

# 2014 State of Colorado Pre-mobilization Seat Belt Survey

Colorado Department of  
Transportation

SEAT BELT  
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STUDY

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**Colorado State University**

COLLEGE OF BUSINESS

*Institute of Transportation Management*

# EXECUTIVE SUMMARY

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In May 2014, the Institute of Transportation Management of Colorado State University conducted a pre-mobilization seat belt usage assessment in the State of Colorado. The study was sponsored by the Colorado Department of Transportation, Office of Transportation Safety and involved observations at 222 sites in 29 counties across the State of Colorado. The survey was conducted from May 11 through 17, 2014, as a “pre-enforcement wave” study, and included drivers and front seat outboard passengers within cars, vans, sport utility vehicles (SUVs), light trucks, and select commercial vehicles 10,000 pounds and under.

Observational data were entered into a SAS system database for computation and review. The survey data and subsequent analyses yielded the results presented below for seat belt usage in the State of Colorado for 2014. Results for 2012 and 2013 are included for comparative purposes.

### 2012

Cars:	81.0%
Vans:	86.1%
SUVs:	84.1%
Trucks:	72.6%
Commercial:	69.3%
Overall Estimated Usage Rate:	80.3%

### 2013

Cars:	82.3%
Vans:	83.4%
SUVs:	86.8%
Trucks:	71.4%
Commercial:	64.5%
Overall Estimated Usage Rate:	81.5%

### 2014

Cars:	83.6%
Vans:	88.9%
SUVs:	87.6%
Trucks:	76.4%
Commercial:	61.7%
Overall Estimated Usage Rate:	83.5%

This was the third year that commercial vehicles were included in the study. All commercial vehicles with a gross weight of 10,000 pounds and under were included with the exception of delivery vans such as FedEx and UPS vehicles wherein drivers are frequently standing and seldom make use of any seat belt or safety restraining device. The usage rate for commercial vehicles of 61.7% represents a decline of 2.8% from the 2013 estimate. This rate is well below other vehicle types and had a negative impact upon the overall usage rate.

All vehicle types used for personal transportation showed improvements in usage rates for 2014. Trucks had an all-time high usage rate of 76.4%, a 5% improvement over 2013. Vans had an even larger improvement moving from 83.4% to 88.9%. Cars had a 1.3% improvement in seat belt usage while SUVs went up by .8%. The higher usage rates among all vehicle types more than offset the decline in seat belt usage in commercial vehicles as the overall estimate of 83.5% is two percent higher than in 2013.

# ADMINISTRATIVE EVALUATION

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Dr. G.J. Francis served as Principal Investigator, Burt Deines as Project Coordinator, and Felicia Zamora as Field Administrator for this pre-mobilization study. Observers and supervisors were trained by the ITM team in observation and recording methods in order to properly conduct the field survey and collect data. The need for consistency and accuracy in the process of data collection was emphasized in the training and pre-survey phase of the study.

Seat belt usage data were collected from 222 separate sites from May 11 through May 17, 2014. With the analyses of the data and the submission of this report, all project tasks and requirements were met within the parameters of the contract.

The majority of the observers gathering data in this study were retired Colorado State Highway Patrol Officers. Because of their familiarity with interstate and state highways, local and county roads, and safety procedures, many potential location and safety problems were minimized or eliminated. The experience and expertise of the retired Highway Patrolmen strengthened the validity and the reliability of the results of the survey.

James zumBrunnen of the Graybill Statistical Laboratory in the College of Natural Sciences at Colorado State University served as the lead statistician in the analysis of the data. Mr. zumBrunnen and others within the Laboratory assumed major roles in the research design and methodology which gave the statistical analyses independence from the survey process.

## **Objectives of the Study**

The primary objectives of the study were to:

- Conduct a seat belt usage survey within the State of Colorado immediately prior to the Seat Belt Usage Awareness Program (“Click It or Ticket”) and the enforcement wave.
- Design a sampling procedure to allow the optimal selection of survey sites that would be statistically representative of State usage figures while adhering to NHTSA guidelines.
- Design a methodology to minimize sampling error and variability.
- Complete the study within budget and file a final report.

# SURVEY DESIGN AND METHODOLOGY

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The 2014 Colorado Pre-mobilization Seat Belt Usage Survey has been designed to meet all the requirements established by the Uniform Criteria for State Observational Surveys of Seat Belt Use issued by the National Highway Traffic Safety Administration (NHTSA) Final Rule, Federal Register, Vol. 76, No. 63, April 1, 2011.

1. Samples were probability-based on population road segments within each county, and estimates were therefore representative of seat belt usage for the State's driver and outboard front seat passenger population for vehicles falling within the parameters of this study.
2. The sample data were collected through direct observation of seat belt usage at the pre-determined sites by qualified and trained observers. Observation times were assigned and rescheduled if weather interfered or other conditions existed which made observations at a particular site unsafe.
3. The population of interest was the driver and outboard front seat passenger of cars, vans, SUVs, light trucks, and select commercial vehicles 10,000 pounds and under.
4. Observations were conducted in daylight hours from May 11 through May 17, 2014 between the hours of 7:00 AM and 6:00 PM.
5. Observation start times were staggered in order to obtain a representative sample from rush hour and non-rush hour time frames.
6. Observational data were recorded on counting sheets and summarized. The data were then transcribed to create a digital record and entered onto field summary forms, which served as input into SAS programs for data reduction.

The pre-mobilization study was designed as a statewide probability-based sample of road segments. In order to provide optimal comparative analyses, the study made use of sites selected from the statewide survey. Observation sites from the statewide survey were randomly selected from each county included in the study. The total number of sites (222) included in the pre-mobilization study represented approximately 30% of the total sites of the statewide study. Weights associated with the statewide sample were adjusted for the smaller sample used in the pre-mobilization study.

As required by the “Final Rule,” the counties that account for 85% of the crash-related fatalities in the State are to be included in the survey sample. As shown in Appendix 1, 29 of the 64 counties accounted for 85% of the fatalities for the period of 2007 to 2009. These counties thus comprise the sample frame and were used as strata for sampling road segments. As was done for the 2013 statewide, Elbert County was substituted for Alamosa County as the “last” county to be included as part of the top 85%. Any one of four counties could have been selected for the final sampling county as each was approximately the same percentage (.7%) of the State’s total fatalities. Elbert County replaced Alamosa County in the study in part because Elbert experienced 13 fatalities from 2009-2011, and Alamosa had 8 fatalities during the same time period. Also contributing to the decision was the travel time of observers and the cost involved during the same time period.

The research design involved a stratified systemic PPS sample of data collection sites described below:

1. Fatality Analysis Reporting System (FARS) data for the period of 2007 to 2009 were used to determine the average number of crash-related fatalities per county. It was determined that 29 counties accounted for 85% of Colorado’s total crash-related fatalities. These 29 counties comprise the sample frame and were used as strata for sampling road segments. See Table in Appendix.
2. Road segments were selected systematically with probability proportional to size (PPS) from all segments in the stratified counties. The road segments were serpentine sorted by latitude and longitude within counties, which makes the sampling spatially more uniform within counties.

For the purposes of this survey, an observational site was defined as a specific road intersection or interstate ramp where observations take place. Observations were conducted at each site for 40 minutes of each hour between the hours of 7:00 a.m. and 6:00 p.m. during the week of May 11. Twenty minutes were allowed for recording data and moving to the next observation site.

The survey was designed to produce an overall state estimate of seat belt usage before the mobilization effort. Roads within the counties were grouped using the State's classification of “major” roads and “local” roads. A major road is determined by the road's length and volume of traffic. All road segments in the sample counties were identified, and a sample of these segments was selected for observation.

A total of 222 sites (road segments) on major roads and local roads was determined to be a representative sample based upon previous surveys. When possible, traffic was observed from inside the sample road segment at or near the point where the traffic was leaving the segment (for safety reasons).

## **Determination of Sample Size**

Sample size determination was, in large measure, governed by time constraints and the precision requirement of the study (the relative error: standard error divided by the parameter estimate  $\leq 0.025$ ). A decision as to how many roadways to select and assign for observation during the observation period required a balance between issues of statistical reliability and observer productivity. Statistical theory, which considers correlations and the need for independent observation, would suggest that the number of roadway locations be as large as possible. However, there was a practical need to select an optimal number of road segments for study so that observers would not spend inordinate amounts of time traveling from site to site. With all of those issues given consideration as well as the needs of the contracting organizations, a total sample of 222 observational time periods and sites were selected.

## **Estimation**

The basic estimate derived from this Colorado Pre-mobilization Seat Belt Usage Survey is the estimate of seat belt usage for all drivers and outboard front seat occupants of cars, vans, sport utility vehicles (SUVs), light trucks, and select commercial vehicles 10,000 pounds and under.

The seat belt usage rate of 83.5% for Colorado was determined by using a survey sampling methodology to obtain information about a large population of Colorado drivers and outboard front seat passengers by selecting and measuring a sample of that population. Fundamental to the analysis of this survey is the concept of cluster analysis, a collection of statistical methods that can be used to assign cases to groups (clusters). Group members share certain properties in common, and it is therefore assumed that the resultant classifications will provide insight into seat belt usage for the State of Colorado.

# SURVEY RESULTS

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The 2014 Colorado Pre-mobilization Seat Belt Usage Survey of the State of Colorado was conducted at 222 sites as a stratified random sample. The design for the survey was developed in compliance with the Uniform Criteria for State Observational Surveys of Seat Belt Use issued by the National Highway Traffic Safety Administration (NHTSA) Final Rule, Federal Register, Vol. 76, No. 63, April 1, 2011. Driver and outboard front seat passenger seat belt usage data were collected from these 222 sites in 29 counties from May 11 through May 17, 2014.

There were 46,951 vehicle observations in this pre-mobilization study. The data were recorded, tabulated, and analyzed with assistance from the Graybill Statistical Laboratory of the College of Natural Sciences. As shown in Table 1, the point estimate of the overall seat belt usage rate for the Colorado Pre-mobilization Seat Belt Usage Survey was 83.5%. This estimate may vary due to sampling variability and a number of uncontrolled sampling errors that may have entered into the observational survey. Therefore, a 95% confidence interval constructed about the point estimated seat belt usage rate is from 81.7% to 85.3%.

**Table 1: Statewide Seat Belt Usage by Vehicle Type**

<b>Vehicle Type</b>	<b>Usage Observed</b>
Cars	83.6%
Vans	88.9%
SUVs	87.6%
Trucks	76.4%
Commercial	61.7%
Overall Average	83.5%

Seat belt usage is slightly different depending upon the speed of vehicles. For example, occupants of vehicles traveling between 0 and 30 miles per hour demonstrated a 80.2% seat belt usage, while occupants of vehicles traveling more than 50 miles per hour had an 86.1% seat belt usage. The estimate of seat belt usage for those traveling between 31 and 50 miles per hour was 83.8%. These estimates in seat belt usage support previous findings and the positive correlation of vehicle speed and seat belt usage. The range of vehicle speed and overall seat belt usage rates are shown in Table 2.



**Table 2: Seat Belt Usage by Vehicle Speed**

<b>Vehicle Speed</b>	<b>Usage Observed</b>
0-30 miles per hour	80.2%
31-50 miles per hour	83.8%
Greater than 50 miles per hour	86.1%

As shown in Table 3, the seat belt usage on local roads (82.8%) was lower than the seat belt usage on primary roads (89.0%). This gap most likely is due to the average speed traveled on the two categories of roads and the length of trips traveled.

There was some variability in seat belt usage across the 29 counties. This is an expected result as the differences in urban and rural counties are exacerbated by the road types, length of trips, and vehicle speed. The rural counties of Baca, Las Animas, and Montrose were among the lowest usage rates with all being at or under 70%. Boulder County, being urban, was an anomaly with one of the lowest usage rates (67.9%). The other more urban counties of Douglas, Jefferson, and Larimer were all above 87% usage rates. Rural counties having rates at or above 85% include Garfield, Grand, La Plata, Mesa, Park, Routt, and Summit. Of these counties, Grand and Summit have been above 85% for two consecutive years.

Table 3 also illustrates the difference in seat belt usage among vehicle types. Van front seat occupants were highest in seat belt usage among vehicle types (88.9%) followed by SUVs (87.6%), cars (83.6%), trucks (76.4%), and commercial vehicles (61.7%). Although there has been some improvement over the last decade, trucks continue to have the lowest seat belt usage of all private, non-commercial vehicles in the seat belt usage surveys.

It was noted by observers again this year that the commercial usage rate was most negatively impacted by “local” commercial vehicles. Drivers and occupants of vehicles used by landscapers, lawn service, and delivery trucks were least likely to make use of seat belts. The usage rates for drivers of vehicles associated with larger companies were much higher and more consistent across all categories of vehicles.

**Table 3: Summaries of Estimates of Seat Belt Usage 2014**

	# of Sites	Estimate %	Std Error	CV	Confidence Interval	
					Lower 95% Limit	Upper 95% Limit
<b>Vehicle Overall Average</b>	222	83.5	0.9	1.08	81.7	85.3
<b>County</b>						
Adams	11	79.3	2.4	3.02	74.5	84.0
Arapahoe	16	83.6	1.4	1.64	81.0	86.3
Baca	4	67.3	3.7	5.47	60.1	74.6
Boulder	11	67.9	5.1	7.55	57.8	78.0
Delta	4	78.6	4.2	5.28	70.5	86.8
Denver	11	84.5	1.6	1.91	81.3	87.7
Douglas	16	87.4	1.2	1.41	85.0	89.8
Eagle	4	74.6	2.6	3.43	69.5	79.6
El Paso	16	84.1	2.8	3.27	78.7	89.5
Elbert	4	82.8	2.3	2.74	78.3	87.2
Fremont	4	80.5	2.4	2.93	75.9	85.2
Garfield	5	86.4	2.9	3.40	80.6	92.2
Grand	4	85.4	1.2	1.43	83.0	87.8
Huerferno	4	76.8	6.6	8.63	63.7	89.9
Jefferson	11	89.0	1.2	1.36	86.6	91.4
La Plata	4	92.8	0.7	0.73	91.5	94.1
Larimer	15	91.4	1.6	1.76	88.3	94.6
Las Animas	4	69.3	7.5	10.8	54.5	84.1
Lincoln	4	82.5	6.6	8.04	69.4	95.6
Logan	4	94.2	3.8	4.07	86.6	99.9
Mesa	8	84.9	2.4	2.79	80.3	89.6
Montezuma	4	85.4	2.2	2.56	81.1	89.7
Montrose	4	70.0	3.7	5.31	62.7	77.3
Morgan	4	81.0	3.5	4.30	74.1	87.8
Park	11	85.6	2.2	2.51	81.4	89.9
Pueblo	16	74.3	3.6	4.78	67.3	81.3
Routt	4	88.4	3.5	3.98	81.5	95.4
Summit	4	98.8	0.6	0.58	97.7	99.9
Weld	11	84.7	3.1	3.64	78.6	90.8
<b>Vehicle Speed</b>						
0-30 miles per hour	41	80.2	2.1	2.63	76.1	84.4
31-50 miles per hour	79	83.8	1.6	1.93	80.6	87.0
Greater than 50 miles per hour	102	86.1	0.7	0.82	84.7	87.5
<b>(Cont'd next page)</b>						

<b>Table 3 (cont'd)</b>	<b># of Sites</b>	<b>Estimate %</b>	<b>Std Error</b>	<b>CV</b>	<b>Lower 95% Limit</b>	<b>Upper 95% Limit</b>
<b>Vehicle Type</b>						
Cars	222	83.6	1.2	1.39	81.3	85.9
Vans	222	88.9	1.3	1.50	86.3	91.6
SUVs	222	87.6	0.9	0.98	85.9	89.3
Trucks	222	76.4	1.3	1.74	73.8	79.0
Commercial	222	61.7	2.9	4.68	56.0	67.4
<b>Road Class</b>						
Primary	48	89.0	0.7	0.84	87.5	90.4
Secondary	126	81.4	0.9	1.10	79.7	83.2
Local	48	82.8	1.3	1.55	80.3	85.3

**Standard Error, CV and Lower and Upper Confidence Interval Limits**

The columns labeled **Std Error**, **CV** and **Lower 95%** and **Upper 95% Confidence Intervals** are statistical terms defining measures of risk. The Std Error is a measure of the sampling errors that are uncontrollable in a statistical experiment. It is preferred that these sampling errors remain below .05 or 5%. The column entitled CV is the coefficient of variation. It is a dimensionless measure of variability, designed to allow comparisons of variation for samples with different sizes. The Confidence Intervals (Lower and Upper 95%) give ranges of results that are most likely to be observed in repeated trials of this statistical experiment.

**Analysis**

The PROC SURVEYMEANS procedure of SAS was used to perform statistical analysis of the survey data. This analytical procedure takes into account the design used to select the sample to be analyzed. The sample design was a complex design which incorporated stratification and unequal weighting. The SURVEYMEANS procedure computes ratio estimates and provides standard errors and confidence intervals for the ratios and for any specified domain analysis, such as road class.

Using this procedure, seat belt usage rates in Colorado were estimated along with a determination of the standard errors and coefficients of variation. The survey sample size was large enough to allow estimates of usage rates for various domains of vehicle, speed, and local vs. major roads. The estimates for all domains, their standard errors and coefficients of variation (CV) and intervals are shown in Table 3.

The seat belt usage rates for the low speed (80.2%), moderate speed (83.8%), and high speed (86.1%) represent an improvement for all speed categories. In combination with these results and similar, consistent findings in previous studies, it can be concluded that there is an increase in seat belt usage at higher speeds.

Usage rates by different types of vehicles were also analyzed (cars-83.6%, vans-88.9%, SUVs-87.6%, trucks-76.4%, commercial-61.7%). Clearly, the differences in usage rates between trucks (76.4%) and commercial (61.7%) vehicles and all other vehicle types are statistically significant. With vans at 88.9%, SUVs at 87.6, and cars at 83.6%, the differences in seat belt usage rates for front seat occupants among these types of vehicles when compared to trucks and commercial vehicles are due to something other than sampling error.

# CONCLUSIONS

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This survey of 46,951 vehicles at 222 sites provided an adequate sample as confirmed through comparative analyses with the results of previous State of Colorado seat belt surveys and by the consistency of the results of several different and independent methods of analyses. The overall statewide seat belt usage rate in this pre-mobilization survey is estimated to be 83.5% with a lower limit of 81.7% and an upper limit of 85.3% at 95% confidence. A standard error of 0.9 was well within the NHSTA established guidelines of 2.5.

Although the pre-mobilization study has fewer sites and observations than the statewide survey, it provides insight into the changing behaviors of Colorado drivers and their passengers. As this study is nearly a year removed from the “Click-It-or-Ticket” program and the enforcement wave, the seat belt usage rates are most likely a manifestation of internalized behaviors and are not influenced by the aforementioned programs. While the improvements over the last several years have come in small increments, the usage rates remain fairly consistent. For a secondary law state, the pre-mobilization seat belt usage rate of 83.5% represents a significant measure of success. The pre-mobilization sample and the results are representative in that both rural and urban observations are included. From a timing standpoint, the study is well removed from any external influences of special education and enforcement programs, and there are no concerns with possible spurious results. In this regard, the results of this study reinforce the importance of continued educational efforts designed to internalize safe behaviors among drivers and passengers and to thus improve seat belt usage in the State of Colorado.

# APPENDIX

**Colorado Average Motor Vehicle Crash-Related Fatalities by County 2007-2009\***

County	FIPS	Average Fatality Counts (2007-2009)	Fatality Percentage Within Colorado	Cumulative Fatality Percentage
WELD	123	43.7	8.2	8.2
EL PASO	041	42.7	8.0	16.2
DENVER	031	40.3	7.6	23.8
ARAPAHOE	005	36.3	6.8	30.7
JEFFERSON	059	35.3	6.6	37.3
ADAMS	001	33.3	6.3	43.6
LARIMER	069	26.0	4.9	48.5
PUEBLO	101	23.7	4.5	52.9
MESA	077	20.0	3.8	56.7
BOULDER	013	19.0	3.6	60.3
DOUGLAS	035	15.7	2.9	63.2
GARFIELD	045	14.3	2.7	65.9
LA PLATA	067	12.3	2.3	68.2
DELTA	029	8.7	1.6	69.8
EAGLE	037	8.7	1.6	71.5
MONTROSE	085	6.7	1.3	72.7
PARK	093	6.7	1.3	74.0
FREMONT	043	6.0	1.1	75.1
ROUTT	107	6.0	1.1	76.2
LAS ANIMAS	071	5.7	1.1	77.3
MONTEZUMA	083	5.3	1.0	78.3
HUERFANO	055	5.0	0.9	79.2
GRAND	049	4.7	0.9	80.1
LINCOLN	073	4.7	0.9	81.0
MORGAN	087	4.7	0.9	81.9
SUMMIT	117	4.7	0.9	82.8
BACA	009	4.0	0.8	83.5
LOGAN	075	4.0	0.8	84.3
ALAMOSA	003	3.7	0.7	85.0

\*Fatality data from the Fatality Analysis Reporting System (FARS) 2007-2009