the severity of crashes (Council et. al., 2004).

The effects of truck lane restrictions on lane usage and traffic flow on freeways were modeled by Cate and Urbanik (2004) using the VISSIM simulation model. The authors found that the implementation of truck lane restrictions in a variety of scenarios is shown to have little effect on a number of traditional measures, including average speed, speed differential between cars and large trucks, and level of service. Lane restrictions were found to change speed differentials by less than one mph in most situations. However, when grades increase speed differentials continue to increase by as much as 10 mph between large trucks and passenger cars. This may seem to decrease safety due to the higher possibility of rear-end crashes, but lane restrictions produce lower frequencies of lane changes which has been shown to reduce conflicts and increase safety. The ultimate results showed that the practice of prohibiting trucks in the leftmost lane when there are three or more lanes of travel in a single direction has no negative effect on traffic safety or efficiency.

Interactions between large trucks and passenger cars are important topics for research since they represent more than 60% of all fatal truck crashes and because the passenger car occupant is much more likely to be killed according to Council et. al. (2003). Blower's (Blower, 1998) primary approach was to analyze driver-related factors in light of how the crash occurred using the trucks involved in fatal accidents (TIFA) files for fatal crashes, and NHTSA's National Automotive Sampling System General Estimates System (NASS-GES) for nonfatal crashes. Using the coding of driver-related contributing factors which contribute to the crash recorded by FARS analysts together with relative movement and position of the vehicles before the crash, one or both drivers were assigned fault in the crash. The TIFA analysis showed the passenger vehicle driver to be three times more likely to be a contributor to the crash. Stuster (1999) developed a set of 26 unsafe driving acts (UDA's) of passenger vehicle drivers in truck-car crashes. The UDA's were identified by police crash investigators and truck drivers. This research only analyzed the fault of the passenger vehicle driver which gives the preconceived notion that passenger vehicle drivers are mostly at fault. There is a lack of input on the behaviors of truck drivers who are at fault.

An analysis of the space and time mean speeds on urban interstates in Kansas City and St. Louis between large trucks and passenger cars will be used to confirm or dispute the notion that trucks travel much faster than other vehicles on urban interstates. The same task was performed for Missouri rural interstates using time mean speeds. Research was also performed to provide more information about the lane usage of trucks on urban interstates in Kansas City and St. Louis. Lastly, comprehensive research was conducted into the causal factors and at-fault percentages of truck-passenger vehicle fatal and injury crashes.

DATA COLLECTION

Previous data collected by researchers in the University of Missouri-Columbia's civil engineering department were utilized in the urban speed differential analyses while MoDOT permanent count station number 500 located on I-70 just east of Boonville, Missouri, provided speed data for the rural interstate scenario. The available urban data was collected using Portable Overhead Surveillance Trailers (POSTs) and analyzed with ReID vehicle reidentification/tracking software. Significant data was available for sections of roadway in St. Louis (I-70, I-270) and Kansas City (I-70, I-435). The time segments include AM and PM peak periods as well as non-peak periods. These data were collected for previous MoDOT and NCHRP studies in 2002 and 2003. The rural speed data set is six 24-hour periods from Tuesday March 20, 2007 to Thursday March 22, 2007 and Tuesday March 27, 2007 to Thursday March 29, 2007. It should be noted that the data collected from I-435 in Kansas City is located just across the state line in Kansas. Although this segment of the interstate is not technically located in Missouri, the traffic is very similar in both states along I-435 due to the frequent travel across state lines in Kansas City.

The same data sets used for determining urban speed differentials was used in the analysis of truck lane-usage. Digital video was analyzed by researchers and the lane in which trucks were traveling was tabulated. Data segments consisted of approximately five minute samples during morning and evening peak and off-peak periods on interstates with three, four, five, and six lanes. A total of 2411 large trucks were visually identified.

The data for determining the at-fault percentages in fatal and injury truck-passenger vehicle crashes was gathered and tabulated from the MoDOT Transportation Management System (TMS) database for fatal and injury crashes involving large trucks. The five-year data set includes all truck-involved fatal crashes that occurred on a Missouri interstate from 2002-2006. Excluding for crashes at interchanges and those not involving a combination of at least one large truck and one passenger vehicle, a sample of 151 fatal crashes was analyzed. The injury crashes were split by severity into disabling injury and minor injury. The disabling injury crash sample was 482 truck-passenger vehicle crashes while the minor injury sample was 2,087 crashes.

METHODOLOGY

In traffic engineering, the use of space mean speed (SMS) is often preferred to time mean speed (TimeMS) since SMS gives a better assessment of the travel over long distances. TimeMS is often used as a surrogate for SMS since SMS is more difficult to obtain. One of the most common methods for obtaining SMS is the use of the average/floating car study. Another method for obtaining SMS is the video reidentification method (ReID) which is video tracking of vehicles from point to point along a freeway. This is the method used in this research for deriving SMS on urban interstates. These speeds were already available since such data was collected for previous MoDOT and NCHRP studies. Since SMS was not available for rural interstates, TimeMS from loop detector stations was used as a surrogate. However, concerns were voiced about using SMS in the urban area and TimeMS in the rural area. Therefore, SMS was converted to TimeMS using the following equation: $TimeMS = SMS + \frac{\sigma_{SMS}^2}{SMS}$

The vehicles that were detected by ReID were then sorted into two categories by vehicle classification. Vehicles were classified as either a large truck or a passenger vehicle. Vehicles listed in the Missouri Uniform Accident Report (MUAR) form by body type numbers 20-26 are considered large trucks, and all other body types, excluding bus body types 6-9, are considered passenger vehicles. For the remainder of the report, any vehicle referred to as a large truck/commercial vehicle or a passenger vehicle are consistent with these classifications. For each urban data segment SMS were calculated for large trucks and for passenger vehicles, and a speed differential was calculated by subtracting the passenger vehicle SMS from the large truck SMS. Average speeds and differentials were computed for interstate segments I-70 and I-435 in Kansas City and I-70 and I-270 in St. Louis.

The rural speed data acquired from MoDOT's permanent count station 500 was available from 60-80 mph in 2 mph bins by hour for trucks and for all vehicles. The data contained truck volumes, total volumes, and truck and total volume speeds for the specified bins. With this information, weighted truck speeds and car volumes could be calculated which in turn allowed for the derivation and calculation of weighted car speeds. Therefore, speed differentials between large trucks and passenger vehicles were determined in a rural setting. The differentials were averaged for 24-hour periods and for the whole data set, and a two sample statistical t-test assuming unequal variances was performed. Speed differentials were also compared temporally between night and day. The nighttime period was from 7 pm to 6 am while the daytime period was from 6 am to 7 pm. The 7 pm and 6 am cutoffs for night and day were chosen by inspection of a clearly visible drop or rise in vehicle volume.

Digital video data collected by the POST systems on urban interstates in Kansas City and St. Louis was visually inspected for approximately five minute periods. The lane usage of large trucks was identified from the video. A lane numbering convention from median, or fastest, lane to shoulder, or slowest, lane was used. For example, on a three lane interstate the median lane is numbered with a 1, the middle lane is 2, and the shoulder lane is number 3. Interstates with four, five, or six lanes in one direction were numbered in a similar fashion. After the truck lane-usage was tabulated, observations were totaled and a percentage of lanes used for each lane scenario were calculated.

The MoDOT Transportation Management System database was queried for all fatal, disabling injury, and minor injury crashes on a Missouri interstate from 2002-2006 in order to perform an analysis of crashes involving both trucks and passenger vehicles. Through code written in Matlab version 6.5 (see **Appendix**) the crashes were filtered to exclude records located at interchanges so as not to introduce other factors of causality and to determine the effects of truck-passenger vehicle interaction on main line interstates.

Crashes not involving at least one large truck and one passenger vehicle were also filtered out in this process. To determine which vehicle was at fault, a driver that is coded with a probable contributing circumstance in the crash report will be categorized at fault. Specifically, if any one or more of the codes 1-21 in the "Probable Contributing Circumstances" section of the Missouri Uniform Accident Report (MUAR) were reported, a driver was considered at fault. Lastly, crashes were classified as 'passenger vehicle only' at fault, 'truck only' at fault, 'both' at fault, or 'none' at fault. Then a percentage was calculated for each at-fault class by dividing by total number of crashes for that segment. Overall at-fault percentages of fatal, disabling injury, and minor injury crashes were descriptive of truck-passenger vehicle interactions, but more analysis was done to determine the significance of an at-fault percentage by further filtering the crashes for rural and urban interstates and then compared to the percentage of volume represented by the vehicle type in question over the same segment.

In order to more effectively quantify the at-fault percentage, the percentages were calculated by segments for four major interstates in Missouri according to urban/rural classification. Interstates 70, 44, 270, and 435 were used for the analysis since they constitute the majority portion of Missouri freeways, and these interstates represent approximately 80% of fatal, 75% of disabling injury, and 71% of minor injury truck-passenger vehicle crashes. Each interstate was divided into rural and urban segments per MoDOT specifications and the at-fault percentage was calculated as described in the paragraph above. For example, I-70 EB is urban from log mile 0 to 23.124 and from 101.118 to 106.375, etc. Once the at-fault classification was assigned for both directions of the interstate, the crashes were totaled for the respective rural/urban classification and divided by the total number of crashes over those segments to attain the at-fault percentage. These segment percentages are more detailed representations of the 'overall' at-fault percentages for all Missouri interstates and can be compared to the respective volumes over the same segments in order to determine the significance of at-fault.

Over the same rural and urban segments that at-fault percentage was calculated, a truck percentage and passenger vehicle percentage of AADT was computed. Over these rural/urban segments, MoDOT has either actual or estimated volumes for smaller segments, ranging from 0.02 miles to 15.5 miles. For each segment, average commercial vehicle and AADT volumes for the five-year span (2002-2006) were calculated. Then this average was weighted by the distance it was measured over. Next, for each rural or urban segment the average weighted volume over that segment was calculated and divided by its segment length. This gives the five-year average volumes over that particular segment. Lastly, truck and passenger vehicle percentages of AADT were computed over the whole rural or urban Interstate.

For a freeway section, **Equation 1** was used to calculate an at-fault crash rate for both trucks and passenger vehicles. The at-fault crash rates were computed to more accurately explain the significance of the at-fault percentages. The crashes that were evaluated for the 5-year study period were further broken down by yearly crashes to attain a significant sample to perform a t-test. In layperson's terms a t-test is a way of determining whether differences in means were random versus systematic. A t-test is a test of the null hypothesis that the means of two normally distributed populations are equal. The significance level of a t-test, defined by the Greek letter alpha (α), determines the value of the t-statistic that will yield the probability of a t value being greater than the computed value. If the probability of the t value is less than the significance level, the difference of means is said to be statistically significant. The results from the yearly at-fault t-test is then used to support the at-fault crash rate ratio in determining whether crashes are over represented by one vehicle class.

Equation 1: At-fault crash rate for a section

- $RSEC_{AF} = \frac{100{,}000{,}000 \times C_{AF}}{365 \times T \times V \times L}$, where

$RSEC_{AF}$ = At-fault crash rate for a section
C_{AF} = # of at-fault crashes
T = time frame of analysis, years
V = AADT
L = length of the section

Now that at-fault crash rates for both trucks and passenger vehicles have been determined for each interstate, the at-fault crash rate ratios (RSEC ratio) can be derived using **Equation 2**. When dividing the truck crash rate by the passenger crash rate the constants cancel out because the two rates are compared over the same time and section length; therefore, the RSEC ratio is simply a function of the number of at fault crashes and volumes. So if this ratio is greater than 1, then it means that the truck crashes are over represented when volume or exposure is taken into account. And if this ratio is less than 1, then it means that the passenger vehicle crashes are over represented.

Equation 2: At-fault crash rate ratio

- $RSECratio = \frac{T_C P_V}{T_V P_C}$, where

RSECratio = At-fault crash rate ratio
T_C / P_C = Truck/Passenger, vehicle # of at-fault crashes
T_V / P_V = Truck/Passenger, vehicle volume

ANALYSIS AND RESULTS

Speed Differentials

An analysis of the speed differentials on urban interstates disproves the notion that large trucks travel at much higher speeds than passenger vehicles. The columns of **Table 1** show the average space mean truck speeds, non-truck speeds, average speed differentials, t-statistic, significance level, number of trucks, percent of trucks, number of non-trucks, percent of non-trucks, and total number of vehicles. The rows show data from Kansas City and St. Louis, and for I-70, I-435, and I-270. As can be seen in **Table 1**, large trucks travel 2.1 mph slower than passenger vehicles on average. There were a few observations where a large truck traveled at higher speeds, but these observations were a small proportion of the total vehicles.

Table 1 – Urban Interstate Space Mean Speed Differentials

Location	Avg. SMS (mph)		Avg. SMS Diff. (mph)	Stat. Significance		Sample Size				
						Truck		Non-Truck		Total
	Truck	Non-Truck		t-statistic	P(T<=t) one-tail	# of Veh.	% of Total	# of Veh.	% of Total	# of Veh.
KC	**45.92**	**48.20**	**-2.28**	**-0.79**	**0.22**	**393**	**8.99%**	**3978**	**91.01%**	**4371**
I-70	46.40	48.46	-2.06	-0.51	0.31	180	9.24%	1768	90.76%	1948
I-435	45.36	47.89	-2.53	-0.60	0.28	213	8.79%	2210	91.21%	2423
STL	**48.22**	**50.15**	**-1.93**	**-0.48**	**0.32**	**264**	**6.74%**	**3652**	**93.26%**	**3916**
I-70	49.24	50.99	-1.75	-0.27	0.39	142	10.86%	1166	89.14%	1308
I-270	47.45	49.51	-2.06	-0.39	0.35	122	4.68%	2486	95.32%	2608
I-70 All	**47.82**	**49.73**	**-1.91**	**-0.39**	**0.35**	**322**	**9.89%**	**2934**	**90.11%**	**3256**
Overall	**47.07**	**49.18**	**-2.10**	**-0.64**	**0.27**	**715**	**8.63%**	**7630**	**92.07%**	**8287**

A total of 715 trucks comprising 8.63% of the ReID vehicles were analyzed. These numbers offer a significant sample of the population and can be expected to represent the travel on urban interstates during morning and evening peak and off-peak periods. In all urban setting scenarios a t-test showed that no significant difference in speeds was present.

Questions were raised about comparing space mean speeds in an urban setting to time mean speeds in a rural setting. Therefore, time mean speeds were calculated from the space mean speeds and are presented in **Table 2**. This conversion to time mean speed increased the average differential between truck and non-truck speeds slightly to 2.27 mph due to the fact that time mean speed is a larger estimate of speed than space mean speed. In turn, this increases the overall average of the faster traveling vehicles (non-truck) by a greater margin than it does the truck speeds. However, time mean speed differentials, like the space mean speed, did not show any statistical significance between truck and non-truck speed differentials when using the t-test.

Table 2 – Urban Interstate Time Mean Speed Differentials

Location	Avg. TimeMS (mph)		Avg. TimeMS Diff. (mph)	Stat. Significance		Sample Size				
						Truck		Non-Truck		Total
	Truck	Non-Truck		t-statistic	P(T<=t) one-tail	# of Veh.	% of Total	# of Veh.	% of Total	# of Veh.
KC	**46.07**	**48.58**	**-2.51**	**-0.87**	**0.19**	**393**	**8.99%**	**3978**	**91.01%**	**4371**
I-70	46.53	48.66	-2.13	-0.53	0.30	180	9.24%	1768	90.76%	1948
I-435	45.54	48.49	-2.95	-0.70	0.24	213	8.79%	2210	91.21%	2423
STL	**48.48**	**50.51**	**-2.03**	**-0.50**	**0.31**	**264**	**6.74%**	**3652**	**93.26%**	**3916**
I-70	49.59	51.47	-1.88	-0.29	0.39	142	10.86%	1166	89.14%	1308
I-270	47.63	49.77	-2.14	-0.40	0.35	122	4.68%	2486	95.32%	2608
I-70 All	**48.06**	**50.06**	**-2.01**	**-0.41**	**0.34**	**322**	**9.89%**	**2934**	**90.11%**	**3256**
Overall	**47.27**	**49.55**	**-2.27**	**-0.69**	**0.25**	**715**	**8.63%**	**7630**	**92.07%**	**8287**

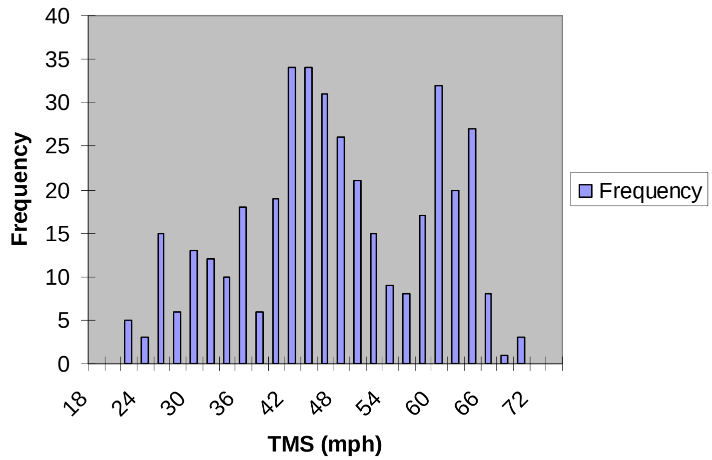
Another measure to look at when determining the safety of highways is the 85^{th} percentile and 95^{th} percentile speeds. **Table 3** shows that the 85^{th} percentile speed for all urban interstates analyzed was 61.4 mph for trucks and 65.1 mph for passenger vehicles. The 95^{th} percentile speed for trucks was 64.8 mph and 69.5 mph for passenger vehicles. Many DOTs often post speed limits based on the 85^{th} percentile speed. It should be noted that all 85^{th} percentile speeds are at or below two mph above the highest posted speed limit on the urban interstates analyzed, which was 65 mph. This may indicate that the majority of motorists are traveling near the posted speed limits; however, the 85^{th} percentile speeds may be skewed a little low due to the fact that more of the data sets were taken during peak hours than during off-peak hours when congestion is less and vehicles travel at faster speeds. If true, the latter suggests that motorists travel at higher speeds during periods of low or non-existent congestion. The 95^{th} percentile speeds also show this trend at as much as six mph above the highest posted speed limit. Another interesting observation is the speed differential between trucks and passenger vehicles increases as the speeds increase. Excessive speeding is a common factor, and although not specifically analyzed in this research, a portion of crashes involving trucks and passenger vehicles could be attributed to the larger speed differentials of the top 15% vehicles.

Table 3 – Urban Interstate 85^{th} % and 95^{th} % Speeds

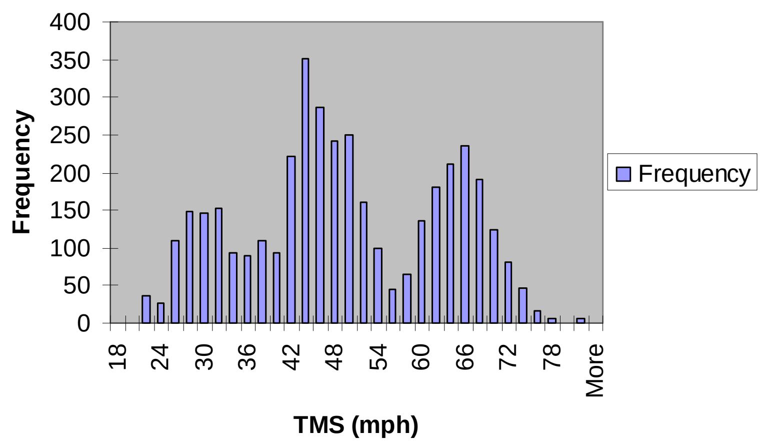
Location	85th % Speed (mph)		95th % Speed (mph)	
	Truck TimeMS	Pass. Veh. TimeMS	Truck TimeMS	Pass. Veh. TimeMS
KC	**60.124**	**64.898**	**63.118**	**69.265**
KC I-70	60.681	63.167	63.100	66.825
KC I-435	59.148	66.412	62.362	71.121
STL	**62.782**	**65.131**	**67.565**	**70.087**
STL I-70	64.464	66.728	68.690	71.074
STL I-270	60.768	64.134	63.341	69.219
All Urban	**61.409**	**65.062**	**64.778**	**69.542**

In order to apply statistical tests, it is important to examine a histogram of speeds to determine the normality of the distribution of vehicle speeds. The following histograms (**Figure 1**) show the TimeMS of trucks and passenger cars in both Kansas City and St. Louis. Speeds in Kansas City look relatively normally distributed, while showing multiple modes due to the peak or off-peak periods of data collection. Similarly, vehicle speeds in St. Louis are fairly normally distributed, but with less cut-offs between periods of congestion and non-congestion.

Histogram of KC Truck TimeMS



Histogram of KC Pass. Veh. TimeMS



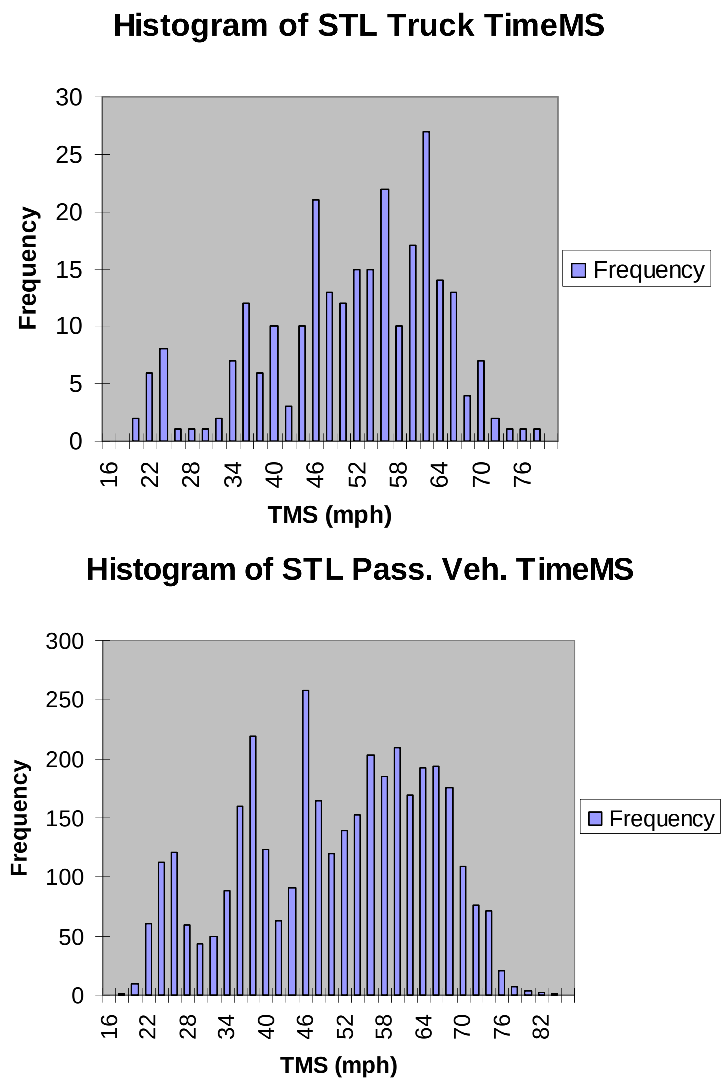


Figure 1 - Histogram of Urban Speeds

The rural interstate speed data support the findings in the urban setting that trucks travel slower, on average, than passenger vehicles. **Table 4** columns show the time mean truck speed, passenger vehicle speed, speed difference, t-statistic, and significance level. **Table 4** shows trucks speeds of 70.03 mph as compared to passenger vehicles of 73.55 mph, for a difference of -3.52 mph. An appropriate two-sample t-test assuming equal or unequal variances was performed on each 24-hour period and all speed differentials proved to be statistically significant. This is significant because as the speed gap grows between large trucks and passenger vehicles, the safety of the roadway could decrease.

Table 4 – Rural Interstate Time Mean Speed Differentials

Sample Period	24-hr Average TimeMS (mph)			Stat. Significance	
	Truck	Pass. Veh.	Difference	t-Statistic	P(T<=t) one-tail
3/20/2007	70.23	73.55	-3.32	-18.10	2.06E-13
3/21/2007	70.12	73.61	-3.49	-21.66	2.58E-16
3/22/2007	70.24	73.72	-3.48	-15.60	3.42E-12
3/27/2007	69.23	73.03	-3.80	-11.90	6.33E-07
3/28/2007	70.43	73.89	-3.47	-21.26	2.58E-15
3/29/2007	69.93	73.52	-3.59	-17.51	2.33E-11
Total	**70.03**	**73.55**	**-3.52**	**-17.67**	**1.05E-07**

Speeds were also analyzed to determine if there is a significant speed differential between night and day. Due to the prevalence of truck travel at night on rural interstates, it is of interest to compare the night segment, 7 pm to 6 am, and day segment, 6 am to 7 pm. These time periods were chosen by the researchers and MoDOT staff given the changes in overall volumes. It can be seen from **Table 5** that there was no statistical significance in the speed differentials between day and night.

Table 5 – Rural Interstate Temporal Speed Differentials

Sample Period	Avg. Temporal Speed Diff. (mph)			Stat. Significance	
	Night (7pm-6am)	Day (6am-7pm)	Difference	t-Statistic	P(T<=t) one-tail
3/20/2007	-3.53	-3.38	-0.15	-0.18	0.24
3/21/2007	-3.39	-3.47	0.08	0.11	0.25
3/22/2007	-3.56	-3.33	-0.23	-0.36	0.22
3/27/2007	-3.56	-3.42	-0.14	-0.06	0.23
3/28/2007	-3.42	-3.44	0.02	0.07	0.29
3/29/2007	-3.52	-3.63	0.12	0.41	0.16
Total	**-3.50**	**-3.45**	**-0.05**	**1.98E-04**	**0.23**

Similar to speeds in an urban setting, it is important to look at the 85th percentile and 95th percentile speeds on the rural interstate. **Table 6** shows that the 85th percentile speed for trucks is 74 mph and 77.5 mph for passenger vehicles. The 95th percentile speeds for trucks and passenger vehicles are 76.6 mph and 80+ mph, respectively. Speeds above 80 mph are not specifically calculated due to data restraints but this would be of particular interest to further research the actual speeds of those traveling faster than 80 mph. If the faster or median lanes, lanes 1 & 3, were looked at and the shoulder lanes discarded, the truck 85th percentile speed would be almost 77 mph and the passenger vehicle 85th percentile speed would be approximately 79 mph or more. The large differential between trucks and passenger vehicles in the faster lanes and those in the slower lanes potentially create an increased opportunity for crashes. The larger the speed differential between vehicles traveling in the same lane encourages more lane changes, more interaction between the vastly different capabilities of the two classes of vehicles and thus, more chances for a crash. Imposing truck or differential speed limits on an interstate with only two lanes per direction like I-70, where the differential between passenger vehicles and trucks is already significant, could increase this speed differential and therefore increase the opportunity for crashes.

Table 6 – Rural Interstate 85th % and 95th % Speeds

I-70 Location	85th% Speed (mph)		95th % Speed (mph)	
	Trucks	Pass. Veh.	Trucks	Pass. Veh.
EB left (median) lane	75.3	77.0	77.8	80+
EB right lane	71.3	76.7	74.5	79.8
EB both lanes	73.3	76.8	76.2	80+
WB left (median) lane	78.2	80+	80+	80+
WB right lane	71.0	76.2	74.0	79.8
WB both lanes	74.6	78.1	77.0	80+
I-70 Overall	**74.0**	**77.5**	**76.6**	**80+**

The following two histograms depict the distributions of truck and passenger vehicle speeds on rural I-70. The distributions are clearly divided into two bell shaped curves representing the distribution of speeds between the slower and faster lanes.

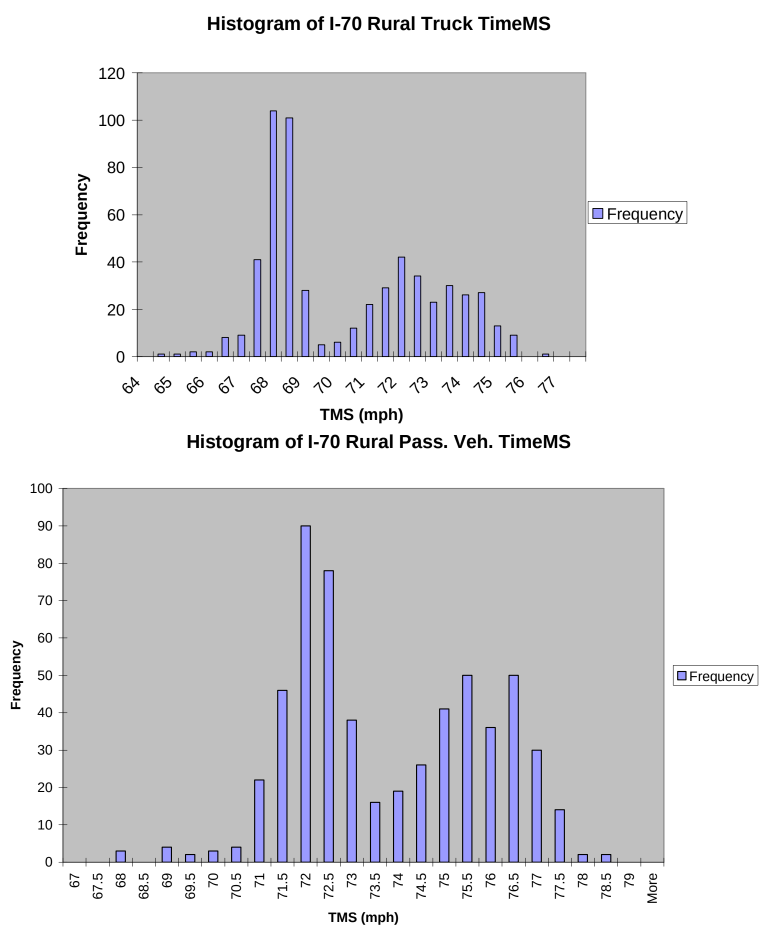


Figure 2 - Histogram of Rural Speeds